



Evaluating Economic Policy Instruments for Sustainable Water Management in Europe

Review Reports

Deliverable no.: D 3.1 and D 6.1
20 December 2011



Deliverable Title	EU and IBE Review reports
Filename	WP3 and WP6 case studies review report
Authors	Manuel Lago and Jennifer Möller-Gulland (Ecologic Institute)
<p>With contributions from: Carlos M. Gómez, Gonzalo Delacámara, Carlos D. Pérez, Estefanía Ibáñez, Miguel Solanes, Marta Rodríguez (IMDEA) - Christophe Viavattene, Joanna Pardoe, Simon McCarthy, Colin Green –(Flood Hazard Research Centre - Middlesex University) - Anders Branth Pedersen, Helle Ørsted Nielsen and Mikael Skou Andersen (Department of Environmental Science, Aarhus University) - Gábor Ungvári, Péter Kaderják, András Mezősi, András Kiss - Budapesti Corvinus Egyetem – Regionális Energiagazdasági Kutató Központ (BCE-REKK) – Sardonini Laura, Viaggi Davide and Raggi Meri (UNIBO) - Hernández-Sancho, F.; Molinos-Senante, M. and Sala-Garrido, R. (University of Valencia) - Marianne Schuerhoff, Hans-Peter Weikard, David Zetland (WUR) - Thomas Dworak, Katriona McGlade, Jennifer Möller-Gulland, Manuel Lago (Ecologic Institute) - Jaroslav Mysiak, Fabio Farinosi, Lorenzo Carrera, Francesca Testella, Margaretha Breil, Antonio Massaruto (FEEM) - Pierre Defrance, Verena Mattheiß (ACTeon) - Maggie Kossida, Anastasia Tekidou (NTUA) - Tiho Anceev, Charles W. (Chuck) Howe, Mike Young, Iddo Kan and Yoav Kislev, Mark S. Kieser and Jamie L. McCarthy, Carolyn Kousky, Ariel Dinar, Yang Xiaoliu and Andrew J. Yates</p>	
Date	20.12.2011

Prepared under contract from the European Commission
Grant Agreement no. 265213
FP7 Environment (including Climate Change)

Start of the project:	01/01/2011
Duration:	36 months
Project coordinator organisation:	FEEM
Deliverable title:	Eu and IBE Review reports
Deliverable no. :	D 3.1 and D 6.1
Due date of deliverable:	Month 11
Actual submission date:	Month 12

Dissemination level

<input checked="" type="checkbox"/>	PU	Public
<input type="checkbox"/>	PP	Restricted to other programme participants (including the Commission Services)
<input type="checkbox"/>	RE	Restricted to a group specified by the consortium (including the Commission Services)
<input type="checkbox"/>	CO	Confidential, only for members of the consortium (including the Commission Services)

Deliverable status version control

Version	data	Author
1.0	December, 2011	Manuel Lago and Jennifer Möller-Gulland (Ecologic Institute)

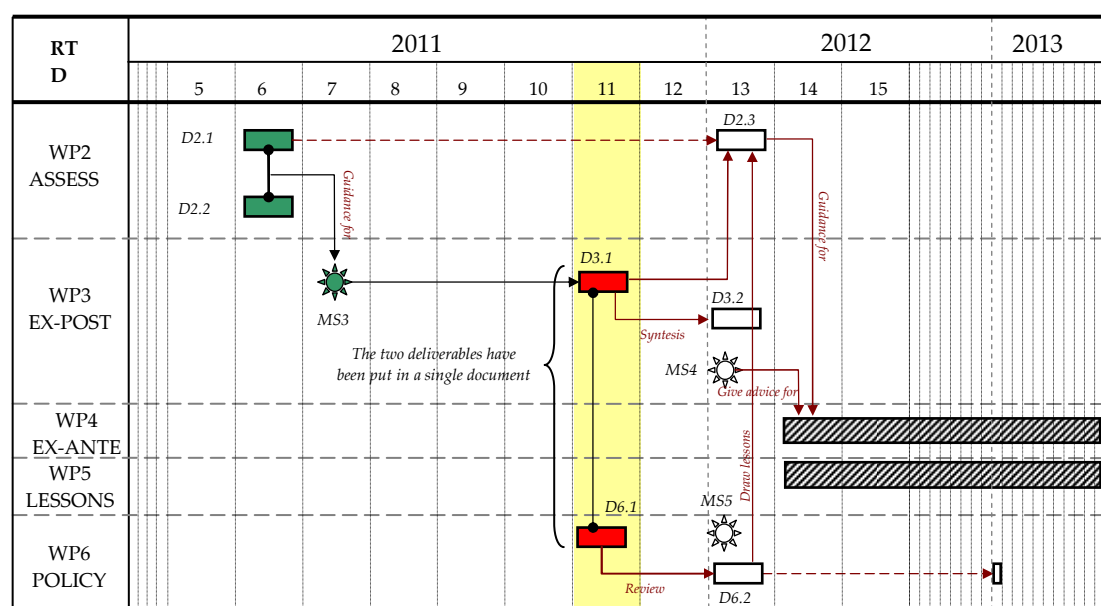
Preamble

Almost a year into the EPI-WATER project, the consortium has made a huge step towards meeting the project's objectives. This more than a thousand pages-long deliverable includes ex-post assessment reports about some thirty economic policy instruments in Europe and overseas. We have analysed many different instruments including voluntary agreements, charges and taxes, water pricing schemes, subsidies, tradable permits and certificates. The cumulative knowledge gained from the review is urgently needed to inform the 2012 EU Water Policy Review (Blueprint for Safeguarding Europe's Water) and to meet the challenges water resources management faces in the future not least because of human-induced climate change and the implied society's transformation.

The assessment has been conducted using the assessment framework and toolbox developed in the WP2 (D2.1 and D2.2). Each economic policy instrument (EPI) is reviewed taking into account the environmental effects, economic assessment and institutional criteria, transaction costs, distributional effects, policy implementability and uncertainty.

On January 26-27, 2012 we will hold a review workshop in Berlin during which the results and lessons learned from the review exercise will be presented to the Policy Think Tank established under this project and wider policy audience. The review workshop will be instrumental for designing the ex-ante assessment of innovative policy instruments we will explore in the WP4 from now onwards. The workshop is an opportunity to meet with the members of the 'Inspiration Beyond Europe' (IBE) group of experts who have significantly contributed to this deliverable and agreed to advise the future research direction of the EPI-WATER project.

Figure 1. Road map of EPI-WATER work packages



Jaroslav Mysiak, project's coordinator



Executive Summary

WP3 of EPI-water conducts a review of empirical evidence, experiences and lessons learned from the practical applications of water related economic policy instruments in Europe and beyond. The scope of the review is to explore and identify conditions under which the EPIs perform well in practice. A large number of economic instruments have been reviewed as ex-post assessment exercises. The full scope of review exercise examines 30 case sites, covering a range of different instruments which operate under different geophysical and socio-economic conditions. Out of these 30 review instances, 10 have been commissioned to “Non-EU” researchers and experts from the “Inspiration beyond the EU” group, coming from the EU neighbourhood countries and overseas (USA, Australia, Israel, Chile, China).

The presented case studies illustrate a diverse range of economic instruments that maximise the relevance of WP3 in the overall context of EPI-Water (to evaluate the application and inform the development of the evaluation toolbox for WP2 (*framework for assessment and evaluation of EPIs*) and the selection of ex-ante case studies under WP4 (*in-depth evaluation of selected economic instruments*)) and of current developments in the water policy field. For the next deliverable of the project: *D3.2 Comparative analysis report*, the case study reviews will be synthesised and cross-compared to extract a set of common features from and formulate hypotheses about the conditions under which economic policy instruments (EPI) contribute to sustainable water management.

The case study review is based on the analytical framework for the assessment of EPIs previously developed in WP2 (see background document and toolbox in the deliverable section of the EPI-Water project web page¹), to guarantee comparable and meaningful outcomes. Common evaluation criteria includes: 1) Environmental Outcomes; 2) Economic Assessment; 3) Distributional Effects and Social Equity; 4) Institutions; 5) Policy Implementability; 6) Transaction Costs and 7) Uncertainty.

This document as part of the deliverable D3.1 of the EPI-water project illustrates the executive summaries of the European and beyond Europe case studies that have been undertaken by all the members of the consortium and guest researchers for the third workpackage (*ex-post assessment*). The following table introduces a detailed summary of all the covered case studies:

¹ <http://www.feem-project.net/epiwater/pages/download-public-deliv.html>

Table ES-DEL3.1 General Overview of case studies covered in WP3

CS#	Name of EPI	Location	Type of Instrument	Sectors targeted	Pressures/ Water issues targeted	Country code	Partner
CS1	Water transfers in the Tagus River Basin (Spain)	Tagus Basin, Spain	Tradable permit for abstraction	Urban and agricultural sectors	Water quantity	ES	IMDEA
CS2	Lower Ebro (Spain): Voluntary agreement for river regime restoration services	Lower Ebro Basin, Spain	Voluntary Agreement, Subsidies on practices	Hydropower generation	Hydromorphology	ES	IMDEA
CS3	Cooperative agreements between water supply companies and farmers in Dorset	The United Kingdom	Voluntary Agreements	Agriculture, water utilities	Water quality (diffuse pollution)	UK	MU
CS4	The Danish Pesticide Tax	Denmark	Environmental tax	Agriculture	Water quality (diffuse pollution)	DK	NERI
CS5	Water Resource Fee - Hungary	Hungary	Environmental charge	Water utilities and water consumers	Water quantity	HU	REKK
CS6	Water load fee, Hungary-Hungary	Hungary	Environmental tax	Water utilities and industrial	Water quality (point source)	HU	REKK
CS7	Water tariffs in agriculture – Emilia- Romagna case study	Emilia Romagna, Italy	Water Pricing	Agriculture	Water quantity	IT	UNIBO
CS8	Increase in the pollution charge at Serpis River Basin	Serpis Basin, Spain	Environmental charge	Urban and industrial water (provided by water utilities)	Water quality (point source), water quantity	ES	UVEG
CS9	Voluntary intersectorial water transfer -Llobregat River Basin	Llobregat Basin, Spain	Voluntary agreements	Urban and water utilities	Water quantity	ES	UVEG
CS10	Negotiation and monetary incentives to promote the use of reclaimed water at Tordera	Tordera Basin, Spain	Subsidies on practices, voluntary agreements	Agriculture, urban and industrial areas	Water quantity	ES	UVEG

	River Basin						
CS11	Groundwater tax in the Netherlands	The Netherlands	Environmental tax	Agriculture, industry	Water quantity (groundwater)	NL	WU
CS12	Payment by the drop: The move to water metering in England and Wales	The United Kingdom	Water Pricing	Urban water	Water quantity	UK	WU
CS13	Water Abstraction Charges and Compensation Payments in Baden-Württemberg (Germany)	Baden-Württemberg, Germany	Environmental charge	All water abstractors	Water quality (diffuse pollution) and water quantity	DE	Ecologic
CS14	Effluent Tax in Germany	Germany	Environmental tax	All water consumers	Water quality (point source)	DE	Ecologic
CS15	Green Hydropower in Switzerland	Switzerland	Subsidies on products (Eco-label)	Hydropower generation	Hydromorphology	CH	Ecologic
CS16	Water tariff system in Italy and tariff structure in the Region Emilia Romagna (RER)	Po Basin, Italy	Water Pricing	Water suppliers, consumers	Water quantity	IT	FEEM
CS17	Green energy certificates and compliance market	Po Basin, Italy	Environmental charge	Hydropower generation	Hydromorphology	IT	FEEM
CS18	Subsidies for ecologically friendly hydro-power plants through favourable electricity remuneration in Germany	Germany	Subsidies on products	Hydropower generation	Hydromorphology	DE	ACTeon
CS19	Financial compensation for environmental services: the case of Evian Natural Mineral Water	Evian, Haute Savoie, France	Voluntary agreements	Agriculture and urban	Water quality (diffuse pollution)	FR	ACTeon
CS20	Subsidies for Drinking Water Conservation in Cyprus	Cyprus	Subsidies on practices	Domestic, agricultural and tourism	Water quantity	CY	NTUA
CS21	Salinity offsets in Australia	Australia	Tradable permit for pollution (salinity increase)	Agriculture, energy (coal)	Water quality (salinity), water quantity	AU	Tiho Ancev



CS22	The efficient water market of the Northern Colorado Water Conservancy	Colorado, USA	Tradable permit for abstraction	All sectors	Water quantity (abstraction)	USA	Charles W. (Chuck) Howe
CS23	The role of the Unbundling water rights in Australia's Southern Connected Murray Darling basin	Australia	Tradable permit for abstraction	Agriculture	Water quantity (scarcity)	AU	Mike Young
CS24	Price setting of urban water under centralized management	Israel	Water pricing	Urban	Water quantity (scarcity)	IL	Iddo Kan and Yoav Kislev
CS25	Great Miami River Watershed Water Quality Credit Trading Program	Ohio, USA	Tradable permit for pollution	Agriculture	Water quality	USA	Mark S. Kieser and Jamie L. McCarthy
CS26	New York City watershed agricultural program	New York, USA	Voluntary agreement	Agriculture, urban, waste utilities	Water quality	USA	Carolyn Kousky
CS27	Water budget rate structure: experiences from urban utilities in California	California, USA	Water pricing	Urban, Water utilities	Water quantity (scarcity)	USA	Ariel Dinar
CS28	Case study China	China	Overview of EPIs in China (discharge levy, sewage treatment fee, discharge permits trading, PPP, and public finance)	Industry, urban and agriculture	Several	CN	Yang Xiaoliu
CS29	Nitrogen Permit Trading in North Carolina's Neuse River	North Carolina, USA	Tradable permit for pollution	Water utilities (WWTP), Agriculture	Water quality (point source pollution)	USA	Andrew J. Yates



CS30	The Chilean Water Allocation Mechanism, established in its Water Code of 1981	Chile	Water markets (allocation of water use rights)	All sectors	Water scarcity	CL	Guillermo Donoso
------	---	-------	--	-------------	----------------	----	------------------

Table of Contents

Preamble.....	i
Executive Summary	3
Introduction	2
Water transfers in the Tagus River Basin (Spain) (#1).....	1
Lower Ebro (Spain): Voluntary agreement for river regime restoration services (#2)	5
Cooperative agreements between water supply companies and farmers in Dorset (#3).....	10
The Danish Pesticide Tax (#4).....	13
Water Resource Fee - Hungary (#5).....	17
Water load fee, Hungary- Hungary (#6).....	22
Water tariffs in agriculture – Emilia- Romagna case study (#7)	26
Increase in the pollution charge at Serpis River Basin (#8)	30
Voluntary intersectoral water transfer at Llobregat River Basin (#9).....	34
Negotiation and monetary incentives to promote the use of reclaimed water at Tordera River Basin (#10).....	38
Groundwater taxes in the Netherlands (#11)	42
Payment by the drop: The move to water metering in England and Wales (#12)	45
Water Abstraction Charges and Compensation Payments in Baden-Württemberg (Germany) (#13)	48
Effluent Tax in Germany (#14).....	53
Green Hydropower in Switzerland (#15)	57
Water tariff system in Italy and tariff structure in the Region Emilia Romagna (RER) (#16)	60
Green energy certificates and compliance market (#17).....	64
Subsidies for ecologically friendly hydro-power plants through favourable electric-ity remuneration in Germany (#18).....	68
Financial compensation for environmental services: the case of Evian Natural Mineral Water (#19)	72
Subsidies for Drinking Water Conservation in Cyprus (#20).....	76
Salinity Offsets in Australia (#21)	80
The Efficient Water Market of the Northern Colorado Water Conservancy District: Colorado, USA (#22) ..	83
The role of the Unbundling water rights in Australia's Southern Connected Murray Darling Basin (#23) ...	86
Urban Water Price Setting under Central Administration (#24).....	91
Great Miami River Watershed Water Quality Credit Trading Program(#25)	95
New York City Watershed Agricultural Program(#26)	99
Water Budget Rate Structure: Experiences from Urban Utilities in California (#27).....	102
Case Study of China (#28).....	105
Nitrogen Permit Trading in North Carolina's Neuse River(#29)	106
The Chilean Water Allocation Mechanism, established in its Water Code of 1981 (#30)	108

Introduction

WP3 of EPI-water conducts a review of empirical evidence, experiences and lessons learned from the practical applications of water related economic policy instruments in Europe and beyond. The scope of the review is to explore and identify conditions under which the EPIs perform well in practice. A large number of economic instruments have been reviewed as ex-post assessment exercises. The full scope of review exercise examines 30 case studies, covering a range of different instruments which operate under different geophysical and socio-economic conditions. Out of these 30 reviews, 10 have been commissioned to “Non-EU” researchers from the “Inspiration beyond the EU” group, coming from the EU neighbourhood countries and overseas (USA, Australia, Israel, Chile, China).

This document, as part of the deliverable D3.1 of the EPI-water project, illustrates the executive summaries of the European and beyond Europe case studies that have been undertaken by all the members of the consortium and “Non-EU” researchers for the third workpackage (*ex-post assessment*).

First, the term EPI and the types of EPIs covered in these case studies will be briefly defined. Second, a list of the case studies will be presented along with the rationale for their selection. Finally, a brief overview of the assessment framework, i.e. the methodological approach followed in the case study analyses will be provided.

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).²

Table 1 Broad categories of EPIs

Type of instrument		Function/main purpose
Taxes and charges	Water tariffs (pricing)	Collect financial resources for the functioning of a given water service and/or promote water efficiency (includes full cost recovery pricing)
	Environmental tax	Internalise negative environmental impacts and/or collect

² 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.

		financial resources for the central budget, as long as these resources are earmarked for water policy objectives.
	Environmental charge	Internalise negative environmental impacts and influence behaviour, to collect financial resources that are allocated to support environmental friendly practices and projects
Subsidies	Subsidies on Products	Increase the attractiveness of "green" products and production factors that have limited negative environmental impact/footprint
	Subsidies on Practices	Increase attractiveness of green products and production processes that limit negative impacts on water sources or producing positive environmental externalities
Markets for environmental goods	Tradable permit for pollution	Improve the allocation (increase the efficiency) of pollution amongst sectors
	Tradable permit for abstraction	Improve allocation (increase efficiency) of water quantity among sectors (including the natural environment)
	Compensation mechanisms	Establish mechanisms where environmental degradation leads to financial payment that is allocated to alternative actions to compensate for the degradation; can also be provided via third parties (e.g., insurance)
Voluntary agreements ³		Establish a contractual agreement between parties to promote good practices for the reduction of pressures on water resources (payment for ecosystem services) often linked to subsidies and compensation mechanisms
Others		Insurance, finance and full cost recovery mechanism

EPI case studies assessed during WP3

The 30 case studies reviewed during WP3 cover a selection of different EPIs addressing specific, recurring themes. Table 1 displays the themes and locations of each case study.

Table 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

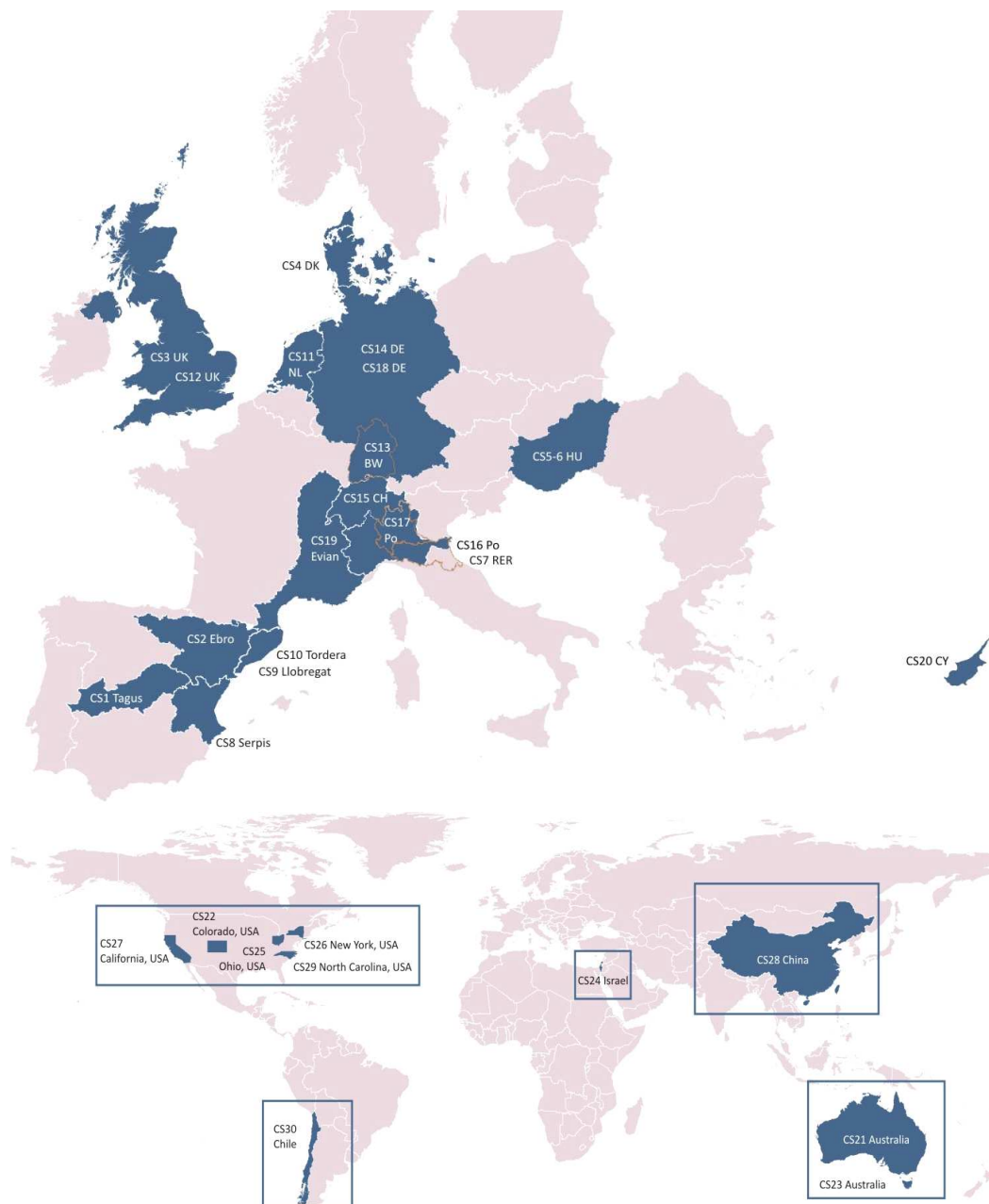
³ For the purposes of this project and because of its current relevance as an instrument for water policy in Europe, Voluntary Agreements (VA) have been included as a category in the broad categories of EPIs. But it is worth noting that there is an on-going debate in the literature about whether voluntary 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.

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	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 intersectorial 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 this deliverable (DEL3.1) of the project contains detailed descriptions of all the proposed case studies.

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



The selection from the EU illustrates a wide geographical distribution of the proposed case studies. They cover: 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.

The EPIs covered in the case studies can be grouped into the following types: taxes and charges (water tariffs/pricing, environmental tax, environmental charge), subsidies (on products, on practices), markets for environmental goods (tradable permit for pollution, tradable permit for abstraction, compensation mechanisms) and voluntary agreements. Below, Table 3 illustrates the general range of EPIs considered in the EPI categories.

Table 3, Distribution of EPI categories in the WP3 case studies

Type of instrument		Matching studies (CS# link with previous table)
Taxes and charges	Water tariffs (pricing)	7 (Emilia Romagna, IT); 12 (UK); 16 (Po Basin, IT), 24 (IL); 27, (Calif., US)
	Environmental tax	4 (DK), 6 (HU); 11 (NL); 14 (DE) 20 (CY)
	Environmental charge	5 (HU); 8 (Serpis Basin, ES); 13 (Baden-Württemberg, DE); 17 (Po Basin, IT)
Subsidies	Subsidies on Products	15 (CH); 18 (D)
	Subsidies on Practices	2 (Lower Ebro Basin, ES); 10 (Tordera Basin, ES); 20 (CY)
	Tradable permit for abstraction	1 (Tagus Basin, ES), 22 (Colorado);
	Tradable permit for pollution	21 (Salinity, AU); 23 (Unbundling, AU); 25 (Miami, US); 29 (NoCar, US)
Voluntary agreements		3 (UK); 9 (Llobregat Basin, ES); 19 (Evian, Haute Savoie, FR) ; 26 (NY, US)

The selection 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). Three studies evaluate the set-up of voluntary agreements in different locations (UK, ES and FR). Subsidies, either on products or on practices, are covered in five case studies (CH, DE, ES and CY). In the EU, there are no explicit examples on tradable permits for pollution control and compensation mechanisms, which is a reflection of the infrequent or simply non-adoption of these schemes in Europe. Nevertheless, a number of the proposed EPIs are applied jointly with compensation schemes (payments for environmental services are just an example – e.g. case study number 2 in the Lower Ebro -ES).

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 the EU (IBE) expert group has delivered experiences on such case studies. The following types of instruments potentially covered by the IBE expert group are of special interest: tradable permits for pollution control (Australia and the

US), tradable permits for water (use) rights (Chile) or novel pricing instruments (Israel and the US).

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 4 and 5 respectively display the allocation of cases among these different themes

Table 4, Case studies by 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
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, 14, 22

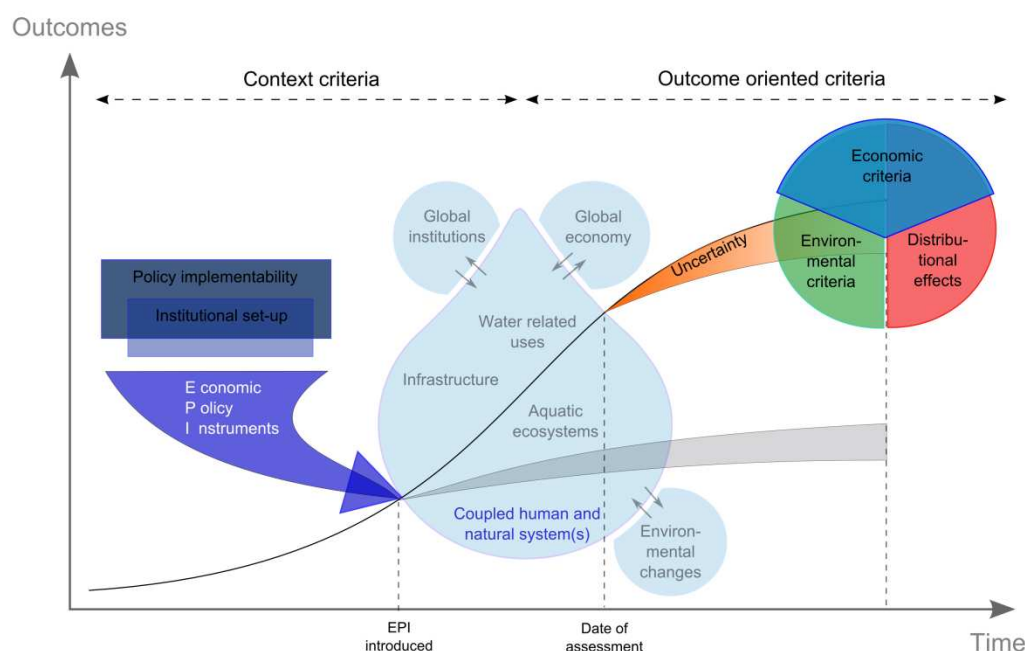
Table 5, Case study by main water management/policy issues

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
Hydro-morphology	2, 15, 17, 18

Overall Assessment Framework

To strategically extract t 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 analyzing and comparing the results of the EPI case studies (Figure A-2).

Figure A-2. 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.

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 behavior towards collective goals. EPIs that target environmental outcomes were assessed by comparing actual outcomes with alternatives (no action or regulation, for example) and evaluating positive and negative side effects. The economic valuation of environmental outcomes was based on avoided costs that were translated into monetary values that could be used in a cost-benefit assessment. This criterion considered 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. Key questions covered under this criteria in the reviewed case studies are:



- What were the changes in individual and collective behaviour (i.e. water withdrawals, wastewater discharges, etc.)?
- What were the observed changes in pressures on water resources and the status of water-related ecosystems?

Economic Assessment Criteria

This task provided an economic synthesis of the contents of the criteria on environmental objectives and facilitated evaluation of the outcomes. The economic assessment evaluated the EPI based on efficiency using a cost-benefit analysis (CBA) that integrated incomplete and/or unreliable economic estimates. In addition, EPIs were evaluated according to cost effectiveness, distributional effects, risk and promotion of innovation. Effects directly linked with environmental outcomes were used as an input to the analysis here. Key questions covered under this criteria in the reviewed case studies are:

- Did the EPI contribute to increase economic efficiency (i.e. social welfare)?
- Was it a least-cost solution, as compared to other water-policy instruments?
- Did it contribute to create the right incentives?

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. Assessment considered both proxy indicators based on quantitative data and quantitative subjective measures of well-being (Stiglitz Commission 2009). These results were assessed by comparing pre- and post-EPI implementation conditions. Key questions covered under this criteria in the reviewed case studies are:

- Did the EPI affect productive activities?
- Did income from production change? Did profits change?
- Did the costs of production change?
- Did the physical strain of work change to the point of affecting workers' health?
- Was a specific level of education or level of experience required for effective implementation?
- Did the EPI implementation process provide education (or awareness) in itself?
- Were leisure activities (indirectly) affected? Were staff reductions or increases made as a result of implementation?
- Do stakeholders feel they have a greater or weaker say?
- Did social connections and relationships change?

Institutions

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. We have separated institutions and transaction costs 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. We aimed to keep TCs 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). Key questions covered under this criteria in the reviewed case studies are:

- How do institutions (culture, attitudes, norms, laws...) affect the creation of EPIs?
- How did these institutions affect the design, implementation and/or operations of the EPI?
- Did the EPI have an impact on existing institutions or establish new ones?
- If the EPI failed, then can that failure be traced to an existing institution?

Policy Implementability

This criterion examined the conditions under which an EPI is or is not implemented. Failure may be traced to faults in design or implementation. Implementation is related to institutions (endogenous) and transaction costs (exogenous). The task identified and defined key factors that are important for implementation of EPIs at the policy level and to make recommendations of methods for their measurement and elicitation for their evaluation. This criterion considered the institutional setting, societal values, power relations, the impacts of other policies (e.g., CAP), and the EPI's flexibility with respect to local circumstances and changing situations (e.g. climate or socio-economic change). Key questions covered under this criteria in the reviewed case studies are:

- To what extent was the EPI a flexible instrument, which could be adapted to local particularities (ex-ante and ex-post implementation)?
- Did public participation play an important role in the choice, design and implementation of the EPI?
- Did the EPI match broadly held societal values?
- Were there powerful stakeholder groups with dominant opinions?
- Was there cooperation and coordination between the different ministries, such as Ministries of Finance, Agriculture etc. and within the different levels of Ministries and the central/ federal government?
- Can synergies between the EPI and sectoral policies be identified and taken advantage of?
- On the contrary, were there any barriers linked to other policies that impeded the successful implementation of the EPI?

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 alongside institutional backgrounds. We have used Krutilla and Krause’s classification of TCs noting that ex-ante TCs are equivalent to fixed costs and ex-post TCs are equivalent to variable costs associated with the EPI. We identified TCs by examining the flow from design and implementation (ex-ante) to monitoring and enforcement (ex-post). Asymmetric information fell under TCs in two ways. Ex-ante and ex-post TCs (have changed?) change the information environment (e.g., establishing and running a monitoring program). Asymmetric information (past tense?) can impose visible and invisible TCs, e.g., the costly change in behaviour in response to incomplete information. Key questions covered under this criteria in the reviewed case studies are:

- How were transaction costs defined in the available literature for the case study?
- What was the number and role of actors involved?
- How many authorities are involved in the EPI design, implementation, monitoring and enforcement?
- Did they have clear roles or did these overlap?
- What was the methodology to choose the EPI? How long did it take to select the EPI? And to implement it?
- What administrative procedures were involved in these steps?
- Was any guidance provided to decision makers?
- Were any decision-support tools (i.e. models) or studies used to understand the EPI? Did these planning instruments consider and/or minimize TCs?
- Was the EPI subject to asymmetric information problems? How were these integrated into its design and operation?
- Was the EPI applied in combination with other EPIs or other water policy instruments, i.e., existing institutions that would raise or lower TCs in the course of changing the EPI’s economic, environmental or social impacts?
- What monitoring and enforcement costs existed? How large were they?
- What TCs can be attributed to formal meetings and negotiations over the form or operation of the EPI?

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 have proposed using 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 were assessed through expert judgment, using qualitative statements. Key questions covered under this criteria in the reviewed case studies are:

- Was the objective of the EPI clearly specified and quantitatively measurable?
- Could the fulfilment of the objective be quantitatively or qualitatively determined with sufficient precision?
- Could the fulfilment (or its part) of the objective be attributed to the EPI? Would the objective have been fulfilled if the EPI had not been introduced? In other words, what was the difference between the baseline scenario (without EPI) and the empirically ascertained outcomes of the EPI?
- To what extent was the EPI felt to be an appropriate tool at the time of introduction?



Water transfers in the Tagus River Basin (Spain) (#1)

Carlos M. Gómez, Gonzalo Delacámara, Carlos D. Pérez, Estefanía Ibáñez, and Miguel Solanes (IMDEA)

Definition of the analysed EPI and purpose

This case study analyses the voluntary transfer of water use rights to guarantee drinking water security in the upper stretch of the Tagus River basin in Central Spain. The most significant and dynamic use of water in the entire Tagus river basin is represented by the demand of potable water in the Madrid metropolitan area including its sprawl eastwards, along the Henares River valley (water abstraction for water supply in Madrid accounted for 558.96 hm³ in 2009; 55.5 hm³ in municipalities supplied by the Sorbe Water Community). Two different experiences, corresponding to both water supply systems, are considered and compared. The former consists in the transfer from the irrigation areas of Alberche River to the Canal de Isabel II, the public water utility providing services in most of the Greater Madrid and its region. The latter consists of formal transfers from farmers in the Henares Canal to the Mancomunidad de Aguas del Sorbe (MAS) (Sorbe Water Community) to bridge the supply gap in the Henares valley.

Introduction

Population and economic activity in the Tagus River basin are concentrated in Madrid and Lisbon at both ends of the river basin. Scarcity problems are also more significant in the first of these ends. Although the quality of surface water is relatively good in the upper basin, only one tenth of rainfall (an average of 413.26 mm for the Henares corridor, in the 1953-2010 period, and an average of 1 300 mm for the Alberche river, in 1946-2010) and runoff is available to cope with more than two thirds of the demand for urban uses in the entire river basin. In clear contrast to that, the intermediate part of the Tagus River basin is dominated by the use of water for extensive agriculture. Yet, the availability of these resources is disputed by the more productive irrigated agriculture in the Segura River basin (SE Spain) close to the Mediterranean coastline and which is connected to the Tagus by a water transfer channel.

Since the mid 1970s, Madrid and its metropolitan area, to which the Henares valley belongs to, have been able to cope with a growing and more affluent population (1.5 million people increase within the last 15 years at an annual average rate of 2.04%) as well as with the increasing demand of a rapidly growing economy (an average rate of 3.28%, between 1996 and 2010) without building any new major water infrastructures and without engaging in any massive groundwater abstractions.

Within the last three decades water management in Madrid provides a clear example of a progressive adaptation towards the more efficient use of infrastructures, together with incentives and pricing schemes designed to adjust water demand. However, in the two decades before the current downturn, the mix of intense population growth, economic expansion, and rapid and extensive urban development pushed to the limit the capacity to manage an increasing water demand within the range of available resources and current water regulation infrastructures.

Legislative setting and economic background

Since the early 1990s, agreements to transfer water use rights from agriculture to urban uses appeared as an alternative to cope with the recurrent water supply deficit during a number of dry periods experienced since 1992 and this option gained social support and political acceptance since the costs of the best available alternatives already in place grew in the margin. In fact, efficiency in water treatment and distribution in Madrid is already above 80%; a high percentage of wastewater is currently being reused for gardening, street washing and to maintain environmental flows. In addition, the limited buffer groundwater stocks available (120 hm³ of renewable resources) have only been used (when not strictly reserved) for extreme events (in drought years, abstraction can soar up to 149.7 hm³). The construction of new infrastructures or tackling resources downstream in the Tagus has been ruled out because of its economic and political cost.

This is the context where pioneer agreements to transfer water between water utilities and irrigation districts sprung up for the first time in Spain. These were market agreements between the parties although actively supported by the water authority. Needless to say that in a drought-prone and water-scarce country as Spain, informal water transfers have always spontaneously occurred and even some important transfers have taken place amongst farmers. The exception in this case derives from the volume of trades, the parts involved in the bargaining process, the purpose of exchanges, and their importance to foster the adaptation of the institutional framework in order to allow for a wider use of water use right trades.

The first agreement considered in this case study took place in the summer of 1993 and actually involved two water transfers. To guarantee the flow of water to the Tagus in the Alberche River and subsequently the provision of drinking water to the city of Madrid (based on the public utility entitlements, 219.8 hm³), irrigators in the Alberche accepted a water transfer from the middle Tagus (35 hm³).

The second agreement took place in early 2002: a water right transfer (of 3 hm³ during 2002 and 14 hm³ during 2005-06) from the irrigators of the Henares Canal to provide water supply for domestic uses in the towns served by the MAS (of which Alcalá de Henares represents the most important one).



Both examples are connected with critical legal developments. After the severe drought of the hydrological year 2004-2005, the Spanish Government passed a decree (RDL 15/2005) including a number of urgent measures for the regulation of water right transactions to expand the scope for water markets as an economic policy instrument to prevent or tackle drought consequences. Yet, there was a previous record of legal measures to foster water markets in Spain, dating back to the drought of the early 1990s; that is actually the focus of this *ex post* assessment.

Brief description of results and impacts of the proposed EPI

Nowadays both transfers are deemed successful examples of drought adaptation. They fed up the process of institutional developments that have moderately boosted the use of voluntary transfers of water use rights as a water security mechanism avoiding other costly or politically challenging alternatives such as new water infrastructures or new expensive water sources.

Conclusions and lessons learnt

The emergence of water markets, as many other once innovative EPIs, is a gradual adaptive and learning-by-doing process that must be judged by its ability to push water institutional development rather than by the failure or success of the experience itself. The water transfer from the Alberche River although useful to manage the supply deficit in the 1990s would not be an alternative in 2011 anymore and many doubts exist as to the real prospect of repeating the 2002 water trade from the Henares Canal to the MAS in the same formal terms. The actual value of these examples is in the lessons that can be drawn and its importance to furthering agreements on reallocating water use rights as an instrument for water security.

Both examples also illustrate the critical importance of managing water use conflicts. It is well known in economic analysis that water management is essentially conflict management. In fact, according to the Spanish law, households have a priority over irrigators in water use, and there is no need for a voluntary agreement to take water away from farms in order to guarantee a sufficient supply of drinking water in dry periods. The real buffer for drinking water in Spain is the irrigated agriculture whose use rights are defined every year depending on the rainy season. Moreover, instead of just taking water or forcing farmers to let water flow, the agreement is easier to reach if alternative resources are available, the harvest is protected and third-party effects are avoided.

This is the real meaning of the 2002 transfer. The existence of these alternative resources is precisely what makes the replication of this trade almost impossible in 2011 (as there is evidence of overallocation of water rights in the middle Tagus river). Nevertheless, lessons learnt can be important to understand how, instead of paying for water, agreements might be easier to reach, in some cases, when alternative

sources are provided to guarantee existing uses, particularly in irrigated agriculture. Nowadays, alternative resources can either come from re-used or desalinated water.

Water trading also faces some important challenges. Allowing transfers from agricultural to urban uses may bring to the negotiating table water resources that are not being effectively used. In fact, given the low quality of soil in the Madrid area, agriculture is a receding activity and in some areas water allowances are higher than the effective demand for irrigation water. Paradoxically, once subsidies from the Common Agricultural Policy have been phased out and agricultural markets have been liberalized, the irrigation sector in some areas may be in excess water supply. The fact that farmers in the Henares valley accepted to give their water up at a price lower than one eurocent per cubic meter is but an indication that probably those water resources were not being used for crops. Hence, water trading might not be a means to reduce water scarcity but rather to increase it and would not be instrumental to reallocate water but to effectively increase its use. This would be a real risk should water saved after the publicly supported shift towards more efficient irrigation systems, becomes part of the water trading system rather than being left in already degraded aquifers.



Lower Ebro (Spain): Voluntary agreement for river regime restoration services (#2)

Carlos M. Gómez, Gonzalo Delacámara, Carlos D. Pérez, and Marta Rodríguez (IMDEA)

Definition of the analysed EPI and purpose

This economic policy instrument (EPI) is based on the voluntary agreement that was generated by public and private incentives, to deliver a set of pulses or artificial floods designed *ad hoc* for the partial restoration of the river regime in the Lower Ebro (NE Spain) by the private operator of the three hydropower dams in that region. Apart from this voluntary agreement, since 2002 the EPI development involves a public-private partnership in order to create, disseminate and use all the information available to identify the courses of action that may contribute to improve the ecological potential of the river.

Introduction

The large dams of Mequinenza (volume: 1 530 hm³; hydropower generation capacity: 324 MWh) and Ribarroja (218 hm³; 262,89 MWh) built back in the 1960s significantly modified the hydrology of the Lower Ebro River. Although the river still experiences natural floods, its physical and environmental conditions have remarkably changed within the last decades.

In 2002, the hydropower company, the water authorities, and the scientific community coordinated efforts to establish and promote a voluntary agreement, which jointly considers the possibility of compensation to the hydropower utility in exchange of water delivery, producing flushing flows as a means to control and remove the excess of macrophytes (visible algae and other flora species) from the river channel. This has been performed twice a year providing a testing scenario for the increasing improvements in its design in order to enhance its effectiveness reaching removal rates.

Legislative setting and economic background

All uses and pressures in the entire river basin heavily burden the lower stretch in the Ebro River. The amount of water reaching the river mouth has decreased since 1921, where the first dam entered into operation, and is nowadays only a fraction of the natural rainfall and runoff of the river basin. As a matter of fact, the Lower Ebro sub-basin's long-term average runoff during the period 1940-2006 was 232 hm³/yr., higher than runoff observed during the period 1980-2006 (182 hm³/yr.). This is

consistent with the values for the whole river basin. In addition, the river stream does not show the seasonal variability distinctive of the Mediterranean rivers anymore and its monthly and daily flows are closer to the minimum environmental flows prescribed by the water authority, which are steady throughout the year (10% of the flow rate under natural regime). Apart from those minimum flows and the variations in annual rainfall, water circulating in the river-channel is basically determined by economic rather than natural factors.

That is to say that anytime any day the water flow in the Lower Ebro depends on decisions made by the hydropower utility, which tries to make the best out of its power generation capacity, and in every month total water flowing down the river depends more on the needs of the irrigation sector than on the priorities of the hydropower sector. All these factors have severely modified the river ecology in many significant ways: for example, sediment retention has increased channel incision (i.e. erosion implies net average exports of 0.18 million tons of gross sediment; this sediment deficit translates into an average incision of 30 mm a year), favoured the penetration of marine silt, reduced nutrients received by fish population in transitional waters and altered sand balances in beaches on both sides of the river delta. The habitat has been seriously modified and invasive species (such as the zebra mussel and the bullfish-siluro) take the place of endemic ones, sometimes creating serious health risks (due, for example, to summer plagues of blackfly). Furthermore, they complicate the operation of power plants (as with macrophyte blooms which impair the functioning of refrigeration devices in the Ascó nuclear plant).

The Lower Ebro is a paradigmatic case of a heavily engineered river. During the XXth century, the series of dams built in the area allowed for the consolidation of agriculture and an incipient hydropower sector, guaranteed water supply for the surrounding urban settlements and significantly reduced flood risk. All this made possible social and economic development in the region, but also worsened significantly the ecological status of the river. This poor ecological status can be explained by increasing pressures from water abstractions, gravel mining, canalization, and pollution discharges as well as by the successive modifications in the river morphology. From a policy perspective, it may be the case that actions to reduce some detrimental activities or to improve the river status can be the source of some important benefits in excess over its opportunity cost. In particular, this will be the case if the improvement in the water river ecology leads to increases in the productivity of water in its existing uses, for instance by reducing the need to treat wastewater, the cost of producing drinking water or by allowing some new uses – i.e. bathing or fishing – that were not feasible with a degraded river status. The existence of these private benefits, which come along with the ecological improvement of the river, is a necessary condition enabling the engagement of private agents in a cooperative agreement. In addition, the public sector would be able to compensate those private agents to engage in practices with the ability to contribute to the improvement of the river ecology, provided the opportunity cost of implementing those actions were higher than the benefits received.

Hydropower companies became aware of the urgent need to recover the river ecology in the early 2000s when macrophyte infestations (aquatic flora more characteristic of a lake than of a flowing river) became a problem for the operation of the nuclear plant (and also for the irrigation pumping stations and Flix hydropower plant). Costly actions were adopted in order to mechanically remove macrophytes. This problem added onto other inconveniences created by the obstruction of water intakes and filters as well as the mussel colonisation of grids.

At that time, the delivery of recurrent pulses in order to remove these plants appeared as an alternative to avoid costly adaptation to degrading physico-chemical water conditions. Of course, the direct objective of these initiatives was the partial re-naturalization of the river regime, covering a wide range of benefits from the control of invasive species to the abatement of salt intrusion in the river mouth, and the improvement of water quality along the river.

Nevertheless, the private interest of power companies claimed the attention to mainly focus on the capacity of the artificial floods to remove the macrophytes in the vicinity of the power generation facilities (which are actually located far away from the river mouth). The good news is that power companies were willing to consider water flow patterns that were not only designed to maximize financial profits within the range of prevailing regulations but also to deliver some improvements in the ecology of the river system, paving the way for a collaborative agreement and for the remarkable research effort made in the area.

Even a mild alteration in the river hydrology would imply changes in the overall amount of water delivered and in the river regime throughout time with major consequences on the value of water for power generation. Taking this into account and considering that new operation rules would mean a shift in prevailing water use rights, the EPI was designed as a reciprocated collaboration scheme. Indeed, since its early stages it involved the possibility of a side payment to the energy operators both to compensate for additional opportunity costs and for the delivery of additional ecosystem services resulting from the river restoration scheme.

Brief description of results and impacts of the proposed EPI

Since 2002 a series of controlled floods has been implemented. At the outset, this was only for experimental purposes, supported by an ambitious research program to design floods and to monitor and maximize its effectiveness; more recently as part of the Ebro River Basin management planning process. These efforts were integrated in the design of the river plan and finished with the agreement to deliver two controlled floods every year (in spring and autumn), deliberately defined to maximize macrophyte removal rates and implying the delivery of more than 30 million m³ in 13 hours in each controlled flood.

The opportunity cost for the power utility depends on many factors and may range from a zero (or even negative) value in exceptionally wet years (where stored water

is at a minimum) to severe dry years (when the value of stored water is at its maximum). Simulation results indicated that measuring the opportunity cost of every flood was expensive and bargaining upon those costs every season was also institutionally challenging. Nevertheless, enough evidence from simulation models reveals that the long-term average cost of a single flood was not significant if compared to the overall turnover derived from selling power back to the grid and was also small if compared to the existing alternatives to remove invasive macrophytes. Regarding social costs of artificial floods (of some eurocents per person living in the area), they are also negligible when related to any available figure of people's willingness to pay to restore the river ecology.

Despite the relative success of the voluntary agreement, recent evidence has shown that the effectiveness of controlled floods to restore the river is now lower than in the previous decade, even for invasive macrophytes removal. Effects are better in the immediacy of big dams and hastily decrease with only marginal changes in the river estuary. Paradoxically while the success in improving the chemical status of the river within these last ten years is a fact; this seems to have driven an increase in the potential for the proliferation of macrophytes and boosted its rate of renewal after every controlled flood. New research efforts are currently being undertaken to shed light on the limits of better-designed or more regular controlled floods. The provisional balance, according to the experts involved in the field, indicates that designed floods help in river restoration but are not sufficient to offset a number of hydromorphological changes affecting the Lower Ebro. To deliver its expected outcome artificial floods should be part of a strategy involving at least better-designed environmental flows (which are now under revision) in order to make the ecology of the river less appropriate for typical lake standing species of flora.

Conclusions and lessons learnt

The experience on voluntary agreements for the delivery of artificial floods in the Lower Ebro is a unique example of public-private partnerships for the partial re-naturalization of a heavily engineered river. The coordinating role played by the Ebro River Basin Authority, visible in the series of assessment programmes and reports and in the constitution of experts' committees, has helped building a transparent bargaining scheme supported by long-term focused research enabling a better understanding of the river ecology and contributing to a better design of restoration alternatives.

The case study also shows how the public interest in restoring water ecosystems can make use of the potential gains for water users to build a self-enforcing cooperation agreement and may serve to deeply change the reactive attitude from many private firms into a proactive one. Businesses engaging in the agreement do not only enjoy certain financial benefits but can also convert these actions into part of their corporate social responsibility strategy. Building cooperative agreements is only

feasible when private interest is somehow compatible with the actual purposes of water policy, such as the recovery of some ecological potential of the river system.

Moreover, in this kind of cooperation setting, when the voluntary participation of critical water users is critical or at least of paramount importance, the emphasis can easily be placed on the design of alternatives with a better potential to contribute to the objectives of private partners (e.g. the removal of macrophytes in the closer areas of the power generation plants at the least opportunity cost in terms of power output and foregone turnover), rather than those objectives of water policy (e.g. maximizing the social benefits of river regime restoration along the whole river).

Payments for environmental services are difficult to implement in societies with advanced water regulations and institutions, especially in EU countries where water resources are not private 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 and will require important legal amendments besides other transaction costs. Difficulties in implementing payments for environmental services presumably reduce the scope for voluntary agreements of the kind illustrated by this example.

The effective contribution of the agreed flushing floods may depend on the previous set-up of many other measures designed to recover the ecological status of the river, such as a properly defined and effectively enforced environmental flows, which are not already in place and that cannot be expected just as the result of an agreement with water users. In fact, voluntary agreements are possible regarding particular measures that are easy to define and to observe, but the recovery of water ecosystems usually involves many different measures that may need to be coordinated.



Cooperative agreements between water supply companies and farmers in Dorset (#3)

Christophe Viavattene, Joanna Pardoe, Simon McCarthy, Colin Green - Flood Hazard Research Centre – Middlesex University

Definition of the analysed EPI and purpose

This case study is a classic example of a water company facing increasing nitrate contamination of its groundwater resources. The pollution is mainly the result of farming activities in the catchment. Potential “cheap” solutions such as blending the water from different sources are increasingly difficult to undertake due to the extent and increase in contamination. As a result the water company has two options: the treatment option or a catchment management approach.

In this case to avoid the high Operational & Maintenance and construction costs of the treatment option the water company (Wessex Water) has approached the farmers in order to cooperate to improve the water quality by promoting better practices. The cooperation involves information and education support but also phased incentive payments. Such an approach is generally defined as a cooperative agreement (Heinz *et al*, 2002) following four criteria:

- It is established on a voluntary basis between farmers and at least one water supplier and relying on the self-interest of the parties involved
- It is based on self-regulation among the key actors
- It includes an important role of the water supplier, either in the negotiation process and/or in the provision of financial resources
- It is targeted to a specific area (e.g. water catchment area; groundwater protection zone)

Introduction

The case study area is located in the county of Dorset, part of the South West region of the UK. The total case study area covers approximately 500km². Dorset is a predominantly a rural region, where agriculture occupies the majority of the land (79%). This includes 39% arable, 34% grassland and 6% rough grazing. In the last 10 years following the foot and mouth disease crisis there has been a decline in livestock farming and an increase in fruit and vegetable farming. The water company, Wessex Water, supplies approximately 370Ml/d of drinking water to a population of 1.2 million. The predominant sources of this water are the aquifers underlying this region. Abstraction from aquifers accounts for 80% of Wessex Water’s domestic supply with reservoirs and rivers providing 22% and 0.2% respectively. Groundwater quality is therefore central to securing the long term future of public



supplies. The water in these aquifers is of a high quality, however, the main issue that threatens the quality of water in the catchments is nitrate pollution.

The approach

In UK the economic regulation system of the water industry is the most significant barrier to the development of cooperative agreements in terms of both the polluter payer principle and consumer's protection. So the cooperative agreement approach developed by Wessex Water is quite unique in the UK and has for a long time been considered as a pilot case study for the institutions. In its early stage the approach was part of an EU life project called WAgriCo, but now the operation is now exclusively led by the water company.

The catchment management approach is primarily focused on advising the farmers to optimise their practices. The advice is based on a risk assessment approach and monitoring N levels at various points within the system (farm, crop, soil, water). The catchment officers work closely with the farmers facilitating the discussion regarding potential individual solutions to reduce the risk. The approach largely favours the development of relationships, trust and a common knowledge of understanding between the catchment officers and the farmers. Grants were phased being mainly used as an incentive at the start of the initiative. The use of compensation can be discussed as part of the solutions but it is limited to individual confidential arrangements between the water company and the farmers.

Brief description of results and impacts of the proposed EPI

- ✓ The farmers' participation in the different catchments can be considered as a success; between 80% and 100% of the catchments at medium and high risk are now engaged with Wessex Water.
- ✓ The current Soil Mineral Nitrogen values sampled in the field following the establishment of EPI indicates similar values as that observed in the average national scale Nitrogen Vulnerable Zones, indicating good farming practices and appropriate fertilizer uses.
- ✓ So far there has not been a change in the groundwater concentrations. This can be attributed to the slow response of the hydrosystem.
- ✓ The annual cost of the catchment management approach is very low at approx. 8% of the treatment cost options. The costs mainly include the catchment officer costs and the sampling costs. However, these costs per farm are 20 times higher than the one observed for a standard catchment management approach.
- ✓ The main impact of the EPI is on social capital: trust, social connections and relationships between the farmers and the water company. A common



knowledge of water catchment management and diffuse pollution is enhanced.

- ✓ Impacts on the economic side are difficult to measure, but the employment of catchment officers is a strong positive contribution of the EPI.
- ✓ The cooperation approach is flexible allowing a focused, tailored and adaptive approach to specific geographic areas which might be more difficult to achieve by a national approach. Such an approach may also easily harmonize with on-going environmental policies.

Conclusions and lessons learnt

The EPI appears to be well-designed answering the needs and the goals of Wessex Water and the farmers involved in the cooperation. The following points try to highlight the key aspects that have enabled the Wessex Water approach to be successful in terms of cooperation:

- ✓ No red tape, no polluter approach. Wessex water went to the farmers explaining the problem and that the farmers could help to solve it.
- ✓ Investment in social capital rather than financial capital.
- ✓ The catchment officers are committed to a limited number of farmers.
- ✓ Risk assessment approach involving yearly field sampling is an important diagnostic tool and negotiation tool.
- ✓ Flexibility in the engagement – no official agreement. If necessary, only simple measures are promoted.
- ✓ Grant involvement but only in the first phase as an incentive instrument.

The transferability of this approach in its current form to catchments with high nitrates concentrations is questionable if changes in crop patterns or a reduction of profits are required. The current case study was limited to a win-win approach. It is therefore difficult to establish if the cooperation is strong enough to support such changes inducing losses for one or both parties.

The Danish Pesticide Tax (#4)

Anders Branth Pedersen, Helle Ørsted Nielsen and Mikael Skou Andersen
(Department of Environmental Science, Aarhus University).

Definition of the analysed EPI and purpose

Denmark's landscape is dominated by agriculture. When the current Danish pesticide tax was implemented, the overall aim was to reduce pesticide residues in crops, water courses, lakes, ground water, soil and rainwater and thereby to lower the risk of environmental damage and negative health effects. Denmark is one of very few countries with largely untreated tap water. Water catchment for drinking water purposes is based solely on ground water (GEUS, 2010). In contrast, most other countries use surface water as drinking water (Aarhus University, 2011a).

The more precise objective regarding the effect of the pesticide tax, which was implemented in 1996, was a reduction of pesticide consumption of between 5 % and 10 %. When the tax rate was doubled in 1998 the stated objective was to reduce consumption by 8 % to 10 % more. Providing an incentive to reduce pesticide consumption, the tax was expected to contribute to reaching the overall aim for the Danish pesticide policy – reducing agricultural pesticide consumption to a level reflecting a treatment frequency index (TFI) of 1.7. The TFI represents the number of pesticide applications on cultivated areas per calendar year in conventional farming, assuming use of a fixed standard dose. The case study demonstrates the challenges of choosing an optimal tax design in a complex world where, additionally, not all individuals in the target group necessarily react to the incentives as predicted by economic modelling.

Introduction

The Danish pesticide tax was introduced in 1996 and is levied on sales prices. At the time, during the planning process it was concluded that it would be impossible to base the tax on the toxicity due to the complexity of determining toxicity and due to the impossibility of ranking the different types of negative effects (i.e. on groundwater, fish in watercourses, biodiversity in windbreaks etc. etc.) of different pesticides. The tax rate was doubled in 1998 (see Table 1.1). The rate is differentiated according to pesticide category.

Table 1.1 - Danish pesticide tax (% of retail price, exclusive VAT and other taxes)

%	1996	1998
Insecticides	37	54
Fungicides	15	33
Herbicides	15	33
Growth regulators	15	33

The tax is charged to manufacturers and importers who then incorporate it into the product price. All manufacturers/importers are obliged to register with the tax authorities. Taxed products have to be marked with a special label designed by the authorities. This special label indicates the tax category and the maximum price of the product, the argument being that this system precludes the possibility of registering the product at a low price (and a low tax) before selling it at a higher price without a higher tax. Customs and taxation authorities are obliged to control manufacturers and importers. Non-compliance can be sanctioned with fines or imprisonment at a maximum of two years (Ministry of Taxation, 1998).

The focus in the present case study is on the pesticide tax on agriculture. The tax is also applied to other pesticide users such as private home owners and horticulturists. Tax revenue is fully reimbursed to the agricultural sector – primarily by a lowering of the land tax.

Legislative setting and economic background

In Denmark, there is a strong preference for having untreated drinking water. Danish drinking water is normally untreated and if pesticide limits are violated in a well for drinking water, the well will normally be closed instead of treated. The introduction of the pesticide tax in 1996 took place against a background of failure to reach the aims of the pesticide policy with the previous policy measures and a general move towards a green tax reform, shifting the tax burden from income taxes to environmental taxes (Ministry of Taxation, 2001). Thus, an expert committee had paved the way for the tax with a 1992 report proposing a reform that would include, among others, more environmental taxes on water, energy and transportation in order to encourage work and discourage consumption (Ministry of Taxation, 2001: 47).

In connection with the implementation of the EU Water Framework Directive (EC/60/2000) the pesticide tax is slated for redesign. In the future, the tax rate is supposed to reflect the environmental harm of the chemical compounds rather than the sales price of the product. Furthermore, the new centre-left government (October 2011) have announced that an increase in the pesticide tax is planned, following up

on similar plans by the former Liberal-Conservative government (Danish Government, 2009, 2010, 2011).

Since the original introduction of the tax, structural developments in Danish agriculture exhibit consistently increasing farm size, which has probably hampered the effect of the pesticide tax, as the evidence indicates that larger Danish farms (above 150 ha) use more pesticides and are less focused on using the smallest amount of pesticides, than smaller farms (Pedersen et al. 2011, 2012).

Brief description of results and impacts of the proposed EPI

A most likely baseline scenario for the development of the TFI, had a pesticide tax not been implemented, would be stability around the 1994 level, the year before the adoption of the tax was known, assuming unchanged policy instruments, crop composition, climate and prices of pesticides and crops. Consequently, the baseline scenario for the development without a pesticide tax would be a stable TFI around 2.5 from 1996 and onward.

The trajectory of the treatment frequency index (TFI) indicates that the tax has had a very small effect, at best. It is conceivable that the developments in grain prices (increases some years) as well as pesticide prices (decreases) have counteracted the effect of the taxes, obscuring an actual effect of the taxes. But while this may hold for 2007 and 2008, which had abnormal price developments, the pattern for the first half of the decade does not appear to support such a conclusion. Neither has the development in the composition of crops substantially changed the need for pesticides. However, poor crop rotations at some farms and appearance of new pests have increased the consumption of pesticides some (Ørum et al., 2008). The isolated effect of the pesticide tax has not been evaluated ex post. Consequently, it is impossible to deem the tax either a success or a failure. However, the Danish pesticide policy instrument mix can be considered a failure since the policy mix has failed to bring pesticide consumption even near a TFI of 1.7, which was predicted ex ante.

The tax has had some distributional effects within the sector; farmers who grow crops with a higher pesticide need and farmers living in regions with lower land values will, on average, experience a poorer net result than other farmers. Furthermore, the price label system connected to the tax is costly for producers and importers of pesticides. Transaction costs were estimated ex ante to be small. Current levels of illegal imports of pesticides are impossible to estimate but every now and then illegal pesticide transports are revealed by the authorities.

There are cross effects with other policies. E.g. 1) the CAP links farm subsidies to compliance with environmental regulation and the CAP's second pillar includes subsidies for pesticide-reduced or pesticide-free crop cultivation. On the other hand, agricultural policy is not yet completely decoupled from production incentives. 2) the Water Framework Directive is one of the causes that the Danish pesticide tax is now slated for redesign 3) the Danish nitrogen regulation causes a lower use of growth regulators in Denmark.

Conclusions and lessons learnt

The precise effects of the pesticide tax are unknown. Due to the relatively inelastic demand for pesticides, environmental effects might be larger for other types of environmental taxes. However, the transaction costs tied to the pesticide tax appear to have been relatively small, which suggests that the tax may still be a relatively cost effective policy instrument, assuming that it has had an effect. Full reimbursement of the revenue, primarily through lower land taxes, made the tax more acceptable to the agricultural sector, but, unsurprisingly, the tax is not popular among the farmers. Redesigning the tax to reflect toxicity might improve the environmental effects as well as the perceived legitimacy of the tax among farmers. Due to the inelastic demand of pesticides relatively high tax levels are probably needed.



Water Resource Fee - Hungary (#5)

Gábor Ungvári, Péter Kaderják, András Mezősi, András Kiss - Budapesti Corvinus Egyetem – Regionális Energiagazdasági Kutató Központ (BCE-REKK)

Definition and purpose of the EPI

The „Water Resource Fee” (WRF) is an abstraction charge. When introduced, it was defined as the main regulatory instrument for water resources. The WRF’s key water policy objectives address the sustainable use of the country’s water resources and the supply of water for economic and public use. The fiscal objective was the provision of financial resources for the Water Fund managed by the water authorities.

The implementation of the WRF was based on a complex design that reflected the diversity of available water resources. The charge aimed to influence water demand in a market compatible way, using a method with which the water authorities - organisations with centralised governing functions – were also comfortable.

From the perspective of the research, this charge is an Economic Policy Instrument (EPI) because it is, in essence, a water charge. More importantly, it is intended to act as an EPI in order to modify water consumption decisions. The WRF offers lessons about the kind of risks and consequences a change in external conditions can bring if multiple goals are compressed into one instrument and the stakeholders do not support the legitimacy of these goals (both users and political decision-makers).

In 1993, the “Water Resource Fee” was introduced to replace a previous water charge for industrial water users and to adapt the regulation to the changes taking place in the economic structure of the country.

Comprehensive analysis of the WRF was conducted as part of the process of laying the foundation for the introduction of the Water Framework Directive (WFD) in 2009 (OVGT, 2010/a). The operation of the instrument has changed in several ways. The structure of the calculation has not changed, but the circumstances in which the water charge operates have.

Introduction

The environmental and regulatory objective of the EPI was the prevention of water resource overuse. Its environmental and regulatory objectives were the improvement of allocation efficiency and the prevention of conflicts related to consumption. The economic and fiscal objective was to maintain revenue flows to the Water Fund and, later on, to the national budget.

In this sense, the EPI is a two-tier instrument with two distinct functions. The registration of abstraction entitlements delivers the function of preventing overuse. The delivery mechanism of the allocation function is the charge on water abstraction.



The charge or fee is calculated according to a complex set of modifying multipliers that depend on which specific economic actor uses the water and which water resource type is used.

The successful operation of the instrument requires the balanced enforcement of its objectives. But its role was ultimately reduced to its revenue generating function. Strong market pressures essentially overrode the EPI's potential and desired impact on environmental and allocation objectives. The earmarked use of the revenues – first for water management and later for water management and environmental protection purposes – was abolished and the Water Fund was liquidated. The fee thus became the general revenue of the national budget. It was a step of a wider and longer process that the central budget centralized revenues to overcome its chronic deficit problem. The payment calculation method remained, but the objectives were overwhelmed by fiscal goals. Based on this outcome, in our opinion the implementation and operation of the EPI was neither effective nor successful.

Legislative setting and economic background

In the context of the EPI, abstraction entitlements were issued and charges for abstraction were collected. The charge was approved by government decree.

It is not within the scope of the EPI to compensate for the external environmental impacts of water use.

The balanced operation of the charge was likewise impeded by the constant restructuring of the ministries and the water authority itself.

The early period of economic transformation in Hungary (during the 1990s) resulted in a severe decline in GDP and the deterioration of the standard of living. The economic problems placed an additional burden on public finances and, at the same time, the national budget was burdened with heavy debt payments. This situation reinforced the revenue centralization efforts of the central budget and placed additional burdens on the economy. All this together resulted in sluggish growth and an exaggerated need for foreign capital inflows, with no additional resources available for, or attention dedicated to, the restructuring of public services. Following an initial trend of debt repayment, after 2002 the situation began to change and the public debt started to grow again, resulting in growing budgetary imbalances.

The water authority (then the National Water Management Directorate General) had an interest in the implementation of the water charge in order to keep financing the sector's development vehicle, the Water Fund.

As the state retains ownership rights to all major waters, this is the basis for the right to collect charges for abstraction. The water charge was applied to all forms of water provision for commercial (industries and firms) and public use (with some exceptions) for both abstractive and non-abstractive uses.



Brief description of the results and impacts of the proposed EPI

Although there has been a general declining trend in water abstraction since the implementation of the instrument in 1993, this is not the consequence of the EPI. The effect of the water charge is negligible compared to two other drivers of change: the increasing price of water and the technological improvement of the Hungarian economy.

For this reason, we estimate that the water charge has not fundamentally altered the behaviour of water users.

Thus, the instrument has had a negligible effect on overall efficiency gains.

The burden of payments was concentrated on a few sectors: in particular the different forms of water use in the energy generation sector and water utility abstraction. Together, these two sectors pay 75% of the fees. Because half of the payment is related to energy production (hydropower plants, cooling water for thermal power plants), from a fiscal perspective the charge ended up serving as an additional tax on energy generation. This means that the cost burden of the charge was spread out across the economy instead of weighing on those that have a real impact on available resources. This situation contradicts the requirements of the “user pays principle” and is likewise disadvantageous from the perspective of social equity. Little-by-little, agricultural water users simply stopped paying the charge. The water charge also discriminates against those industrial users who depend upon the water utilities for their water needs.

The water charge (independently of its original justification) was viewed as just another tax that a strong bureaucracy had imposed on users and, in short order, was captured by the central budget. The instrument was thus transformed into what stakeholders originally thought it was.

The original design of the instrument was built upon the component features of a previously functioning instrument. This provided short-term gains during the implementation stage, but resulted in the long-term problem of stakeholder lack of acceptance. The instrument has an unfortunate design – a very detailed set of charge-modifying multipliers - that encourage targeted lobbying activities and attempts to gain preferential treatment. The quality of the administrative supervision (management of the instrument) declined after the abolition of the revenue’s earmarked status.

The intended outcome of the charge was twofold. First, demand would be regulated and modified through adjusting the multipliers in the payment calculation. Second, the financial resources to cover administrative costs and the small-scale development projects of the water authority would be expanded. These intended outcomes were not realized. The actual outcomes were increased budget revenue and the improved monitoring of water abstraction. The introduction of the cost-based pricing of water supply promoted improvements in water resource allocation efficiency, not the

complicated manipulation of abstraction charges. In this sense, the general impact of the strategy was unintended.

Moreover, the reporting discipline of water users has declined.

Conclusions and lessons learned

Below are the principal reasons why the coherence of the instrument dissolved when financial pressures on the state budget grew.

- The water charge addressed an important, but very technical problem that lacks public acceptance of and support for the respective policy action.
- No clear priorities were set across the multiple stated functions of the instrument.
- The lack of clear political motivation and the subsequent objectives resulted in the implementation of an instrument for regulatory purposes, the design of which was impacted by an interest in preserving a decentralized revenue stream.

The institutional interests of the water bureaucracy however were ultimately hurt by the centralization of the revenue stream. This centralization eliminated the incentives of the water authorities and accurate resource monitoring ultimately lost its priority.

In spite of the long operation of the instrument from 1993 to the present, its strategic impact was never re-assessed. An assessment conducted in the context of developing the National Water Basin Management Plan was the first, coherent evaluation of the instrument (OVGT 2010/a). This analysis assessed the instrument's compatibility with the WFD criteria, i.e. whether it is a suitable instrument for recovering the resource cost of water use in accordance with the more complex criteria of WFD art 9. "applying the user pays principle". The answer is no..

The Plan included a proposal for bringing the WRF instrument in line with the new WFD requirements.

The proposal targeted the WRF calculation method, the use of the revenues and the allocation method for abstraction entitlements in cases where water bodies were found to be in a poor ecological status.

The proposal further defined the purpose of the charge as a revenue vehicle for covering the administrative costs related to implementing and managing the monitoring functions specified in the WFD. This change could provide a clear mandate for raising revenues. In order to enhance the public right to sustainable resource use, water users must cover the cost of administrating and monitoring their activity.

Regarding the method for calculating fees, an additional role of the fee should be to signal relative scarcity, not coerce compliance. (A resource with higher utilization requires more concerted control). In order to fulfil this goal, the modification of the end-user based water charge multipliers was proposed. The new multipliers should be differentiated based on the effect of the use on the status of the individual water body (and not on their end-use, as was previously the case). They would distinguish between abstractive and non-abstractive uses, the timing of the withdrawal and would consider the preference for (increased) storage (relative scarcity) of the available resource.

In the case of water bodies that have been found to be in a poor ecological status, in particular due to over-abstraction, the decrease of licensable quantity and the introduction of market based procedure for the allocation of the licenses were proposed.

Water load fee, Hungary- Hungary (#6)

Judit Rákosi, Gábor Ungvári, András Mezősi, Lajos Kelemen, Péter Kaderják -
Budapesti Corvinus Egyetem – Regionális Energiagazdasági Kutató Központ (BCE-
REKK)

Definition of the analysed EPI and purpose

The Water Load Fee (WLF) is an effluent tax, it is intended to reduce the amount of pollutants discharged directly into the running water and has been in effect since 2004. The WLF is based on point sources and is assessed based on the total amount of pollutants measured and on the expected damages.

The WLF regulation is intended to reduce the total amount of pollutants discharged directly into running waters. The fee is based on the multiplication of four factors. The rate of the water load fee is defined by the product of: 1) the total amount of the annual discharge of the contaminant measured in kilograms, 2) multiplied by a specific rate per pollutant, 3) a measure of area sensitivity and 4) sludge disposal factors.

Nine contaminants are regulated: COD, phosphorus, inorganic nitrogen, mercury, cadmium, chrome, nickel, lead and copper.

The fees determined by the Act were phased-in gradually. In the first few years, 2004-2007, only a share of the calculated fees had to be paid. The total fee was assessed only from 2008 onwards.

No explicit, quantitative WLF target was set when it was introduced. Only general principles were formulated: pollution reduction and the implementation of the polluter pays principle. However, its introduction was primarily the result of fiscal goals.

No official re-thinking, review, formal assessment, or evaluation has been prepared since its introduction seven years ago. What is more, the system fell completely out of the scope and responsibility of environmental governance regulatory institutions.

Introduction

The dominant water protection regulation that decisively changed the behaviour of those affected is the Command and Control (CC) regulation introduced in 2001. When the WLF was introduced, it was not compared to the water protection regulation (CC). It operates rather as an alternative to it and is essentially regarded as an amendment to the CC regulation. The impact of the WLF cannot be appropriately evaluated. No data collection has been carried out and no other information is



available on its effectiveness. Not even stakeholders have relevant information. Thus no clear contribution increased economic efficiency can be identified.

Legislative setting and economic background

The legal basis for applying environmental load fees was established by the Environmental Protection Act (Act No. 53, 1995). The introduction of the WLF failed several times between 1996 and 2002 due to stakeholder resistance. The bill was finally passed in 2003 as a result of the Ministry of Finance's promotion of the bill and as part of an attempt to improve the income of the state budget. Three kinds of fees were introduced in the 2003 Act No. 89 on environmental load fees (ELF): an air load fee (ALF), a water load fee (WLF) and a soil load fee (SLF).

All polluters, including public utilities, who discharge contaminants into running water are required to pay the WLF. Service provider companies charge users the WLF through their prices. Thus the WLF is ultimately paid by the households, the industrial and commercial sector and those utilizing the sewage system.

The main stakeholders and social groups affected by the WLF are the general population (households), wastewater service providers and businesses. Among the latter, those who discharge directly into running water and those who discharge into the public sewer are affected differently. The service provider is responsible for most of the liability. Altogether, in 2005 municipal sewage and wastewater treatment amounted to a share of 90% in the total WLF payment.

Brief description of results and impacts of the proposed EPI

The WLF has an impact on production. It increased the costs of production and thus influenced the amount of profit at a rate that depends on the market situation. The WLF paid in 2005 (when the payment obligation was only 30% of the total fee) was 0.005% of the net revenue of industry and 0.07% of the profit. The fee liability amounted to 1.5% of revenue and 26% of after-tax profits in the public water utility sector. Sectors were affected differently by the regulation. According to the preliminary socio-economic assessment (ÖKO CO. Ltd, 2003), compared to the GDP of the sectors, the following are more heavily affected than the average: fisheries, the wood-working industry, the food industry, metallurgy, metal-working and the chemical industry.

The WLF raises the prices paid by users in areas with public utility sewage disposal and the service provider pays the collected fees into the central budget. Settlements and service providers are most affected by the water load fee where there is a sewage system without wastewater treatment. Between 2004 and 2010, when the Budapest Central Wastewater Treatment Plant (BCWTP) was built, Budapest was among the most highly affected settlements. The WLF's share of the total wastewater price was approximately 16.5% in 2008, when the total WLF had to be paid. In 2011, when the

BCWTP had already been in operation for an entire year, the total amount of the WLF had declined to less than half of its previous amount and its share had decreased to one-third because less pollution was discharged.

In Hungary in 2010, the WLF differs between settlements, the WLF was between 0.5-11% of the average wastewater price.

As a result of the increase in wastewater (and water) prices, water usage declined and the degree of affordability changed. In the case of the most affected sector, urban wastewater services, the wastewater programme is mainly financed from state and EU sources and only to a smaller extent by the municipalities. But it is not financed from water fee revenues. Thus neither the municipalities, nor the wastewater service providers have been able to achieve significant improvements solely because of the WLF. Thus its impact is more limited. However, some service providers were able to achieve the modernization and environmental-friendly operation of wastewater treatment technologies. The new CC regulation is also crucial in the case of those directly discharging into running water. In this case, the necessary technological improvements became more affordable as a result of the contribution provided by the WLF.

The decline in water use resulting from the fee increase is clearly an advantage. On the other hand, high prices led to an increase in environmental and health risks increased, primarily in poor rural regions. The number of those supplying themselves with water from groundwater resources, instead of relying on the public water supply, and the number of those illegally disposing of their wastewater, has increased.

From a strictly fiscal viewpoint, the WLF is a failure. Revenues have been far less than expected. The primary reason for this is that fee payers significantly (and excessively) exploited the system of allowances intended to finance investments and the purchase of metering devices. The system of allowances likewise had a market distorting effect because of the often-unnecessary acquisition of new of laboratories. Thus, on the whole, the WLF more like a financing instrument than creating incentives to change behaviour.

The failure to harmonize the operation of the administrative structure with parallel legislation (the CC) is an important factor. While the operation of the CC regulation remains under the governance of the Ministry responsible for environmental protection and its regional bodies, the collection and control of the WLF falls under the responsibility of the National Tax and Customs Administration (NTCA). This complicated institutional and political situation resulted in the fact that the WLF has been operated entirely from a fiscal perspective. Moreover, the competent authorities do not have the means to ascertain the principal component features of the WLF: the total amount of pollutants emitted and operational and transaction costs.

Conclusions and lessons learned

Both from an environmental as well as from economic point of view, parallel regulations and double taxation (CC regulatory fines and the WLF fee) should be avoided or introduced and operated in a harmonized fashion. Environmental improvements should have the smallest social impact and the lowest possible cost.

It is not a good idea to treat an environmental, emission-based regulation solely from the standpoint of tax collection.

The WLF system's undeniable advantage is the fact that water pollution generates extra costs and damages. For the first time, in part as a result of the WLF, it became clear that polluters should pay these costs. Industry, service providers and the general population have now accepted this, and the level of environmental awareness has increased over the past seven years.

The WLF regulation clearly needs to be revised, not only because the list of regulated pollutants is out-of-date (e.g.: BOD should be regulated instead of COD), but also because it is necessary to fulfil the requirements of the Water Framework Directive (WFD). The water protection regulation (CC) also needs to be brought into compliance with the new situation. So-called basic measures were to be realized by 2010, except for the development of wastewater treatment in settlements with a population between 2,000 and 10,000, where the deadline is 2015. The new principal aim is the implementation of the programme of measures and especially the implementation of the supplementary measures, as defined in the river basin management plans in accordance with the WFD. This requires revision both of the CC regulation and the WLF.

Water tariffs in agriculture – Emilia- Romagna case study (#7)

Sardonini Laura, Viaggi Davide and Raggi Meri (UNIBO)

Definition of the analysed EPI and purpose

The Economic Policy Instrument (EPI) considered in this WP3 case study of the EPI-WATER project is related to the introduction of a volumetric water pricing system as a cost recovery measure for the delivery of irrigation water. The area analysed, Tarabina, covers 700 ha and is located in the province of Ravenna (Emilia-Romagna Region).

A pressure pipe system was built in this area in 1982, but without the use of a water metering system. An area-based contribution system was in place for cost recovery purposes. The move from an area-based water pricing system to volumetric pricing took place in 2006. This EPI implementation addresses all the farmers in the area.

The main motivations for the introduction of the EPI were the increasing M&O costs (due to high water use) and the fact that both irrigators and non-irrigators paid the same area-based tariff, (hence causing inequity problems between the two farmer groups). The motivations for the EPI implementation, while legally driven by the cost recovery obligations of the Reclamation and Irrigation Board (RIB), were a mix of efficiency (cost reduction and, indirectly, water use reduction) and equity (intended as the “right” cost distribution among farmers) concerns.

Water tariffs were considered socially “wrong” because the allocation of costs was not related to actual use. For this reason, the introduction of a volumetric water pricing system based was justified. The new pricing is trinomial and the tariff is the sum of three components:

- a fixed component (€/ha): paid only by non-irrigators and representing a payment for M&O costs;
- a volumetric component (€/m³): representing the real water use quantified by water meters and paid only by irrigators;
- a variable component (€/ha) introduced to recover all the remaining costs (not covered by the previous two components); this part is from one year to the next and includes additional costs such as non-ordinary interventions, unmetered water use and M&O costs, and is paid only by irrigators.

The payment of each farmer, computed and paid in year t , is currently computed on the basis of real water use measured in year $t-1$.

The purpose of this analysis is to understand the conditions for EPI implementation related to the specific characteristics of the case study area and to provide a tentative *ex post* analysis of its impacts. The bulk of the work focused on obtaining the necessary information in order to understand the effects of the EPI (in comparison to



a counterfactual area) and to assess the enabling and disabling factors of the EPI design, implementation and effectiveness.

The analysis was carried out in collaboration with the Reclamation and Irrigation Board of Romagna Occidentale (RIBRO).

Introduction

The case study is located in the South-East of the Emilia-Romagna region and is part of the district managed by the RIBRO.

The focus of the study is the introduction of the EPI in a sub-area of RIBRO. The case study area, Tarabina, is located in the province of Ravenna. The Tarabina area covers about 700 ha and includes approximately 50 farms.

In the 1970s, there was debate in the area with regard to the possible construction of a pressure water system. The pressure system was eventually built using a government subsidy and was completed in 1982. Since its construction, the water pressure system has been defined as a “costs centre” system, meaning that costs for the Tarabina system are calculated separately from general RIBRO costs.

Since 1982, the water tariff has been calculated on the basis of an area-based water pricing system, but during that period the tariff increased from 20€/ha in 1983 to 155€/ha in 2005 for all farmers (irrigators and non-irrigators). Accordingly, farmers complained of the water tariff increases, and the management committee proposed to improve the water cost distribution. The solution proposed was the introduction of water metering in order to attribute payments on a “user pays principle” basis.

Legislative setting and economic background

With regard to this case study, the relevant institutions are: the Reclamation and Irrigation Board of Romagna Occidentale (RIBRO), Canale Emiliano Romagnolo (CER) and the Tarabina Management Committee (TMC).

The main objectives of the RIB are: planning reclamations and irrigation structures, participating in activities related to land protection, managing water use for irrigation and other uses. In our case study we focus on the RIBRO (www.bonificalugo.it) and its focus is: planning suggestions for hydrological harmonization, planning future programmes related to reclamation and irrigation, construction of infrastructures for reclamation and irrigation. For our purposes, the main relevant activity of the RIBRO at the local level is related to water distribution for irrigation purposes.

Another important institution is the Canale Emiliano-Romagnolo (CER) which is a second level RIB. It manages the homonymous canal, which is one of the most important hydraulic infrastructures in Italy. It takes water from the Po River to plain areas, making water available for irrigation uses in the RIBRO area.

The Tarabina Management Committee (TMC), for its part, was instituted after the construction of the pressure pipe system in 1983. The formation of the management committee was justified by the definition of Tarabina as a “costs centre”. The TMC also has its own statute. The TMC is elected by farmers located in the Tarabina area



and is composed of 9 members of which 7 farmers are elected by farmers and 2 members represent the RIBRO.

The economic sector of interest is agriculture. Data on land use and the crop mix in the Tarabina area are not available from statistical sources (due to lack of information at the appropriate scale), but qualitative information was provided by the technical staff of the RIBRO by way of unstructured interviews. In their view the main specialisation in the Tarabina area is horticultural crops; heterogeneous crop mixes are also present at farm level based on combinations of other crops, such as seeds for industrial use, cereals and fruit (peaches, kiwis, apricots, and plums).

Brief description of results and impacts of the proposed EPI

The Tarabina case study investigates the implementation of a volumetric water pricing system in the agricultural sector. The EPI provided multiple impacts related to environmental, economic, and social aspects; those most evident are mainly the economic impacts such as those related to the decrease in water delivery costs and the change in the distribution of farmer contribution costs. In particular, a noteworthy cost reduction for non-irrigators occurred, due to a more efficient cost distribution based on quantity used. With regard to the environmental outcome, due to a decrease in water used, the amount of water remaining in the environment increased. Finally, regarding social aspects, the EPI increased the level of “social agreement” within the group of non-irrigators.

Even though the area examined is quite small, the EPI application could be considered significant within the Italian context. In fact, based on the authors’ knowledge, the case study represents the only one of its kind related to EPI implementation.

Some specific conditions had a crucial role in the EPI implementation. Firstly, a pressure pipe system was already in use in the Tarabina area hence no costs for its construction needed to be considered. This offers a suitable case for the construction of a baseline able to isolate the effect of the EPI from other interventions (e.g. pipe construction). In addition, the definition of Tarabina as a “cost centre” allows for the measurement of (and hence potentially recovering) all costs related to it, as they are already separately identified in the RIB accounting system. Moreover, the presence of targeted institutions able to offer clear and timely solutions reduced transaction costs associated with changes in the tariff system. Finally, long-term contracts between RIBRO and CER for water supply eliminated problems related to water scarcity, hence allowing the EPI to focus only on economic aspects (as opposed to EPIs mainly driven by water saving concerns).

The EPI implementation involves the shift from an area-based system to a volumetric water pricing system for irrigation uses in the agricultural sector.

The main reason for EPI implementation was the increase in water tariffs during the period 1983-2005. Such increases also caused significant inequalities between users (irrigators and non-irrigators). Consequently, farmer representatives elected to the



management committee, with the assistance of the RIBRO, sought a solution to reduce cost inequalities and potentially the overall cost.

The solution identified was the implementation of water metering and the shift to a volumetric water pricing system.

Conclusions and lessons learnt

The implementation of this EPI can be considered to have been successful with respect to its main (explicit or implicit) objectives.

One reason lies in the mechanism that generated the EPI and the fact that it was proposed by farmers themselves. The fact that the mechanism was voluntarily adopted by the effected farming community made the implementation more acceptable from a social point of view. In particular, the main objective was to address an existing inequity between irrigators and non-irrigators, and to reverse increasing cost trends. The disparity prior to the implementation of the EPI was perceived mainly by non-irrigators who paid the same area-based tariff as irrigators. Improved equity was obtained by introducing a volumetric water pricing system that applies tariffs based on differing water usage.

Due to their sense of involvement and indeed participation in the decision making process, the degree of agreement on the part of the farmers with regard to the implementation of an economic instrument was high.

The direct consequence of the EPI was a significant tariff reduction for non-irrigators. A secondary effect was a more rational use of the resource by irrigators in two ways: reduced use (water conservation) and increased awareness of the resource value. Altogether this allowed for a clear increase in the efficiency of the distribution system.

Increase in the pollution charge at Serpis River Basin (#8)

Hernández-Sancho, F.; Molinos-Senante, M. and Sala-Garrido, R. (University of Valencia)

Definition of the analysed EPI and purpose

The instrument is focussed on water and is an increase in pollution charge in order to reduce water consumption and pollution contributing to achieving the good ecological status for water bodies.

The increase in the pollution charge has two main objectives:

- Economic objective: ensure the cost recovery of the wastewater treatment process as a consequence of the application of the polluter pays principle.
- Environmental objective: reduce the consumption and pollution of water in order to maintain the ecological flow even in during droughts.

Regarding environmental objectives, specific goals were not defined. In the case of the economic objective, an increase in the pollution charge has been estimated based on the investment and operation costs of the measures implemented in the two largest wastewater treatment plants (WWTPs) located in the watershed.

The research interest in this case is based on:

- The potential of extrapolation to other Mediterranean river basins in which the achievement of the good ecological status is conditioned by the quality of the discharge of the WWTPs.
- Demonstrating the importance of the valuation of environmental benefits to justify the economic feasibility of the necessary measures to fulfil the objectives set by the Water Framework Directive (WFD).
- Providing evidence on how the payment capacity may condition the achievement of a good ecological status for EU water bodies.

The increase in the pollution charge was implemented in 2010. For this reason, there is no statistical information relative to the reduction in water consumption. Through the implementation of the instrument, measures to improve the effluent from two WWTPs have been financed and so contributing significantly to the improvement of the quality of the river. In this sense, there is information relative to the improvement in the organic matter and phosphorus concentration after the implementation of the measures in WWTPs. The current version of the instrument is the result of a well designed and planned process.



Introduction

An increase in the pollution charge has been implemented in the Serpis river basin – which is located in the region of Valencia (Eastern Spain), within the Jucar River Basin District. It is a typical Mediterranean watershed. In order to fulfil the Water Framework Directive some measures needed to be implemented.

Because effluent from WWTPs represent a high percentage of the total stream flow, accounting for up to 50% during winter and 90% during summer, water administrations have established that it was necessary reduce water consumption and improve the quality of the effluent from the WWTPs.

In this context, the increase of the pollution charge was considered a good instrument for achieving the economic and environmental objectives – taking into account the principle of polluter pays and the cost recovery.

From the economic point of view the intended objective was to recover the investment and operational costs of implementing measures in WWTPs. Because the increase in the pollution charge was defined taking into account this premise, the objective has until now been achieved.

Regarding environmental objectives, the quality of the river has improved significantly but it is difficult to evaluate what percentage is attributable to the instrument. In relation to social aspects, no significant impacts have been found relative to affordability.

Legislative setting and economic background

The approval of the increase in the pollution charge did not require the adoption of any legislation or regulation. The Valencian government Act 2/1992 establishes that the powers for approving pollution charge belong to the 'Entidad Pública de Saneamiento de Aguas Residuales (EPSAR)' and therefore as an autonomous administration it can approve its own pollution charge. However, we must remember that the power for water management at the watershed level belongs to the state administration.

For the implementation of the EPI is unnecessary to consider and remedy the externalities derived.

The performance of the instrument is not affected by institutional constraints. However, it is very important to have available information concerning the elasticity of the demand curve for fixing the increase in the charge so that the defined objectives are achieved.

The EPI was implemented in 2010 in the middle of an economic crisis. However, independently of this circumstance the WFD requires the recovery of costs. For this reason, one of the criteria for determining the increase in the pollution charge was to recover the costs of investment and operation of the measures implemented in the WWTPs.



There were no economic distortions in the implementation of the instrument and no vested interests.

Water rights did not affect the design and implementation of the increase in the pollution charge since the tax is levied on water consumption by domestic users.

Brief description of results and impacts of the proposed EPI

Despite the fact that the EPI was implemented in 2010, it can be considered that it has succeeded because the quality of the Serpis River has increased. Nevertheless it is difficult to know the percentage of this improvement that is attributable to the increase in the pollution charge.

The increase in the pollution charge has enabled the financing of the cost of the measures implemented in the largest WWTPs aimed at improving effluent quality. Moreover it has been demonstrated that the benefits of these measures overcome the investment and operation costs. Hence their implementation is feasible in economic terms. It has also been verified that there are no problems of affordability regarding the increase implemented.

The environmental outcomes of the implementation of the EPI are subject to high levels of uncertainty because there is no statistical information on the reduction in water consumption. However, it is estimated that a reduction of 10% can be achieved. Also a comparison of pollution charge in Spanish regions reveals that there is room to increase the pollution charge in the SRB and achieve additional reductions in water consumption.

Education has revealed as an essential factor for the effectiveness of the instrument in social terms. It is important to make citizens aware about the real costs of water supply and wastewater treatment in order to contribute to modifying their behaviour. The willingness of citizens to pay for improving the quality of the river is higher than the increase in the pollution charge. Therefore, the instrument was well accepted.

Transaction costs were not taken into account neither in the design nor implementation of the instrument. However, they can be considered as insignificant. Hence, they did not affect the environmental, economic, and social impacts derived from the increase in the pollution charge.

The environmental outcomes from the instrument were vaguely defined and subject to high uncertainty. Hence, it is not possible to quantify the difference between the intended and actual outcomes. Regarding economic objectives, the target of cost recovery has been achieved at a 100% level.

Conclusions and lessons learnt

The main lessons learnt from increasing pollution charge are as follows: (i) the increase in the pollution charge has partially contributed to increasing the water quality of the SRB and a significant reduction in water consumption is expected; (ii)

the estimation of the cost of the measures implemented in the WWTPs has been used to determine the increase in the pollution charge necessary to recover all the costs; (iii) in the SRB there are no problems of affordability in relation to the increase in the pollution charge; (iv) cooperation between state and regional administration was essential for the implementation of the EPI; (v) pollution charge is a flexible instrument since the increase is defined depending on the objectives to be achieved and the elasticity of water demand; (vi) the main transaction costs are the ex-ante costs and they are associated with the research needed to define the increase in the pollution charge; and (vii) while economic objectives were clearly defined, environmental objectives were vaguely established.

As the elasticity of water demand is known, the willingness of citizens to pay for improving the quality of the river and having a clear institutional framework are the essential items for the success of the instrument. However, the lack of awareness of some citizens relative to the charge paid for sanitation service is the main disabling factor.

The design of the instrument would be improved if a social pollution charge was considered as an exception to be applied in some special conditions.



Voluntary intersectoral water transfer at Llobregat River Basin (#9)

Hernández-Sancho, F.; Molinos-Senante, M. and Sala-Garrido, R. (University of Valencia)

Definition of the analysed EPI and purpose

The voluntary intersectoral water transfer is focused on water management. By the use of reclaimed water by farmers, freshwater can be released and used for the higher quality urban supply. In this way, the availability of water is guaranteed for irrigation purposes and in the metropolitan area of Barcelona. Since intersectoral water transfer is integrated in a broader context (integrated water resources management) it also enables the water quality of the Llobregat aquifer to be improved and domestic water consumption decreased.

The main objectives of the instrument are: (i) to ensure the supply of water for urban and agricultural demands and so enabling increased economic activity; (ii) improve river flow, the creation of a hydraulic barrier against seawater intrusion and maintenance and restoration of wetlands; and (iii) increased income for farmers. No specific quantitative targets were defined.

The research interest in this case is based on:

- The potential of extrapolation to other EU areas in which there is a growing water demand with different quality requirements while facing droughts.
- Demonstrating that if institutional and regulatory frameworks are adequate, it is possible to reach agreements among water users for improving the management of the water resources available in an area.
- Providing an example in which transaction costs are affordable since negotiation benefits all water users.

The implementation of the EPI started in 2009 after the adoption of the Catalanian Water Reuse Program. No assessments of the outcomes of implementation have been made until now. The current version of the EPI is the result of a well designed and planned process.

Introduction

The EPI has been implemented in the Llobregat Delta which is located in the NE of Spain. It is an area with endemic water shortages and includes the Barcelona metropolitan area, the second largest city in Spain. The need to improve the availability of water was highlighted during the severe drought of 2007-2008.



Voluntary intersectoral water transfers was considered as the cheapest alternative to guarantee the water availability for irrigation and domestic purposes and also to improve the water quality of the Llobregat aquifer.

After the implementation of the instrument, and as a consequence of the important environmental education campaign carried out, domestic water consumption in the city of Barcelona in the period 2000-2010 has decreased from 133 to 107 litres per capita per day and the seawater intrusion in Llobregat aquifer has decreased noticeably. As regards economic impacts, the income of farmers has increased as a consequence of the abandonment of rain-fed agriculture and the use of reclaimed water for irrigation. The water supply company has saved costs since it has been able to avoid water transfer from remote sources.

This instrument can be considered relevant as it can be adopted in other areas with water scarcity problems, because it is adaptable to local circumstances and can be modified ex-post implementation.

Legislative setting and economic background

Because the instrument is based on negotiation and cooperation between farmers and the water administration it was not adopted by legislation; although the adoption of the Catalanian Water Reuse Program was key for the development of the EPI.

For the success of the instrument it is not necessary to consider and compensate external impacts although some of the benefits derived from the implementation of the EPI are environmental. However, these benefits have not been quantified and included in the economic assessment.

Voluntary intersectoral water transfer is affected significantly by institutional constraints. National and regional legislation relative to wastewater reuse imposes the quality criteria that regenerated water must meet. Hence, the cost of reclaimed water, and therefore the economic assessment of the instrument is indirectly determined by legislation. Information also plays an important role since to increase the willingness of farmers to use reclaimed water, they had to made aware of the advantages and disadvantages of its use.

The EPI has been introduced in the context of an economic crisis. Hence, it was essential to ensure cost recovery. The cost of regenerating the water is paid by for by domestic users in application of the polluter pays principle. However, the cost of distributing the regenerated water is paid by farmers since they profit from its use. In this way, the cost recovery of the process is ensured.

The farmers affected by the instrument do not obtain agricultural subsidies, therefore, there are no economic distortions in the implementation of the EPI and no vested interests.



Water rights were not well defined in the area. Traditionally farmers can draw a fixed quantity of water ($1.5 \text{ m}^3/\text{s}$) in normal periods, and in periods of water shortage this volume was reduced ($0.8 \text{ m}^3/\text{s}$). The water administration was aware that this was an inconvenience for farmers because crops were not guaranteed. Moreover, if severe droughts occurred in the future, the water flow for irrigation could be further restricted because domestic use has priority.

Brief description of results and impacts of the proposed EPI

The EPI has succeeded because since farmers have started to use reclaimed water, and so freshwater has been released. Hence, the availability of water for the Barcelona metropolitan area has improved and for irrigation has been guaranteed even in summer so the income of farmers has increased. Moreover, water consumption for domestic use has decreased and the water quality of the Llobregat aquifer has improved. All of these outcomes have been achieved by employing the cheapest alternative.

Concerning the economic efficiency, the use of water regenerated in the Sant Feliu del Llobregat WWTP has increased the income of farmers by 20%. The item that most contributes to this increase is the abandonment of rain fed agriculture, and the use of reclaimed water for irrigation. In this case, the investment of one euro in the use of reclaimed water creates an income increase in agriculture of approximately EUR 1.6.

In the case of El Prat de Llobregat, there are no changes in yield and sales revenue in spite of the improvement in water availability. The use of regenerated water enables farmers' income to increase by 5%. The most important cost saving is associated with the avoidance of pumping surface and groundwater. The investment of one euro in the use of reclaimed water yields an agricultural income of 1.9 euros.

The total net profit of water transfer when considering the farmers and the city is around EUR 16 million per annum and this shows that despite the fact that the water reclamation costs are not offset by the added values in agriculture (farmers' cost savings and increased sales revenues), the use of reclaimed water in agriculture is economically efficient due to high level of profits resulting from the intersectoral water transfer.

Regarding the environmental sustainability, an improvement in the aquifer for all parameters related to seawater intrusion has been verified. Moreover, indirectly the implementation of the EPI has involved a decrease in domestic water consumption as a consequence of the increased level environmental awareness by users.

From the social point of view, the main stakeholders in the project were farmers, the water company of the metropolitan area of Barcelona, the water administrations (at regional and local level), and the environmental administration. Because the intersectoral water transfer was made between farmers and the city, a cooperation and negotiation process between farmers and the water supply company was essential.



The implementation of the EPI has not altered the employment levels for farmers although their income has increased. As a key actor, farmers have actively participated in the decision-making process, and feel that the administration has taken into account their interests before adopting final decisions in the framework of water management.

The second main stakeholder in the process was the water administration at regional and local levels. Both administrations cooperated in the design and implementation of the instrument. Once it has been implemented, the local administration is responsible for monitoring since it has powers for urban water supply and for wastewater treatment.

When the EPI was being designed, the environmental and economic outcomes were vaguely defined and had no quantitative target. Hence, it is impossible to quantify the difference between the intended and actual outcomes.

Conclusions and lessons learnt

The main lessons learnt from this instrument are as follows: (i) the implementation of the voluntary intersectoral water transfer has enabled users to be made aware citizens about water scarcity problems. Significant water savings have been produced as a consequence of their behaviour; (ii) the EPI was designed in order to increase the benefits for both farmers and municipalities. It has been proved mutually beneficial. This issue was one of the key aspects for the success of the instrument; (iii) considering the opinion of farmers from the beginning of the process and not trying to impose any policy was key for the success of the EPI; (iv) the institutional framework for developing the instrument is wide. The careful definition of regenerated water uses and quality criteria has eased the design and implementation of the EPI; (v) voluntary intersectoral water transfer is a flexible instrument because it enables negotiation between the parties involved in the agreement and adaptation to local circumstances including ex post adaptations; (vi) the ex-ante transaction costs are the costs associated with the negotiation between the parties. The ex-post costs are associated with the monitoring of the quality of the reclaimed water. Both types of transaction costs are insignificant; and (vii) the uncertainty is mainly associated with the environmental outcomes derived from the implementation of the EPI.



Negotiation and monetary incentives to promote the use of reclaimed water at Tordera River Basin (#10)

Hernández-Sancho, F.; Molinos-Senante, M. and Sala-Garrido, R. (University of Valencia)

Definition of the analysed EPI and purpose

The negotiation and the use monetary incentives to promote the use of reclaimed water is an EPI focused on the management of water resources. The EPI is focus on improving water management by using non-conventional water sources. It is considered a win-win strategy since all parties involved in the process improve their situation in economic terms or water availability.

The instrument has on the one hand, an economic objective which is to ensure the availability of water including in the summer and so maintain economic activity (agriculture and golf course). The environmental objective is to reduce the overexploitation of local aquifers by reducing water and energy consumption. The volume of water that should be reused as a result of the implementation of the instrument was not well defined.

The case has been chosen for:

- Its potential for extrapolation to other EU areas in which competition for water resources is high.
- Providing evidence that negotiation enables agreements to be reached that benefit both parties following a 'win-win' strategy.
- Demonstrating that non-conventional water resources are a valuable source in shortage areas and that they should be considered as an alternative to increase water supply.

The negotiation to promote the use of reclaimed water started at the Tordera delta in 2003. During that year, the Mas Pijoan Ranch reached an agreement with the managers of a nearby golf course to share water reuse infrastructure. The assessment of the outcomes derived from the instrument is only the measurement of the volume of regenerated water that is reused. The current status of the EPI is the result of a planned process.

Introduction

The instrument was implemented in the southern boundary of the Costa Brava in the North-Eastern Spain. It is an area with endemic water scarcity problems in which there has always been competition for water use. In the last 20 years, due to the development of golf courses water shortage problems have accentuated.



Since 1985 water has been reused for golf course irrigation in the Costa Brava and the social acceptance of water reuse is good, the water administration believed that a good alternative to address the growing regional water shortage and pressures on the local aquifers was to promote the use of reclaimed water through negotiation and the use of monetary instruments.

After the implementation of the instrument, the urban demand of freshwater has decreased significantly since regenerated water is used for garden irrigation. Water availability has increased even during summer months at the time when the water demand from crops is highest. The adoption of the win-win strategy between farmers and golf-courses has enabled an increase in benefits mainly by sharing water reuse infrastructures.

The instrument can be considered effective and it can be adopted in other areas that face to water scarcity problems since it's adaptable to local circumstances and parties involved.

Legislative setting and economic background

For the choice, design, and implementation of the instrument there was no specific legislation or regulation. Given that the implementation was based on the promotion of negotiation between stakeholders, the Administration only acted as a catalyst. Nevertheless, the 2009 Catalan Water Reuse Program has been an impulse for new agreements.

For the success of the instrument it is not necessary to consider the external benefits achieved as a consequence of its implementation.

Institutional constraints significantly affect the performance of the instrument. Both national and regional legislation establishes the uses for regenerated water, and consequently affects the parties that can be involved in the negotiation process. The norm also determines the quality criteria for the regenerated water, and therefore water regeneration costs are an important issue to take into account when developing a water reuse project. Information also plays an important role in the sense that if parties are unaware of the benefits derived from the use of regenerated water, then the negotiation process never will start.

The implementation of the EPI started in an economic boom. Although the economic context has now generally changed, tourism in the area remains stable since it is exclusivity aimed at wealthier individuals. Hence, activity on the golf courses has not decreased and arrangements reached in the past with farmers could be maintained.

There were no economic distortions in the implementation of the EPI.

The stakeholders interested in the implementation of the instrument were mainly farmers and golf courses managers since both could improve their situation if agreements to use regenerated water were achieved. Because a win-win strategy was



followed in the negotiation process, water rights did not affect the implementation or operation of the EPI.

Brief description of results and impacts of the proposed EPI

Positive environmental, economic, and social impacts have been generated as a result of the implementation of the EPI.

From perspective of economic efficiency, it should be highlighted that the negotiation between farmers and golf courses managers has enabled the incomes of both stakeholders to increase. The availability of water for agricultural irrigation has increased by 1.43 hm³/yr. This figure has represented an increase in the farmer income since the cost of water regeneration and distribution is less than the benefits obtained by increasing the irrigated area, as well as the savings for reducing groundwater pumping, the reduced use of fertilizers, and avoidance of the need to construct a new freshwater pipeline. When compared with the alternative of seawater desalination, the agreement reached with farmers was the cheapest alternative to maintain golf course activities.

Regarding environmental impacts, the main outcome is associated with the use of regenerated water for the irrigation of municipal gardens. This measure, together with increased user awareness, has meant a 20% reduction in urban demand of freshwater during the period 2003-2010 – despite the fact that the population increased 35% over the same period. This has resulted in less pressure on local aquifers. Another significant positive environmental impact has been the decrease in the use of chemical fertilizers since reclaimed water contains nutrients meaning significant energy savings and the increased availability of non-renewable resources such as phosphorus.

The main stakeholders involved in the implementation of the instrument were farmers, golf course managers, and residents. As a consequence, the increase in the irrigated area has meant the generation of new jobs. The social perception of the regenerated water by farmers has improved after the implementation of the EPI. The use of regenerated water has contributed to improving the social image of golf courses since the population perceives that they are not using local resources for business but are only take advantage of a resource that nobody else uses. The environmental awareness of citizens was raised after the announcement that some of the municipal gardens are irrigated with regenerated water. The implementation of the instrument has enabled awareness to be raised about the serious water scarcity problems in the area.

The transaction costs associated to the instrument are minimal, therefore, they do not affect the impacts of the EPI.

When the EPI was designed, environmental and economic objectives were defined in general terms, without specifying precise quantitative data. Therefore, it is not possible to quantify the difference between the intended and actual outcomes.



Conclusions and lessons learnt

The use of monetary incentives and negotiation for promoting water reuse has taught some lessons: (i) crop production and golf course irrigation is now independent from variable rainfall patterns and groundwater availability; (ii) a mutual win-win strategy reliability and flexibility can be offered to the parties involved; (iii) the social perception relative to water reuse has been improved by the EPI implementation; (iv) the culture of water reuse has conditioned the choice and the implementation of the instrument; (v) sharing the information relative to previous experiences was essential to develop new water reuse projects; (vi) overall, transaction costs are very low and are associated with monitoring the quality of the regenerated water; and (vii) the objectives of the instrument were vaguely defined and in qualitative terms.

The main enabling factors that have contributed to the success of the instrument can be summarized as follows:

- Strategy win-win: The negotiating process between the two or more parties should be governed by a win-win strategy, in other words, both parties must obtain benefits as a result of the cooperation.
- The social acceptance of the water reuse. All the stakeholders should be aware of water scarcity problems and the challenge that they face.
- Institutional framework. The existence of specific water reuse legislation helps the success of the instrument because many of the aspects to be considered are defined by law.

There is no room to improve the design and implementation of the EPI, since it is largely conditioned by legislation. The capacity of the WWTPs to produce water with enough quality also affects the implementation of the EPI.



Groundwater taxes in the Netherlands (#11)

Marianne Schuerhoff, Hans-Peter Weikard, David Zetland (WUR)

Definition of the analysed EPI and purpose

The Economic Policy Instrument (EPI) we analyse in this case study – a volumetric tax on groundwater extractions levied on a subset of groundwater users in the Netherlands – is simultaneously an instrument for raising revenues and modifying behaviour. The EPI's impact depends on the choices facing users of groundwater. Some will have an incentive to increase water efficiency; others will shift to other sources like surface water; some will not respond at all. All things equal, we know that any water user subject to the groundwater tax will face higher costs, either through the payment of the tax or through the cost of changing behaviour to avoid the tax.

Introduction

The Dutch national groundwater tax (GWT – as opposed to the extant provincial groundwater extraction fee, which is dedicated to groundwater management) was presented as a “green tax” that would simultaneously provide revenue to the central government that would make it possible to lower taxes on “productive behaviour” (income tax) and increase the cost of behaviour with an environmental impact (resource tax).

Our case study examines the tension between a tax that generates revenue (its publicized goal) and a tax that modifies behaviour (its indirect, but predictable effect) while noting that complete success in one implies complete failure of the other. Given its age (passed into law in 1994, and in force since 1995), we can look back on its economic, environmental and social impacts.

The GWT is levied on almost all water extractions made by particular entities – generally large net water extractors. Like other green taxes (e.g., taxes on fuel and rubbish disposal), it was levied on a “resource consuming” behaviour that the Dutch government wanted to reduce.

Legislative setting and economic background

The GWT's fiscal design as a tax (instead of a regulation) reflects a desire to generate revenue at the same time as it modified behavior. It also reflects the existence of provincial fees that funded groundwater regulation; it made more sense to levy a tax as a complement to regulation than add another level of regulation.

The GWT was implemented in 1995 under the Environmental Taxes Act of 1994, which was enacted as part of a general trend to “green” taxes in the 1990s. The GWT

was designed to minimize adverse impacts on “sensitive” groundwater users. These were, first, farmers who were mostly exempt from the taxes and, second, industry which was originally taxed at 50 % of the rate levied on drinking water companies. The impact on other payers (drinking water companies, for example) was minimized by the tax’s relatively simple reporting requirements: annual self-reporting of extractions. Although it is possible to assume that agricultural exemptions provided a form of subsidy to their operations, it is not clear that farmers were getting very much of a subsidy or lax regulatory environment. That is because farmers got their water from many sources, were already subject to regulation regarding “bad” practices affecting groundwater (via provincial fees, but often exempt there too), and suffered production losses when groundwater levels were too high for their crops.

Brief description of results and impacts of the proposed EPI

The GWT has been successful as a fiscal instrument designed to raise revenues without affecting behaviour too much. Although the cost of administering the tax was relatively low (EUR 220 000 for a revenue of EUR 170 million) – compared to other taxes – it was also a tax that its few payers (most obviously drinking water companies) disliked immensely, since they saw it as an “optional” cost that they would prefer to do without.

The GWT was immediately successful in raising revenues. Its impact on groundwater levels and environmental quality is hard to determine. First, the government *presented* the tax as a fiscal measure, not as a measure to impact behaviour. Second, there was no systematic collection of groundwater levels before and after implementation of the tax – making it difficult to know if the tax had any impact on groundwater levels. Third, there was no agreement on whether groundwater levels should be higher or lower. The Netherlands has a long history of trying to remove water to reclaim areas for human use (particularly in the western part of the country). At the same time, the Dutch recognize the need to raise groundwater levels in some places where excessive consumption has reduced groundwater levels and environmental health.

The economic impacts of the GWT are, likewise, difficult to either trace or explain. From an economic perspective, the tax raised the price of raw water supplies to drinking water companies and industrial firms. Although these costs amounted to around EUR 170 million per year, they amounted to only 10 % of the cost of tap water to residential users, a number that few would notice. Industrial firms paying the tax probably paid more attention to its financial impact, but few would make significant changes in their operations (beyond perhaps using more surface water) due to the tax being quite small relative to the value of water as an input. We might imagine that farmers would have the strongest response to the tax, but they were mostly excluded from paying the GWT because they individually did not pump enough groundwater to meet the threshold for payment. Many farmers take water from ubiquitous surface water supplies that are connected to groundwater sources,

rely on precipitation or are exempt from paying taxes because they use the water for sprinkling and irrigation.

The social impacts and distributional effects are difficult to trace, due to the tax's light burden on water choices that most make while paying more attention to other, larger costs and constraints..

It is important to note that the GWT was implemented at the same time as provincial groundwater fees were already in effect. These fees – although quite small relative to tax revenue – had a much larger impact on groundwater levels in the Netherlands. That is because fee revenues were used to pay the salaries of staff charged with monitoring and managing local groundwater supplies. These regulators already influenced practices with (in)formal guidance before the introduction of the GWT.

Conclusions and lessons learnt

There are several lessons for outsiders to take from the Dutch GWT experience. First, pay attention to the difference between the fiscal and behavioural dimensions of a tax. Second, remember that a tax – no matter how efficient or how easily passed through to consumers – is still a tax that payers wish to avoid. Third, not all “green taxes” are green in either design or operation; they may only be a way of raising revenue. That said, it is also important to track the behavioural impact of a tax – if only to understand its economic, social, and environmental impacts.

We therefore recommend that anyone considering a GWT monitor and assess behaviour before and after the GWT is implemented – in terms of groundwater and total water consumption – as well as groundwater levels and groundwater “health.” Such data collection, although increasing the administrative costs of the GWT, will facilitate discussion of the environmental and economic impacts of the GWT.



Payment by the drop: The move to water metering in England and Wales (#12)

David Zetland and Hans-Peter Weikard (Wageningen University)

Definition of the analysed EPI and purpose

Volumetric water pricing, as an Economic Policy Instrument (EPI), is different from non-volumetric pricing in several aspects. First, volumetric pricing reduces the quantity of water demanded because payments for water rise with use – unlike the case of fixed pricing in which water service – at high or low volumes – costs the same to every household. Second, volumetric pricing makes it easier to create a direct link between costs and benefits, making it easier to charge heavier users a larger share of water system costs. Finally, volumetric pricing, by requiring measurement of water use, makes it easier to understand where water goes in a distribution system – whether to high demand customers, low demand customers, or leaks that are expensive in terms of lost water and the costs incurred in sourcing, treating and moving the water through the system before it's lost.

In this case study, we examine the implementation of residential volumetric pricing in England and Wales through the most basic delivery mechanism: a water meter.⁴ For convenience, we will use “EPI” to refer to either water metering or volumetric pricing, taking them as synonymous.

Introduction

Meters are necessary (but not sufficient) for allocating costs in proportion to use and identifying leaks that contribute to environmental stress and increase the cost of running a water system. The combination of meters and sufficiently high charges for volumetric use can encourage customers to use less water more efficiently. Volumetric water pricing reduces demand (by linking payments to consumption) but it also makes it easier to charge users according to their consumption (“economically fair”) and incentivize leak repair within homes.

England and Wales had adequate water supplies and supply infrastructure for most of the twentieth century, but water stress has increased under two influences: demand has increased under the twin forces of greater population and an expansion of lifestyle uses of water; supply has decreased as “available” waters (net of environmental base flows) have shrunk. Although scarcity can be addressed by

⁴ We do not examine non-residential water metering or the design of volumetric water tariffs.

reducing demand (consumption and leaks) or increasing supply (via, e.g., desalination), there is more emphasis on reducing demand in England and Wales.⁵ The 1989 privatization of England's water companies neither alleviated these pressures nor created an automatic response. That's because volumetric pricing requires water meters that were not widely used in England and Wales. The privatization bill allowed companies to compel consumers to adopt meters and set a year 2000 deadline for replacing charges based on rateable value (RV, or the value of a house) with charges based on consumption volumes (Walker 2009).⁶ This was a big goal since only 3 % of residential customers had meters in 1992-3 (Ofwat 2006). Although the year 2000 goal was not met, metering penetration continued to increase. Forty per cent of households are now metered (Defra 2011).

Legislative setting and economic background

The Water Industry Act 1999 sets metering policy for England and Wales. It gives households the right to opt for a meter ("optants") or continue to be billed on RV. Metering is often mandatory for businesses (not examined in this case study), new homes, homes with a change in occupant, homes with characteristics that correspond to high water use (e.g., lawn sprinklers), and homes in officially "water stressed" areas; see Ofwat (2011) for more details.

From an economic perspective, water meters add costs (installation and reporting) while possibly reducing revenues (through the fall in demand). These factors, together, suggest that metered customers will see some combination of higher fixed and variable charges for water. Against these costs come the benefits of reducing water stress (via falling demand and leaks) and reducing the need for investments in new water supplies. Meters also make it possible to charge customers based on their water consumption. This distributional aspect -- combined with a concern for "affordable" water, spreading the meter installation cost among other metered customers, and unwinding some cross-subsidies at the center of RV pricing -- means that the most interesting economics of water meters involve changes to the mix of costs and benefits among various groups of consumers.

Likewise, it's difficult to separate out the costs and benefits of meters in comparison to other methods of reducing demand (via public education campaigns or installation of high-efficiency water appliances, for example). Meters can act as complements as well as substitutes to these measures. The relative cost-effectiveness of these programs is difficult to measure when they are part of a general trend, e.g., a "water conservation ethic" that is part of increasing environmental awareness or high-efficiency appliances that come to market due to technological advance.

⁵ See Ofwat (2011a) for demand-side activities.

⁶ The move from RV to meters was also part of a Thatcher-era trend of replacing funding of government services lump sum property taxes with user fees.



Brief description of results and impacts of the proposed EPI

The impact of water meters on water scarcity and stressed environments is yet unknown. Their effect on leakage and consumption is broadly positive, i.e., leakage is falling via a combination of incentives to reduce leaks and an easier way of identifying their location while consumption is falling among optants who can now be rewarded – through lower bills – for using less-than-average quantities of water.⁷

The distributional impacts of water meters are not as easy to characterize. On the one hand, there are those who argue – from theory or passion – that meters are unfair to poor families that use a lot of water. On the other hand, there are those who argue that meters make it possible to pay for infrastructure repairs in proportion to use and give stronger incentives to reduce demand. These perspectives drive arguments over metering implementation, i.e., whether to emphasize social, environmental or economic criteria.

Conclusions and lessons learnt

The roll-out of water meters to residential water customers in England and Wales has advanced on mostly positive terms. Policies targeted at unwinding some cross subsidies, gradually implementing metering, targeting metering to water stressed areas, and ensuring that volumetric pricing does not cause undue harm to the poor have been pragmatically successful in maintaining public approval while taking cost-effective steps towards sustainable water management in England and Wales.

⁷ “Network meters” have had a measurable effect on reducing leaks within “district meter areas;” the effect of household meters on leaks is harder to measure because it’s unclear when demand reductions are the result of changes in behavior or repairing leaks.

Water Abstraction Charges and Compensation Payments in Baden-Württemberg (Germany) (#13)

Jennifer Möller-Gulland, Manuel Lago (Ecologic Institute)

This case study analyses the policy mix of economic and regulatory instruments introduced in the Land of Baden-Württemberg to address two key water management problems of excessive nitrate concentrations in groundwater and unsustainable water abstraction.

The policy mix consists of the following instruments:

- Regulation on Protected Areas and Compensatory Payments (SchALVO)⁸
- Water Abstraction Charges
- Market Relief and Cultural Landscape Compensation (MEKA)

The introduction of the SchALVO in 1988 in Baden-Württemberg was then and still is today unique in Germany and within the European Union and receives a high level of attention. The same year, Baden-Württemberg became the first German *Land* to establish an abstraction charge on water. The *Land* has the longest experience with abstraction charges in Germany, and its regulatory framework has been copied by many other German *Länder*.

Four years later, in 1992, the innovative MEKA program was introduced as a pilot project from the European Union and has proven to be successful. It provides an incentive for farmers, via compensation payments, to implement voluntary environmentally sound agricultural practices

As the objectives of the SchALVO and the MEKA complement one another, they are analyzed conjointly in this paper. The water abstraction charge, on the other hand, relates with these instruments mainly via the implementation and institutional process leading to their design.

Definition of the analysed EPI and purpose

The SchALVO is both a regulatory and economic instrument; hence its purpose is twofold. On the one hand it curtails standard agricultural practices in water protection areas to reduce nitrates and pesticides leaking into water bodies (regulatory instrument), and on the other hand it introduces a compensatory

⁸ Verordnung des Umweltministeriums über Schutzbestimmungen und die Gewährung von Ausgleichszahlungen in Wasser- und Quellschutzgebieten (Schutzgebiets- und Ausgleichs- Verordnung – SchALVO)

payment scheme for farmers that are affected by the aforementioned curtailment in order to increase the acceptance and enforcement (economic instrument).

Conversely, participation in the MEKA program is voluntary and payments are only made for farmers outside water protection areas, with the exception of farmers in low-risk areas of water protection areas who do not receive SchALVO compensations (since 2001). By financing measures which promote environmentally sound agricultural practices, it changes the market incentives for farmers. Farmers can choose from a toolbox of measures which enables a high degree of regional customisation.

Water abstraction charges are levied for the actual water abstracted with the objective of improving the sustainability of abstractions, particularly with respect to pressures from flow regulation, and to internalise the environmental and resource costs of abstracted water.

Introduction

Two legislative changes can be said to have initiated discussions on SchALVO and water abstraction charges. First, the thresholds of acceptable nitrate concentrations in the Drinking Water Ordinance were tightened from 90mg N/l to 50mg N/l in 1986. Second, compensation payments to farmers that were restricted in their agricultural practices by constraints in water protection areas were made compulsory with the amendment of the Federal Water Law in 1986 (§19(4)).

The *Länder* could decide whether they wanted to implement §19(4) via a centralized model, i.e., the *Land* is responsible for compensation payments to farmers, or via a decentralised model, i.e. the compensation has to be paid by the water suppliers to the farmers directly.

In Baden-Württemberg, at the time, around 1,000 water companies were responsible for water supply and agricultural activities took place in some 2,400 water protected areas. In addition, Baden-Württemberg's history and geography led to very small average farm sizes (in 1987: 13.1 ha) which would have increased the transaction costs of negotiating compensations. Under these conditions, the centralised version was deemed the more suitable option.

An array of options was considered to finance the compensation scheme, among which water abstraction charges crystallized as the most promising. However, earmarking the revenues of the water abstraction charge for SchALVO payments raised serious legal concerns. Thus, the focus of the water abstraction charge was changed to reflect the objectives of increasing sustainable abstractions and to internalize the environmental and resource costs of water abstracted. While the compensation payments and the water abstraction charge are legally unconnected, the budgetary importance and the relevance of this link for the implementation of the water abstraction charge cannot be denied.

Legislative setting and economic background

Instruments discussed in this policy mix had to adhere to the wider framework laws provided by federal legislation such as the Federal Water Act (WHG, 1957), with which the Water Framework Directive (WFD) was transposed. Given the federal system in Germany, however, and the nature of the instruments, only changes to legislation at *Länder* level were required.

As the Federal Water Act does not provide for abstraction charges, the *Länder* are neither obligated to introduce these charges, nor are they limited in their design if they decided to introduce these. The introduction in Baden-Württemberg thus only required amendments in Baden-Württemberg's Water Act (*Wassergesetz*).

The SchALVO and MEKA, while introduced before the transposition of the WFD to federal law, are categorized as “supplementary measures” within the WFD and are framed by federal legislation on agricultural practices. The SchALVO, for example, curtails standard agricultural practises (*ogL*) in water protection areas. These standard agricultural practises are defined by, among other legislations, the Fertilizer Ordinance (transposition of the EU Nitrate Directive) which is now included in the WFD. The Regulation on Protected Areas and Compensatory Payments (SchALVO) was introduced in 1988 into the *Land* legislation of Baden-Württemberg. The MEKA program is co-financed by the Pillar II payments from the European Common Agricultural Policy (CAP), which are implemented via the “Action and Development Plan for the Rural Area of Baden-Württemberg (MEPL)”.

Brief description of results and impacts of the proposed EPI

The change in behaviour of the economic agents, as a result of the SchALVO (1988) and MEKA (1992), resulted in a decrease of nitrate concentrations. From 1994 to 2010, nitrate concentrations decreased by 5.7 mg N/l, a reduction of 19.5%, outside water protected areas and by 6.6 mg N/l, a reduction of 15.9%, within water protected areas. When contrasting the nitrate concentrations in 2010 to the baseline, the SchALVO measures led to an additional 0.9 mg N/l improvement when compared to the MEKA measures.

In 2001, the SchALVO was amended to focus measures on areas with high nitrate concentrations classifying them into ‘problem’ and ‘decontamination’ areas - thus linking the immissions and emissions of nitrate. By 2010 the average concentration of nitrates in decontamination zones had decreased from 52.1 mg N/l to 46.5 mg N/l (-10.7%) – a reduction which can be seen as a step towards the achievement of the goal of ‘no measuring station exceeding concentrations of 50mg N/l by 2015’. However, the overall reduction of nitrate concentrations in water protected areas only decreased by 1.3 mg N/l between 2001 and 2010, while it had decreased by 3 mg N/l before the amendment between 1994 and 2001. Thus, while the focus on areas with high nitrate concentrations led to a reduction of concentrations below the thresholds (50 mg N/l), overall the reduction of nitrate concentrations in water

protected areas slowed down. This could be explained by the fact that only 38% of the water protection area was targeted after the amendment and by the low levels of monitoring in low risk areas. However, the impact of other factors on nitrate concentrations over time, such as differing hydrogeologies, climatic conditions or the impact of other direct regulation, e.g. Fertiliser Ordinance, cannot be attributed with certainty.

Following the implementation of the water abstraction charge in 1988, total water abstraction has decreased from 7,619 mil m³ in 1987 to 5,015 mil m³ in 2007 (-34%). This can be attributed to changes in production processes that increased water productivity by 61.3% between 1991 and 2007. The energy sector, for example, decreased the litres needed to produce energy by 39% over this period. As the energy sector was the main driving force behind the increased water abstraction between 1975 and 1987, these changes led to a 37% reduction in water abstraction between 1987 and 2007. However, the impact of other factors, such as increasing water and wastewater prices, on these changes in behaviour cannot be identified with certainty.

Conclusions and lessons learnt

The MEKA and SchALVO measures have been considerably successful in reducing groundwater nitrate concentrations in Baden-Württemberg. However, it can be assumed that the success would have been higher if monitoring activities had been expanded and enforcement measures, such as fines for non-compliance with constraints, had been imposed. Monitoring the impact of agricultural practices, e.g. via nitrate levels in soil, are aggravated by the impact of climatic conditions on these values and thus pose a challenge to a strict enforcement.

While the water abstraction charge internalises the environmental and resource costs, the compensation payments for farmers arguably contradict the “polluter pays principle”, both of which are set out in Article 9 of the Water Framework Directive.

Experience with these measures in Baden-Württemberg has shown that transaction costs can be reduced by introducing joint applications for compensatory measures (e.g., for MEKA and SchALVO) and by harmonizing administrative procedures to already existing economic or regulatory instruments (e.g., the water abstraction charge was linked to existing procedures of the effluent tax).

Legal certainty and clarity regarding reduction schedules for the water abstraction charge appeared to be crucial for increasing acceptability among industries (e.g. energy, chemical and paper) and decreasing transaction costs, particularly legal costs, for all stakeholders. Furthermore, the option to offset investment costs for ecologically friendly measures against the abstraction charge further increased acceptance among the industry and was perceived as compensation for any competitive disadvantage the charge might have caused. The perception that revenues are being used to finance measures which improve water quality (i.e. MEKA and SchALVO) increased the acceptability of water supply companies which depend on water sources endangered by agriculture.

Close cooperation between water suppliers and the government enabled the shared use of the water suppliers' water quality monitoring data. This reduced annual transaction costs by EUR 500,000 and enabled the control and assessment of compensation payment measures.

The fragmented structure of the water supply industry and the small average size of farms essentially prohibited voluntary agreements between farmers and water suppliers to improve water quality programs. This, however, led to the introduction of a regulation covering all water protection areas (SchALVO) that resulted in coherent efforts to reduce nitrate concentrations and decreased the potential for moral hazard. However, voluntary measures that offer a high degree of flexibility to adjust to regional particularities, such as MEKA, enjoy high levels of acceptance among farmers.

The WFD, the Nitrates Directive and the Natura 2000 sites create synergies with the implementation of the MEKA, SchALVO and water abstraction charges. Contrary, the combination of the Atomic Energy Act and the Renewable Energy Directive pose barriers to the effective implementation of the MEKA, SchALVO and water abstraction charges. The CAP (Pillar I) creates a further barrier to MEKA and SchALVO programs

Market incentives, such as increasing food prices and increased demand for biofuels accelerated by e.g. the Renewable Energy Directive and the Atomic Energy Act, exceed the incentives which can be provided by compensation payments, such as the MEKA, thus disabling their full environmental protection potential. Future developments will have to find the means to compete with these market forces to ensure that the prospect of short term profit does not outmatch sustainability.

Effluent Tax in Germany (#14)

Jennifer Möller-Gulland, Katriona McGlade, Manuel Lago (Ecologic Institute)

This case study analyses the policy mix of economic and regulatory instruments introduced in Germany to reduce point source pollution.

The policy mix consists of the following instruments⁹:

- Discharge Permits (Federal Water Act, implemented in 1957)
- Effluent Tax (Effluent Tax Act; implemented in 1976)
- Discharge limits and technological standards (Waste Water Ordinance; implemented in 1997)

While all of the above mentioned instruments are considered in the analysis, the focus lies on the effluent tax.

Definition of the analysed EPI and its purpose

All discharges of effluent require a permit. This permit is issued only if the effluent to be discharged is kept as low as possible for the required process and with the best available technology. In 2004, the emission-related requirements, such as pollutants limits and technical standards, were further specified for 57 areas of origin and production sectors by enforcing the Waste Water Ordinance. Permits can be granted temporarily or permanently and can be withdrawn if concerns regarding water protection and management arise (Kraemer, 1995).

The effluent tax is based on these permits, rather than on actual measurements. The tax rate is based on damage units, which are calculated as the equivalents of pollutants in the discharged effluent. Measured pollutants include phosphorous, nitrogen, organic halogen, mercury, cadmium, chromate, nickel, lead, copper, and indicators on the chemical oxygen demand and the toxicity for fish eggs.

The effluent tax should implement the “polluter pays principle”, i.e. lead to the internalisation of external costs. In conjunction with direct regulations on the discharge of effluents, the effluent tax shall provide an economic incentive to avoid or reduce harmful effluent discharges. The revenue of the effluent tax is earmarked for investments in water quality programs by the *Länder*, such as the construction of municipal sewage treatment and the administration of water quality programmes tax’s incentive effect in improving water quality.

⁹ Federal Water Act (Wasserhaushaltsgesetz); Effluent Tax Act (Abwasserabgabengesetz); Waste Water Ordinance (Abwasserverordnung).

Introduction

The exceptionally high growth in pollution-intensive sectors (such as energy, chemicals, and construction) in the post-war period caused serious environmental problems as the construction of wastewater treatment facilities did not keep pace. Compared to other industrial nations, such as the UK and Japan, Germany did not have the option to dispose wastewater from its industrial areas directly to the sea, which led to highly polluted river systems. Under invariable conditions, a future acceptable water supply as well as other water uses would have been under a serious threat (SRU, 1974).

The inception of the federal Effluent Tax Act in the early 70s occurred during a re-orientation period in the political life of the Federal Republic of Germany, following the election of the first government of the German Social Democratic Party (SPD) and the Liberal Party (FDP) in 1969. This government identified protection of the environment as a major new policy area and initiated measures to establish the institutional framework for environmental policy, notably at the federal level

The effluent charge was introduced in 1976 as a reaction to the insufficient implementation of direct regulation (Federal Water Act, WHG) of effluent discharges by the water management administrations of the Federal States of Germany (*Länder*) and the resultant non-compliance with prescribed discharge standards in the private and municipal sectors.

Legislative setting and economic background

Given the federal nature of Germany, a distinction needs to be made between laws passed at federal level and those passed at *Länder* level. In Germany, two federal laws determine essential elements of water management: the Federal Water Act (WHG) of 1957 and the Effluent Charges Act (AbwAG) of 1976. These laws are obligatory for the *Länder*.

The Federal Water Act and Federal Effluent Charges Act were passed as framework laws, which had to be transposed into the federal state legislation before coming into force.¹⁰ Most *Länder* introduced the effluent charge in 1981, with others following in 1982-83. After the German reunification of the Federal Republic of Germany and the German Democratic Republic (GDR) in 1990, the five new federal states adopted the tax as of 1991. The Waste Water Ordinance concretises the technical standards which are stated in the Federal Water Act into regulations for effluent discharges from various sources. It transposes the EC Urban Wastewater Directive (Council Directive 91/271/EEC).

¹⁰ As part of the Federalism Reform in 2006 the framework law of the Federal Water Act was amended and is now partially replaced by full regulations controlled by the federal government (concurrent legislation).

Brief description of results and impacts of the effluent tax

While the policy mix makes it difficult to single out the impact of the effluent tax, it can be stated that the policy mix as a whole was instrumental in achieving most of its targeted objectives:

- The quantity of overall discharges of pollutants into water ways was reduced by 4%, while discharges of private emitters were decreased by 18%. The harmfulness of effluents was decreased substantially. Mercury discharges were reduced by 99% from industrial dischargers and by 65% by municipal treatment plants in 2003-2005, when compared to the baseline of 1987. Nitrogen discharges from point sources were reduced by 76% in 2003-2005 when compared to the baseline of 1987
- The quality of water bodies increased substantially, with 65% of all surface water bodies achieving a water quality II status. The concrete objective, however, of improving all water bodies to water quality II status by 1985 failed.
- Waste water treatment plants were upgraded to the state of the art. In 2007, 92.6% of effluents in Germany underwent tertiary treatment—a percentage which, when compared to other Western European countries, makes Germany a frontrunner of advanced wastewater treatment standards
- Industries, such as the paper industry, developed production processes which required less wastewater development. Others, like the chemical industry, invested in effluent abatement measures and considerably reduced the discharge of pollutants
- The costs to mitigate, eliminate, and balance damage to water bodies were distributed among the polluters, which reflects a successful implementation of the polluter pays principle.

In addition, the effluent charge contributed significantly to capacity building in the water management administration.

Conclusions and lessons learnt

This case study illustrated that a policy mix consisting of regulatory and economic instruments can be very powerful in implementing and enforcing policies to address direct effluent emissions.

However, it has also shown the importance of creating the right incentive structure to achieve the targeted objectives – it was found that the effluent tax rate has been set too low since its introduction in 1979. In addition, the effluent tax rate has not been adjusted to inflation. As the cost of measures for abatement have increased with inflation, and as the standards for BATs in the Waste Water Ordinance have become more stringent, the effluent tax could not develop its full potential for setting innovation incentives to abate residual pollution. While good results have been

achieved in terms of environmental outcomes, the policy mix has been deprived of the effluent tax's essential contribution to achieve its objectives.

The reasons for the lack of adjustment can be explained by the influence of dominant interest groups in the policy implementation process and by external shocks, such as an economic crisis, which aggravates the potential to increase tax rates. On the other hand, external shocks such as the algae bloom in German waters, which led to a widespread decline in seal populations, raised public awareness in water pollution. On the basis of this political climate, the effluent tax rate was increased slightly.

A further finding of this case study shows that the incentives created by the effluent tax may be different for private and public dischargers. As such it was found that mainly the private sector changed their behaviour in order to reduce the effluent tax as much as they could as part of their profit-maximizing behaviour. Municipalities, on the other hand, focused on complying with the regulation and thus forewent reductions in the effluent tax.

Finally, the introduction of the effluent tax led to significant capacity building in the water management administration.



Green Hydropower in Switzerland (#15)

Thomas Dworak (Ecologic Institute)

Introduction

Hydropower in Switzerland accounts for about 59% of the electricity supply and has clear advantages in terms of the CO₂ balance, but hydropower creates environmental disturbances in river systems. After the Swiss hydropower boom in the 1950s and 1960s, public opinion began to turn against plans to invest in new hydropower plants in the late 1970s and early 1980s due to their negative impacts on ecosystems and landscapes. Grassroots movements against new hydropower projects gained widespread public support and now more people are willing to pay extra for so-called 'renewable electricity'.

The development of the green hydropower standard was initiated by and commissioned to the research team of EAWAG (Swiss research organisation) in the late 90s. It developed the basic scientific concepts and tried to mediate between the different interest positions. At the end of 1999, a private, nonprofit organization (the Association to Promote Environmentally Friendly Electricity (VUE)) was founded to develop a broadly accepted standard of quality for green electricity in Switzerland. In the summer of 2000, the label "Naturemade" was publicly launched.

Definition of EPI and purpose

The concept of the EPI "green hydropower" covers has two main objectives (EAWAG, 2001):

- Economic objective: to have a reliable and objective certification scheme that is trustfully accepted by the consumers and ensures fair competition on the market
- Ecological objective: the improvement of local river conditions by setting an incentive to develop sustainable hydropower

The EPI ("green hydropower") contains two delivery mechanisms. The first one is a standard covering 45 scientifically defined criteria. They allow a supra-regional comparable certification of different power plants, regardless of their age, size, or how they are built or operated. The second delivery mechanism consists of eco-investments defined as a fixed mark-up on every kilowatt-hour sold as green hydropower. On an annual basis, this surcharge must be re-invested in the river system in which the plant is located in the form of river restoration measures adapted to the demands of the individual river system. (EAWAG, 2001).

However, the definition of 'green' is not straightforward and therefore requires a credible certification of high ecological standards. The concept guarantees both

general standards for different schemes operating in different types of watersheds and flexibility for local particularities. The Swiss Federal Institute of Aquatic Science and Technology (EAWAG) developed an environmental management matrix that considers basic criteria and eco-investments and covers five environmental areas of concern (i.e., hydrological character, connectivity, morphology, landscape, and biological communities). The ecological perspective is complemented by five management domains.

With this in mind, the EPI can be described using the classification developed in the D 2.2- Toolbox and guidance document as a voluntary instrument which represents a combination of voluntary standards and payments for ecosystem services.

Rationale for choosing the case study

The rationale for choosing this case study is the unique situation that, in a sector that already is considered to produce green energy, the scheme goes even further to become even greener. Instead of using a command and control approach, it is the customer's choice how green energy production should become.

Legislative setting and economic background

The EPI is a voluntary label that goes beyond the legislative requirements of environmental performance of existing hydropower plants. It is an incentive to invest in environmental protection (i.e., improvement of local river conditions) because green electricity production are estimated to be better marketed. Thereby it clearly contributes to the recovery of costs of water services, in particular to environmental costs due to the second level payments which are earmarked for environmental improvements. However, this contribution is not one of the main aims of this EPI.

Due to the loose relationship to legislative approaches and its voluntary nature, there are no distorting interactions. However, the opposite can also be recognised. The standards set by the label have been gradually turned into legislative requirements. Nowadays, the legal requirements for construction are the same as basic requirements under the EPI.

Brief description of results and impacts of the proposed EPI

Due to the lack of studies and the lack of information, only a few impacts of the EPI could be identified. These are:

- Market impacts: about 3% of the total hydropower production in Switzerland is certified
- Environmental impacts: the eco-payments have created environmental investments for improving hydropower of about 6,5 million Euros (8 million Swiss franc) for the period 2000-2009. The main environmental investments that have been made are the revitalisation/connection and improvement of

sediment transport in 24 km of rivers and the creation and restoration of aquatic and terrestrial ecosystems over an area of 950,000 m². In addition, several smaller improvements on terrestrial and aquatic ecosystems have also been achieved.

- Educational impacts: Besides using the second-level payments for improving the environmental performance of a plant, the money has also been spent for setting up a youth program „Viva-Riva.“ This program offers excursions for young people that explain aquatic ecosystems to them. Furthermore, several information campaigns have been held as well as trainings weeks in cooperation with the WWF.
- Due to the only partly liberalised energy market in Switzerland, only limited impacts have been tracked on tariffs and consumption. More tariffs offering green hydropower have been developed, but this does not impact the competition on the market as these tariffs are offered by the same company which has a monopoly to supply households. Energy consumption has not been affected as this is not the aim of the EPI.

No other impacts have been found so far. In particular, the impacts on economic efficiency and social equity have not been sufficiently investigated and could thus not be analysed further due to a lack of time and resources.

Conclusions and lessons learnt

The main lesson learned from the case study is the fact that economic interests and ecological concerns can be combined in one voluntary instrument based on economic and regulatory instruments (standards). In other words, it is possible to combine the demands of different actors and stakeholders in the electricity market and thereby:

- Guarantee quality
- Label sustainable electricity and electricity from renewable energy sources
- Improve the status of the environment on a broader level (basic requirement) but also consider specific local environmental issues (eco-investment payment)
- Establish a competitive advantage for “greener” electricity from renewable energy sources compared to electricity from other renewable (e.g., non-certified hydropower) and non-renewable energy sources (e.g., petrol).

A further enabling factor for this EPI is the fact that environmental stakeholders and energy producers have agreed to use scientific criteria to develop an instrument that provides a win-win situation for both sides. Using scientific criteria as a basis for certification and making them publicly available to consumers is also stated as a factor that ensures public acceptance and uptake (VUE, personal communication).

Water tariff system in Italy and tariff structure in the Region Emilia Romagna (RER) (#16)

Jaroslav Mysiak, Fabio Farinosi, Lorenzo Carrera, Francesca Testella, Margaretha Breil, Antonio Massaruto (FEEM)

Definition of the analysed EPI and purpose

Introduction

This report analyses residential water tariffs in the administrative Region Emilia Romagna (RER), situated in the Northeast Italy, and partly included in the Po River basin. A residential water tariff is a price of *water service and sanitation (WSS)*; that is abstraction, storage, potabilisation, conveyance, wastewater collection and treatment.

The water pricing and tariffs pursue multiple policy goals, seemingly at odds but reconcilable in principle: water use efficiency, that is avoiding wasteful use of water; allocation efficiency, thus maximising overall society's benefits from water uses; financial viability, meaning ability to compensate capital, skills and technology needed to ensure water services and sanitation; and social equity, standing for affordability of water as a public interest good. For other than economic reasons the actual water tariffs rarely reflect the effective costs of water service, including financial, environmental and resource costs. Here we focus on the extent to which the water tariff system in Italy and RER managed to ensure adequate investments in water supply infrastructure, satisfactory quality of water service provisions, and conservation of water resources.

The water tariff system (WTS) described in this report was introduced in Italy back in 1994. It is embedded in a comprehensive legislative framework that determines the organisational and management structure, as well as legislative jurisdiction of the so-called integrated water service (IWS, in Italian *servizio integrato idrico*). The framework had been laid down in the law 36/1994 (so-called law Galli), later incorporated into the law 152/2006 (so-called Environmental code).

Introduction

The Po river is the largest and in many respects the most important Italian river. It is 652km long, whereas the river basin extends over 71,000 km² (25 per cent of the national territory). According to the results from the census of 2001, agriculture in the Po basin accounts for approximately half of the overall land surfaces with even higher percentages in the downstream regions (Veneto, Emilia Romagna and Lombardy) (EUROSTAT, 2011),

The Po River depends on an extended hydraulic network of more than 140 major water courses and an almost ten times larger secondary reticulum of natural and artificial water bodies, irrigation and reclamation channels. In the Alpine area, 174

water reservoirs manage 2.803 billion m³ a year, of which 143 artificial reservoirs for hydropower production, controlling 1.513 billion m³, and another 1.290 billion m³ controlled by natural lakes; furthermore the basin comprises circa 600 km² of glacier areas.

The Po Valley covers the economically most important and active area of Italy, hosting 27 per cent of the national population and producing 40 per cent of the national GDP (AdB Po 2006). The GDP per capita (thousands euro) in the regions interested by the river basin ranged, in 2009, from 21.6 € (Piedmont) to 26.8 € (Valle d'Aosta), fairly above the national average of 20 € (ISTAT 2011).

Legislative setting and economic background

The primary piece of legislation that regulate the water services is law 36/1994 (so-called law Galli), in 2006 incorporated into the law 152/2006 (so-called Environmental Code). The water and waste public services are organised within the so-called Optimal Territorial Area (ATO), defined by the regional authorities by apposite regional normative acts. Ideally, the whole territory of an ATO was to be served by a single water utility. In practice, it is common that several water utilities serve the municipalities of a single ATO.

The law 36/1994 assigned the competences for specifying water tariff system to the central government. Article 154 of the Environmental Code (law 152/2006) equals water tariffs to compensation for water services and connects them to quality of water and water services, amortisation of physical capital, costs of maintenance and return to capital investments. The water tariff system is based on the so-called 'Normalised Method' (NM) introduced by decree 1st August 1996 and revised every five years. Using the normalised method, the AATO determines the reference tariff within their jurisdiction. This in turn are translated into actual tariffs by taking into account organizational model of the management, water quantity and quality, the level of quality of water service, financial plan developed in line with by article 11 of law 36/1994 and, last but not least, the actual costs of the management. Usually, the water tariffs for domestic water use employ three blocks – subsidised, standard and penalising the excessive water use. The tariff contains a fixed and a variable component of water supply, purification fee and sewage fee.

The Region Emilia Romagna (RER) transposed the law 36/94 by the regional law (RL) n. 25 of 6 September 1999, later modified. The RL of 14/04/2004 n. 7 assigns the regional government the task of defining the water tariffs. This has been contested by the Constitutional Court with the sentence 29/2010, arguing that the protection of the environment and the guarantee of market competition are of exclusively competence of Central State. The Court affirmed that the aims of water tariff discipline are to protect the environment and to apply a uniform tariff system in all the country without any difference among the various Regions.

In 2006, the regional government's presidential decree (DPRG) n.49 of 13 march 2006 (modified successively by the DPRG n.274 of 13/12/2007) adopted a tariff method for

the integrated water service. The peculiarity of the method is the introduction of the performance factor PCn that offers an incentive to deliver a better service, while preserving natural environment and water resource. The water utilities with high performance are allowed to increase the tariff, whereas utilities that fail to do so are penalised with a reduction of the tariff. The DPRG 49/2006 introduced the obligation that within 5 years, or at the time of the first revision after 1/12/2007, the tariffs have to consider the number of household components (art. 10, comma 5).

Brief description of results and impacts of the proposed EPI

Although the available data is patchy and rife with uncertainty of many kinds, a decreasing trend can be observed in water abstraction/consumption pro-capita and water pipeline leakage. Similarly, the household access to WSS has steadily improved. Region Emilia Romagna performs better than the national average in all environmental outcomes, with a high variability across the Optimal Territorial Areas (ATOs). The price of a cubic metre of water and wastewater services, adjusted for inflation, increased significantly over the past years. Compared to other OECD countries, the water price adjusted by purchasing power parities is still low (OECD 2009), mainly because the initial capital investments borne by the central state are not amortised in the current tariff systems.

However, the tariff system has not guaranteed necessary investments into extension and modernisation of water infrastructures. The planned investments in water infrastructure are by far too low in order to guarantee a sustainable and reliable water services. The failed attempt to reinforce participation of public sector in WSS provision introduced a regulatory uncertainty discouraging from further investments. The water utilities will have access to external sources of finance, such as loans, only if a sufficient and reliable stream of revenue is ensured.

Conclusions and lessons learnt

Empirical evidence shows that water pricing is a suitable tool for encouraging water conservation and demand management. Water is a social good whose service provision can be governed by economic instruments. The recognition of right to water as a fundamental human right is not at odds with the participation of private sector in the water service provision. The access and affordability of water can be reconciled with water pricing in several ways. In RER, it is managed by social tariffs whose costs are distributed among the wealthier consumers. Alternatively, it could be managed either by income support (connected or not to water consumption), or by facilitated payments. See OECD (2009) for further discussion of both.

The extent of litigation with respect to regulatory authority over water supply and sanitation services underlines the unresolved issue of power sharing between the state and regions. Given the large economic and social disparity across the administrative regions, more flexibility and discretion is warranted at the regional

level in order to adapt water pricing schemes to specific environmental and socioeconomic conditions. The performance factor introduced in RER is an example of regulatory innovations that are worth to pursue. However, it should be based on a simple set of service quality indicators that can be easily collected and assessed.

The water tariffs system in Italy and elsewhere is vulnerable to arbitrary political interference. The current water pricing scheme blurs the distinction between the regulator and regulatee. On the one hand, local governments of municipalities assembled in a single Optimal Territorial Area play a part in water services regulation and tariff specification. On the other hand, it is common that the water utilities to which the WSS is commissioned are controlled by local governments.

Regulatory uncertainty is detrimental to the success of an economic policy instrument. The 2011 abrogative referendum in Italy has questioned the remuneration of capital investment into water infrastructure. The lack of regulatory response has negative effect on planned investments and obstructs implementation of the existing plans.

Green energy certificates and compliance market (#17)

Jaroslav Mysiak, Fabio Farinosi, Lorenzo Carrera, Francesca Testella, Margaretha Breil, Antonio Massaruto (FEEM)

Definition of the analysed EPI and purpose

Introduction

The kinetic energy contained in natural water flow is a renewable, carbon dioxide emission-free and easily exploitable source of energy. Making use of water to generate electricity is a conventional water use, analogous to irrigation or cooling, except for it does not 'consume' water nor alter its physical or chemical properties. The hydroelectricity generation however requires structural modification of water courses and, in the case of larger plants, a construction of water reservoirs.

In the modern carbon-free economies hydropower plays an important role, as one of few sources of renewable energy for which the technology is available, affordable, and reliable. Here being available means that the technology produces at least 1,000 terajoules a year (~277,8 MWh) (2009). The past experience shows that it takes roughly thirty years for a technology to reach a significant level of deployment (Kramer and Haigh 2009). Hence hydropower is an important source in the mix of renewable energy sources (RES) on the pathway to meet the ambitious targets set in the EU Directive 2009/28/EC and Europe 2020 strategy. In this context it is worth to recall that the national target for the share of renewable energy in electricity, in terms of gross final consumption, is 26.39 per cent by 2020 whereas in 2005 it amounted to 16.29 per cent, to a large part from hydropower.

The way the hydropower exploitation alters water courses and flow, along with the related processes (e.g. sedimentation), is or may, be if not implemented in a sensible way, at odds with the recent efforts to restore the integrity of water courses and river health (Dugan and Allison). The clash of the two objectives - renewable energy development and river restoration – caused that hydroelectricity generation grew into a controversy. On the one side, hydroelectricity generation is relatively safe, efficient and flexible technology enabling water flow regulation and flood risk management. On the other hand the hydropower development may cause negative, often significant environmental impacts, if pursued in wrong places or using wrong technology. The Hydropower Sustainability Assessment Protocol (Tollefson 2011) assessing the impacts of dams in all phases, from development to operation, is one of the recent initiative to reconcile the positive and negative environmental effects of hydroelectricity generation.

In this report we explore a mix of economic policy instruments, designed separately and partly for different purposes, but all acting together to in a way hydropower potential is exploited in Italy. Feed-in tariffs (FIT) and later tradable green energy

certificates (GEC) had been introduced in Italy in 1990s in order, among others, to reduce the country's carbon dioxide emissions and dependency on energy imports. Both FIT and GEC contribute to make the production of renewable energy cost-efficient (Ringel 2006). The latter, more sophisticated among the both, also introduce a supply-side competition that should under favourable market conditions curtail the generation costs of renewables (Bertoldi and Huld 2006). Neither FIT nor GEC as implemented in Italy take into account the peculiarity of hydropower generation and treat all renewable energy sources (RES) in the same way.

The concessions to build a new HPP are in principle granted upon the results of environmental impact assessment (EIA). In addition, to limit the development of hydropower in less or not suitable places, the *water abstraction* charges can be designed in a way sensible to the environmental impacts. In Italy this hasn't been done yet but is being discussed in some regions. Finally, the government-auctioned concession for operating the state-owned hydropower reservoirs provide another opportunity to control the hydropower operations in a sustainable way and taking into account the costs of decommissioning and removing the *dams*. *Italy extended the concessions and postponed the auctions, a move that has been contested both by the European Commission and the Constitutional Court.*

Legislative setting and economic background

The green certificate system in Italy has encouraged the production of electrical energy from renewable sources. Initially introduced by the Bersani Decree, and later modified by laws 244/07 and 239/04 and Legislative Decree 387/03, the system consist of obligatory quota of renewable energy to be supplied by the importers or producers of energy. The quota were first set to 2 per cent and later increased by an annual rate of 0.35% (from 2004 to 2006) and by 0.75% (from 2007 to 2011). The producers or importers of energy can either directly produce a growing amount of energy from renewable sources or cover part or all of their requirements by buying green certificates on the compliance market. These producers of energy from renewable sources benefit from a double source of income, from both the sale of electrical energy and the sale of green certificates. The compliance market was first set for 8 years, then extended to 12 years by the decree 152/2006, and 15 years by the law 244/2007 for power plants built or restored after 2007 (Repubblica Italiana 2007; GSE 2010b). The legislative decree 28 of March 3rd, 2011 (the so-called Romano decree) marks the end of the GEC system in Italy. It gradually phases out the compulsory quota between 2012 and 2015. Green certificates exceeding the demand will be withdrawn from the market at a price corresponding to 78% of the previously determined level. The incentives introduced in favour of small renewable energy plants will remain in place for the whole envisaged incentive period.

The water concession fee (WCF) for the hydropower uses is based on the installed capacity of the plant. The WCF vary across regions in the interval between 10 and 35 Euro per kW. Additional supplementary water abstraction fees and charges have

been introduced to benefit local communities. These include supplementary fee for *mountainous basins* and supplementary fee benefiting *riverine communities*. The wealth from the supplementary fees is used to finance local infrastructures and economic development of the local communities.

The final economic policy instrument addressed in this report refers to tenders for renewal of the large water derivation for hydropower purpose. Introduced in the law 79/1999, the postponed tendering and favourable conditions for the incumbents were examined both by the Constitutional Court and European Commission who initiated infringement procedure in 2004 and considered another one in 2011.

Brief description of results and impacts of the proposed EPI

As a result of the incentives, from 1999 to 2009 the number of hydroelectric power plants grew at an annual average rate of 1.3% but the installed capacity increased only by 0.7% per year. In Po river basin, the installed gross capacity has increased steadily from 10,036 MW in 1997 to 11,062 MW in 2010, with Lombardy producing 5,988 MW and Piedmont 3,544 MW, respectively 54% and 32% of the total basin hydropower production. HPP number increased from 825 in 1997 to 1,155 in 2010 (Terna, 1997-2010). Even so the ambitious indicative national target set in the Directive 2001/77/EC has not been reached. In 2008 the share of RES in the gross electricity consumption amounted to 16,6 per cent; 0,6 per cent up from the 1997 level. Ironically, the share of RES in the gross electricity consumption had been for the most period between 1997 and 2010 below the initial level of 16 per cent.

Hydropower development is meeting increasing social resistance fuelled by perceptions of social and geographic injustice. Concentrated in less developed, mountainous areas, the hydroelectricity generation is associated with negative externalities (negative environmental impacts, modification of water courses and landscape) in proximity of the plants, whereas the downstream communities take most benefits. Sondrio district is an emblematic case for overexploitation of the hydropower potential and adverse public participation. The district became one of the most hydropower-developed areas in Italy. Some 12.45% of the national and about 40% of the Lombardy's hydroelectric production is generated here. Over the past twenty years the hydropower development in the district was closely examined several times. Triggered by the local resistance, and upon invitation of almost all political parties and civil society organisations, the 13^a permanent commission (Territory, environment and environmental goods) of the Senate held hearings about the water crisis in Sondrio district, and asked the government to limit the hydropower concessions in the district for 2 years. Successively, the 2007 Financial Law (law 296/06 article 1, 1106 commas) established that new concessions for both large and small hydropower plants, exclusively for the Province of Sondrio, from 1st January 2007 to the 31st December 2008, were granted only after the binding advice of the Ministry of Environment.

The GEC system as introduced in Italy is comparable with similar schemes introduced in other countries. Under market conditions, the producers of RES bear the price uncertainty and the competition between the different sources of renewables ensures that the policy targets are achieved at least costs. In Italy, the market became soon saturated with the excessive certificates and the price of GEC started to decline. Partly, this is a result of the (many) exemptions from the initial obligation to supply energy from renewable sources granted to the producers or importers by the initial design of the scheme. The government intervened by guaranteeing a fixed price of the certificates, and by doing so removed the price uncertainty and competition between the different renewables. In principle, through this intervention the initial tradable incentive scheme had been turned into indirect subventions. Overall the costs of RES were borne by final consumers, contributing so to making the electricity price for consumers one of the highest in Italy.

Conclusions and lessons learnt

Hydropower energy differs from other renewable energy sources (RES) in two important aspects: First, as a mature technology it offers relatively little room for improvement in the efficiency of generation. The existing and easy-to-tap potential has been already exploited. The deployment of small (> 10 megawatts) 'run-of-river' HPP that produces power from the natural flow of water provides potential for greater hydropower exploitation, with lesser environmental impacts but at much higher costs. Second, impact assessment and certification of HPP require different, more comprehensive and meticulous procedures than in the case of other RES. The assessment should not only address the marginal effect of a single HPP, but the cumulative impacts of hydropower exploitation across the entire river system, identifying the best sites and coordinating energy production between the up- and downstream plants.

The reclamation of existing, and construction of new HPP, may require different incentive schemes. The reclamation of large HPP requires investments that are likely not paid back within the eight years of incentivised RES. The concession tendering would have been a more suitable economic policy instrument to address the peculiarity of the large HPP.

The existing water abstraction charges can be integrated with the GEC to control the environmental impacts particularly of the small HPP. To this end the abstraction charges can be differentiated according to the marginal environmental impacts of a new plant. In order to guarantee sustainable and socially beneficial hydropower exploitation, the whole system of concession and certification has to be embedded within a well developed river basin plan that identifies and priorities the sites suitable for hydropower development.

Subsidies for ecologically friendly hydro-power plants through favourable electricity remuneration in Germany (#18)

Verena Mattheiß (ACTeon)

Definition of the analysed EPI and purpose

In Germany, the 2000 Renewable Energy Sources Act (EEG) is the main instrument to promote the use of renewable energy sources. It guarantees for electricity production a defined remuneration per kWh which is above free market prices. The present case study looks at the environmental preconditions for the eligibility of hydropower plants to increased tariffs which form part of the EEG since its amendment in 2004. The environmental measures required aim at substantially improving the ecological status of water bodies next to hydropower plants, if not at reaching good ecological status, as asked by the Water Framework Directive (WFD). However, neither quantitative targets nor a time span for reaching these objectives have been set at the introduction of the instrument.

The case study has been chosen for several reasons. Hydromorphological pressures – including those originating from hydropower use – are an important barrier for reaching the good ecological status (or the good ecological potential) of water bodies in European countries. The favourable EEG remuneration for ecologically friendly hydropower plants in Germany is one of the rare economic policy instruments (EPIs) that have been developed to target those pressures, and not much documentation of this instrument at international level is available so far. The case study provides a good example of how the promotion of renewable energy produced by hydropower can take nature conservation issues into account.

Existing since 2004, the ecological requirements have been further specified in the EEG amendments which enter(ed) into force in 2009 and 2012, following the regular reports of experiences on the implementation of the law. They concern, among others, the biological passability of the weirs and the provision of minimum water flow.

Introduction

The EEG and its ecological conditions for hydropower plants are applied all over Germany and are in theory relevant for all of the existing 7 500 hydroelectric power stations. Since its introduction in the year 2000, the EEG constitutes an important instrument for maintaining and extending hydropower production. This effect is untouched by the ecological provisions, which do not preclude the plants to be remunerated according to the EEG 2000 conditions. The focus of this case study lies,

however, on the increased remuneration proposed after the establishment of ecological improvements on the plants.

Hydromorphological deficits are a major cause for failing to reach good ecological status of river water bodies in Germany. The instrument targets hence an essential water management issue, which is all the more relevant as it represents an area of conflict between water and energy policy targets.

Legislative setting and economic background

The EPI has been established in the form of an amendment of a law (the EEG), without being compulsory for the hydropower sector. Each hydropower plant operator can decide whether implementing the ecological improvement measures and receiving the higher remuneration is profitable in his case or not. The instrument has been designed to internalise external effects of hydropower use, as the EEG remuneration is apportioned to the electricity consumers, with some exemptions made in the industrial sector. The ecological requirements have been introduced into the existing remuneration framework of the EEG, while considering the demands of the European WFD. They are also a direct result of the prevailing discussions between the supporters of hydropower production as a source of renewable energy and nature conservationists (as well as angling associations) which highlight the negative impacts of hydropower use. The choice of the instrument in its present form was very much facilitated by the already existing EEG remuneration system of hydropower plants. No specific selection process took place.

The practice of concession rights for hydropower plants in Germany and the legal security linked to it has been a major driver for the introduction of the EPI. The approval procedure for new concessions requires compulsory compliance with the new German water law (WHG 2009) – and hence the application of measures foreseen in the WFD river basin management plans to reach good ecological status. Hydropower plants possess, however, concession rights for a period of several decades, or even unlimited user rights. The EPI provides hence incentives to improve the ecological situation earlier in time. In order to ensure investment security, once the ecological measures approved, the remuneration is guaranteed for 20 years (according to the most recent amendment). The EPI, which is a national policy instrument, is in some cases complemented by additional subsidies for ecological improvements, depending on the different German Länder.

In general, the German hydropower sector is well established. This is, however, only partly the case for the small hydropower plants (SHPs), which are particularly dependent on the EEG remuneration to operate in an economically viable way.

At the time of introduction of the instrument, it had been subject to significant data deficits, concerning for example a missing centralised inventory of all existing hydropower plants. Whereas this has changed in the meantime, information lags

persist regarding the reporting of the types of measures implemented following the introduction of the EPI as well as regarding their environmental effectiveness.

Brief description of results and impacts of the proposed EPI

The most important measures which need to be implemented in order to improve the ecological status of water bodies in the area of influence of hydropower plants are the establishment of migration possibilities for fishes upstream, fish protection measures for migration downstream and the provision of minimum water flows (Naumann, 2011). This corresponds basically to the measures applied following the EEG amendment in 2004, as revealed in a recent research project (Anderer et al., 2011 *in print*), indicating a general good steering effect of the EPI. The results of the mentioned project indicate also that a total of about 10 % of the existing hydropower plants dispose of equipment which assists the upstream migration of fishes and / or provide minimum flow conditions. Regarding upstream passability for instance, about half of the measures have been financed by the increased remuneration according to the EEG 2004 and 2009 conditions.

In many cases, ecological improvements through the modernisation of existing plants are technically possible, but face limitations of economic feasibility. While for bigger plants – producing over 150 kW – the financial EEG incentive is often sufficient for the ecological modernisation, a problem persists mainly regarding the existing SHPs with a production capacity up to 100 kW (Knödler and Wotke, 2009). At the same time, SHPs are particularly important from an environmental point of view, as they are often located on small and only little modified rivers. The remuneration level which would be necessary to provide sufficient incentives for SHPs is considered to be not economically reasonable from the policy maker's point of view.

Regarding social effects of the EPI, the EEG apportionment constitutes only a minor part of the electricity bill of households, indicating that the EPI is not linked to a disproportionally high burden for electricity consumers. Other significant distributional or social impacts of the EPI have not been reported.

The relevant transaction costs of the instrument consist mainly in the research processes which accompany its implementation. Monitoring and enforcement costs are negligible, as no controls of the functionality of the measures take place once they have been implemented and accepted by the responsible water authority.

Uncertainty aspects are a major issue in the assessment of the instrument. It is noteworthy regarding the application of measures, their actual ecological effectiveness and the incentive effect of the EPI, compared to other reasons for carrying out ecological improvements. More detailed research is necessary in this regard.

Conclusions and lessons learnt

The remuneration provided to hydropower plants, which is linked to ecological conditions according to the German EEG after 2004, can generally be considered as a successful instrument, which led to the implementation of ecological improvement measures in several documented cases. The extent to which the measures are applied depends mainly on the amount of remuneration foreseen by the EEG. With the remuneration being proportional to the amount of electricity generated, the potential surplus for SHPs is in most cases not enough to finance the environmental measures. Additional instruments are needed to address their ecologically important impact. A major criticism of the EPI is, that it is designed to promote ecological improvements on hydropower plants where they are economically feasible, and not where they would be ecologically most effective. Furthermore, missing data on the type and number of measures applied and a missing control of their ecological effectiveness constitute a significant source of uncertainty regarding the actual impact of the EPI. With regards to the potential transferability of the instrument, it is facilitated in countries where comparable remuneration systems for hydropower plants exist. In all other cases the introduction of the EPI will be linked to significant transaction costs.



Financial compensation for environmental services: the case of Evian Natural Mineral Water (#19)

Pierre Defrance (ACTeon)

Definition of the analysed EPI and purpose

The Evian Company initiated in the late eighties a promising multisectorial water protection policy tackling wastewater collection and treatment, town and country planning, wetland protection, tourism, biodiversity and agriculture. This policy is still followed today. It relies on the association for the protection of the catchment area of Evian mineral water (APIEME), an association which comprises the villages from the spring area that benefit from a government tax on bottled water, the villages from the catchment area, the Evian Company and national public bodies.

Its objective is to protect the Evian Natural Mineral Water (NMW) by promoting a sustainable development of its catchment area. The main principles of this participative protection policy are: i) favouring both the protection of the NMW resource and the local development; ii) involvement of collective projects only; iii) reliance on a strong technical support from scientists.

The present case study assessment focuses on the APIEME “agricultural economic instrument” policy which can be classified as a scheme of payment for ecosystem services (voluntary agreement between farmers and one industry), hereinafter referred to as the economic policy instrument (EPI). It is oriented towards the development of a modern environmentally friendly agriculture focusing on dairy production linked to cheese making under the protected designation of origin (PDO). Basically, the Evian Company help financing projects to maintain a land use on the catchment area presumed to preserve the quality of the Evian Natural Mineral Water.

Twenty years ago, two long-term evolutions could have affected this area and the NMW, even though the NMW was not reported to be threatened by any kind of pollution at the time the EPI was introduced: i) the evolution of agricultural practices from traditional dairy farming to more intensive agricultural practices, and ii) the drive to open up the area by improving links to other regions in France and to Switzerland.

We could have assessed the whole APIEME protection policy through the same approach than the EPI considering all assessment criteria. However, we chose to focus the analysis on agriculture, as considering the policy of the APIEME during the assessment might have included too many measures (mix of regulatory approaches



and economic instruments) to conduct the analysis properly considering the whole policy of the APIEME.

This policy has not been assessed before and literature is relatively scarce except for hydrogeological studies. In addition, outcomes could not always be assessed with certainty due, amongst others, to the hydrogeological context of the aquifer as infiltration from catchment to spring takes more than 20 years on average. However, the involvement of local and strategic stakeholders and its potential of extrapolation to other EU areas (WFD, drinking water catchment protection, etc.) or environment protection sectors clearly justified this choice.

Introduction

Evian is one of the major brands of bottled NMW originating from preserved areas in France. Two specific zones are considered for this case study: the Evian spring area with a surface of 16 km², where the water outflows from the mineral aquifer, and the Evian catchment area, with a surface of about 35 km².

Land use in the catchment area is shared between agriculture (60 %; among which 51 % of meadows and around 9 % of crops represented by local market gardening, orchards and some maize for the cattle), woodland (20 %), wetlands (10 %) and 10 % of villages (Buric et al., 2011). The main economic activity in the impluvium area is thus agriculture, represented by dairy cow breeding for cheese production, which form part of a typical local PDO cheese making (*Abondance* and *Reblochon*).

The EPI was designed to maintain or increase farmers' income by reinforcing their link to the PDO system through collective projects funded by the APIEME. This redistribution of means from the beneficiaries of the NMW (the Evian Company and the villages located in the spring area) to the villages located in the catchment area also contributes to maintain traditional landscape and to preserve biodiversity through the type of agriculture it promotes.

Legislative setting and economic background

In France, the legislation for NMW is very strict: the purity, composition, temperature and other essential characteristics of natural mineral water must remain stable. The right to use the "Natural Mineral Water" label would be lost if mineral concentration was to change. In addition, NMW may not be the subject of any treatment except elimination of some natural unstable elements.

The Evian Company designed a participative policy which relies on voluntary actions (no legal obligation) to reinforce the natural protection of the aquifer. For each project, an agreement was signed by the APIEME and the project owner designed by the Gavot Plateau farmers' association (SICA). For instance, subsidies



were targeting small to medium size farms, helping them to follow the European sanitary norms evolution and to favour close loops and a higher income.

In addition to these actions, a charter of good practises was developed with the contribution of the French National Institute for Agricultural Research (INRA), the SICA, farmers and the APIEME. Some of these subsidies were depending on the signature of this charter.

Brief description of results and impacts of the proposed EPI

Estimated TCs are relatively high in comparison to the cost of the EPI, both ex-ante fixed costs and ex-post variable costs. However, it appears to be a condition for the success of the EPI anticipated by the Evian Company before it implemented it. First, the partnership developed between the Evian Company and INRA in 1990 contributed to get a better understanding of the impluvium area in terms of ecological functioning and the diversity of practises and potential pressures. Thus it played a strong role in determining the preventive approach and actions as Evian did not have competencies in agriculture. The diagnostic helped to reduce asymmetric information while the results were shared with farmers. Involving INRA in the process finally contributed to reinforce reciprocal trust between the Evian Company and farmers.

Second, the creation of the APIEME allowed parties to build shared ownership on the issues and to take part in the decision making. It also gave space to discussion and negotiation by externalising the initiative. In addition, the creation of the SICA helped harmonizing the request of the farmers and contributed to reduce TCs, while the Chamber of agriculture provides technical support.

Finally, the delivery mechanism the Evian Company chose through the APIEME both contributed to the high level of TCs and helped reducing them. Indeed, the EPI allows flexibility (extension of the duration of subsidies) and requires regular meetings with stakeholders. But, it also prevents from conflicts and complex legal procedures - both associated with high transaction costs - by trying to reach compromises between the expectations of the Evian Company and the requests of farmers. The EPI has thus been welcomed by most of the stakeholders.

The outcomes of the EPI were more difficult to assess with certainty. First, the hydrogeological context of the aquifer made it difficult to assess properly final environmental outcomes: behavioural changes of stakeholders on the catchment area due to the EPI will not be reflected in the NMW quality before 2012. In addition, there was no specific quantified objective for agriculture. Finally the EPI has been performed in a context of multi-sectoral policies and regulatory instruments (policy mix) and specific outcomes of the EPI are difficult to isolate.



The design of the EPI directly contributes to the redistribution of means from the beneficiaries of the NMW (the Evian Company and the villages located in the spring area) to the villages located in the impluvium area. Even though this contribution appears to be low (less than EUR 35 per hectare for agriculture) in comparison to the profits of the Evian Company or the tax revenues, the collective projects which were funded through the APIEME helped developing a modern environmentally friendly agriculture associated to the PDO system. It also contributed to limit the increase of maize surface and even reduces it in the catchment area, whereas the baseline scenario predicted an increase.

In addition, the EPI contributed to maintain traditional landscape and to preserve biodiversity through the type of agriculture it promotes. The use of pesticides has been reduced and the farmers were encouraged through the EPI not to use atrazine since 1994 while it was prohibited in France in 2003. Benefits from the EPI are difficult to measure but they might have been higher than the costs if we consider the EPI has a multiplier effect.

However, the number of farms continued to decrease in the catchment area during the past three decades and the tendency of intensification was confirmed in 2002 compared to the diagnostic INRA realised in 1993.

Conclusions and lessons learnt

On the whole, gathering all stakeholders and sharing knowledge and point of views to define and fund collective projects ahead of its time can be considered as a successful EPI, which contributes both to preserve the stability of the Evian NMW and to develop a modern environmentally friendly agriculture. Nevertheless, both this decrease and intensification are most surely lower than expected without the EPI.

The financial dimension may not be the most important one for explaining the success of the EPI as it remains relatively low in comparison to the benefits. Indeed, a good understanding of the situation helped defining relevant actions at the right scale. Technical support from INRA to the APIEME and from the Chamber of agriculture to farmers thus contributed to the success of the design and implementation of the EPI. The approach used to give room for discussion reinforced trust between parties. These three dimensions (financial, technical and social) and their relative importance in the process are thus considered as key factors to explain the success of the PES scheme.

The following criteria were identified as key factors for the success of the EPI: i) the dynamism and involvement of stakeholders; ii) the relatively small size of the territory to be protected; and iii) the quality oriented approach promoted by the APIEME and the SICA.



Subsidies for Drinking Water Conservation in Cyprus (#20)

Maggie Kossida, Anastasia Tekidou (NTUA)

Definition of the analysed EPI and purpose

This study investigates the four subsidies for drinking water conservation initiated in Cyprus in 1997 by the Water Development Department (WDD). At the beginning, the subsidies encouraged the construction of domestic boreholes for garden irrigation and the connection of a borehole to toilet cisterns for flushing. These were followed in 1999 by additional subsidies to install domestic grey water recycling systems, and hot water recirculators. During the same period (1997) public water supply of desalinated water has been introduced as a source for domestic water to meet the deficit resulting from the growing demand. The rationale and underlining policy objective of the WDD on launching this EPI was to reduce demand for distributed drinking water in households (part of which was now coming from desalination) that is too expensive to be used for gardens and toilet flashing, especially during drought periods.

Introduction

The WDD was the single responsible entity involved in the design and implementation of the subsidies. The subsidies were granted following an application submission by the beneficiary and two inspections prior to the initiation (for approval) and after the finalization (for consistency check) of the associated works. In the case of drilling a borehole, a permit was first to be obtained by the local District Office. Regarding monitoring and enforcement, a cap of 250m³ groundwater abstraction per year was imposed to the new boreholes, the meters though were not checked for compliance by the WDD, nor have any other safeguarding mechanisms after start-up been implemented by the WDD. The amount of the subsidy was formulated at 700€ for the boreholes drilling or connection to toilet cisterns, 220€ and 3,000€ for the installation of recirculators and grey water recycling systems respectively. These prices are applicable in 2009, yet the subsidies were initiated at much lower grants which gradually increased. In 2007-08 extreme drought influenced the beneficiaries into heavily applying for the subsidies which was probably driven from their will to secure water. Regarding the EPI's design, no detailed study prior to the launch of the subsidies has been identified that assesses their impact and effectiveness or identifies a logical basis on how the subsidy amount has been set, with the exception of a pilot study on grey water recycling in 7 establishments in Nicosia (5 households, 1 hotel, 1 stadium) that was run for 1.5 years prior to the subsidy as experimental work and identified the water saving potential. Similarly, post-implementation evaluation was practically inexistent, apart for one

identified follow-up study to assess the actual performance of boreholes for garden irrigation: in 2004, potable water consumption of 20-30 households was monitored in a suburb of Nicosia, 12 months before the installation of a borehole and 12 months after the installation of a borehole, and concluded a 27% saving.

Legislative setting and economic background

The most important economic sector of Cyprus is the tertiary sector, both in terms of economic output and employment, showing upward trends. The agricultural sector, on the contrary, has experienced downward trends. Nevertheless, when it comes to water use, out of a total of 254 mio m³/year, about 62% is used for agricultural, 30% for domestic, 5% for tourism and 3% for industrial purposes.

In Cyprus water legislation was mostly developed during the colonial era (1928-1950). The most important laws around water management in Cyprus are the Government Waterworks Law (Cap. 341, 1959), the Wells Law (cap 351, 1959), the Water Supply (Municipal and Other Areas) Law (Cap 350), 25/1972, 31/1982, 172/1988, the Water (Domestic Purposes) Village Supplies Law (Cap 349), 66/1990, and after November 2010 the New Uniform Management of Water Resources Law which gives all the responsibilities of water management mostly to the WDD (including issuing of the borehole permits).

The relevant institutional setting is built in 3 levels: a policy level (cooperation among 4 Ministries, namely the Ministry of Agriculture, Natural Resources and Environment (MANR&E), the Ministry of the Interior, the Ministry of Finance and the Ministry of Commerce and Industry), an executive level (with responsible actors being the WDD of the MANR&E and the District Administration (DA) of the Ministry of Interior), and an end-user level (local organisations like the Municipal Water Boards, the Village Water Commissions, the Irrigation Divisions and Associations, the Sewerage Boards).

Regarding the domestic water supply, the WDD is currently responsible for the construction, operation, administration and management of all Government Water Works related to freshwater provision, and the bulk water supply provision for domestic use (collection and storage of water in reservoirs, treatment, distribution of potable water to the cities and villages - approximately 80%). At the users' level, the domestic water is supplied to the population by the Town Water Boards, the Municipality Boards and the Village/Community Boards, who obtain their bulk supplies from the WDD and partly from boreholes, subject to the prior approval of the Council of Ministers and the Parliament.

Brief description of results and impacts of the proposed EPI

From 1997-2010 a total of 13,172 subsidies have been granted (of which 59% for new boreholes, 34% for connection of boreholes to toilets, 6% for recirculators and 1% for grey water recycling systems installation). The vast majority (61%) of the subsidies were given in households of the Nicosia water district, 13% in Lemessos, 10% in Ammohostos, 9% in Larnaka and 9% in Pafos water districts. By looking at the temporal evolution of the number of subsidies as compared with the respective precipitation, it is observed that subsidies paid pick-up in periods of low precipitation/drought events, conveying a message that the motivation of the beneficiaries was securing uninterrupted water supply for their gardens, rather than conservation.

The cumulative drinking water savings (as estimated based on the number of subsidies and assumptions on potential savings) from all subsidies during the 14-year period 1998-2010 are about 12,420,240 m³ (or 12.42 mio m³) and represent 1.50% of the total 1998-2010 domestic water use and 3.37% of the total desalinated water provided by the public water supply system (PWSS) in 1998-2010. The above percentages vary from year to year. Although the EPI introduced savings in the drinking water supplied by the PWSS, its impact on the total domestic water use can not be clearly assessed, since the use of free groundwater may have led the beneficiaries to over-pump and irrationally use excess water. Although in the design of the subsidy meters were provisioned to be installed in the boreholes in order to measure the consumption, and a pumping cap of 250m³/year has also been introduced, enforcement by the WDD was very loose (practically non-existent) and thus no regular monitoring of the boreholes' meters has been implemented in order to (a) check whether the cap has been respected, and (b) maintain a register of the total abstracted volumes. Furthermore, the borehole abstractions may have put additional pressure on the groundwater resources. WDD stated that the aquifers where subsidies were approved are marginal and of poor quality and thus practically not exploitable for many uses.

The water saved from the subsidies would probably have originated from desalination, thus it can also be translated to equivalent energy savings (due to the decrease in desalination production needs) and corresponding CO₂ emissions reduction. Each m³ of water produced by desalination requires on average 4.5 KW, thus 3.43 KgCO₂ are generated per m³ of water produced. The subsidies granted from 1998-2010 resulted in a total 55,891,080 KWh of energy saving and 42,601 tones of CO₂ emissions saved for the entire period, or 3,277 tones/year on average.

The total amount of € paid in subsidies from 1997-2010 is about 5.5 million € (of which 59% for new boreholes, 34% for connection of boreholes to toilets, 3% for recirculators and 4% for grey water recycling systems installation). The overall average cost per m³ saved from all the subsidies during the whole 1997-2010 period is 0.43€. To these costs though, transaction costs associated with the design and



implementation of the EPI (e.g. expenses related to the inspections, labor expenses etc.) are not considered and thus should be added on top.

Conclusions and lessons learnt

At the beginning of the implementation, the EPI comes at a high cost, e.g. subsidies provided for connection of a borehole to toilet cisterns in 1997 and 1998 result in 2.83 and 1.52 € paid per m³ water saved respectively. As the EPI implementation progresses and water saving is accumulating over the years, the unit cost is decreased as low as 0.10 €/m³ (years 2001-2005). A time frame of about 3 years was thus required for the EPI to become cost-effective as compared to the selling prices of the Desalination Plants and water tariffs. From 2006 onwards the unit cost has highly and abruptly increased, reaching values higher than the desalinated water selling prices (maximum observed in 2007 was 2.5 €/m³). This change is due to the fact that the payments were significantly increased, as well as the number of subsidies awarded (dramatic increase of 100-400% in some categories), supporting evidence that its cost-benefit clearly relates to the design parameters.

The overall performance of the EPI is subject to uncertainty. While drinking water conservation has likely been achieved, due to the fact that no monitoring was implemented all results are based on proxy calculations, and thus are subject to bias. The selection of boreholes as one of the subsidies creates ambiguity, regarding the adverse impacts on groundwater and the irrational use of a free water supply (thus resulting in an overall increase if domestic water use). Weaknesses in the design (no impact assessment prior to implementation, no research behind the selection and updates of the amounts paid, etc.) and enforcement of the EPI (no monitoring and follow-up) cause reservations regarding its effectiveness. In parallel to the subsidies, the WDD had launched a bundle of measures targeting water saving and demand reduction: awareness campaigns, water reuse, water pricing, water metering installation, leakage reduction. Thus, it is difficult to decouple the actual effect of the investigated EPI and the savings that are explicitly attributed to the subsidies.

While the EPI was aligned with the prevailing laws and policy setting and in terms of flexibility, it has the potential to be adjusted to local conditions, public participation, inclusion of stakeholders in the discussions and collective design were not pursued by the WDD, which, if incorporated, could have brought up issues of social equity, possible unsustainability of the measure as such, and useful suggestions for re-design and enhancement.



Salinity Offsets in Australia (#21)

Tiho Ancev, University of Sydney

Introduction

Salinity of river water and soil has been a long standing problem in Australia, in particular in areas with significant irrigation development, such as the lower reaches of the Murray-Darling Basin. The problem manifested strongly in the 1980's and 1990's, which led to significant research effort into ways to mitigate it. Around the same time, the use of market based instruments (MBIs, an euphemism used in Australia, with the same meaning as EPI) was lauded by economists. As a result, many initiatives to explore the possibilities to use various MBIs for salinity mitigation were put in place. The largest was the Australian Government's initiative to fund two rounds of National MBI pilot programs for natural resource management. The two rounds took place between 2003 and 2008, and comprised 20 projects with total funding of about \$10 million. Several funded projects had to do with pilot testing MBIs designed to mitigate irrigation induced salinity, including couple of salinity offsetting programs.

Definition of the analysed EPI and purpose

This report reviews three salinity offsetting programs in Australia – two that were piloted under the National MBI pilot program: Coleambally Irrigation Area (CIA) and Ulan Coal Mine (UCML), and one under the South Australian (SA) Irrigation Zoning Policy – with an aim to evaluate their performance and to discern the noted shortcomings of the programs, or the noted features that have been working particularly well. An additional aim is to identify aspects where possible improvements in the existing offsetting programs could be achieved. This will be used to inform the activities, findings and recommendations of the EPI-Water project.

Legislative setting and economic background

The contexts, scales, and policy goals and targets of these offsetting programs have many similarities, but also have clear distinctive features. The unifying theme for all three offsetting programs is that they aim to mitigate salinity caused by irrigation in a cost-effective way. In all three cases other policy alternatives have been considered, but the evidence suggested that offsets offer an adequate and cost-effective solution to the problem. Thus, economic motives stand very strongly behind the establishment of the offsets. Another similarity between the three offsetting programs is that they all represent a significant institutional innovation in dealing with the problem of salinity. While engineering and direct regulatory approaches were the dominant strategies to address salinity problems in



Australia in the past, there was a significant move towards incentive based approaches, including offsets, over the last ten years.

Main differences among the three programs are in relation to the scale of the potential salinity impact (UCML has impacts on a local scale, CIA has a shire to regional scale impacts, and Irrigation Zoning in SA has large, state level impacts). In addition, the legislative setting is quite different in the three cases: UCML operates the salinity offsets as a part of their environmental protection license (a license that all industrial enterprises are required to have); CIA operates their net recharge offset policy through the statutes of the local irrigation cooperative; offsetting under Irrigation Zoning in SA is implemented through state legislation.

Brief description of results and impacts of the proposed EPI

The review was approached by collecting, collating and processing significant amount of publications and data pertinent to the case studies. In addition, several people involved in various aspects of the management of the three offsetting programs were interviewed. It was evident from the available literature and the interviews that there has not been much evidence that can be used for *ex-post* evaluation of these programs. The present report is a first scholarly attempt in that direction.

The findings that emerged from the collected evidence are mostly consistent across the three considered offsetting programs. In terms of environmental effectiveness, it is not possible to clearly discern the effects of the offsetting programs from the effects pertinent to the climatic and hydrologic conditions over the last 7-8 years. At any rate, the salinity threats in Australia have abated over the period, and various salinity mitigation initiatives, including offsets, can probably claim at least some credit for it. The real environmental effectiveness of the offsets will be tested when the climatic conditions allow for improved irrigation water availability, as is currently the case.

Conclusions and lessons learnt

The economic effectiveness of the salinity offsetting programs is clear. In all cases, salinity offsets provided a cost-effective way to mitigate salinity, when compared to alternative approaches. In addition, salinity offsets have desirable distributional effects, as they transform the costs associated with the environmental damage borne by the public at large, to costs associated with providing the offsets borne by those who cause the environmental damage. The social effects of the offsets are minor, and in principle they can be seen as enhancing social equity in relation to environmental health.

The institutional innovation represented through the implementation of salinity offsets is probably the most exciting and promising feature of these programs. Incentive based approaches to deal with environmental problems, including tradable permits, taxes, and offsets, have become widely accepted in Australia over the last decade. Given that this type of approach effectively corrects for an outdated institution that has governed resource

use and environmental management (i.e. the institution of 'open access') in the past, it is satisfying to witness that new institutions that highlight the importance of 'property' or 'use' rights, are slowly but surely taking the front stage in this domain.

The shortcomings of the reviewed offsetting programs relate to potentially high transactions costs and the widespread uncertainty, especially in relation to the environmental outcomes from salinity offsets. While in some cases the transactions costs appear to be acceptable (UCML) due to the small number of affected agents, they are likely to be very high in other cases (Irrigation Zoning in SA). In the latter case, there is clear opportunity for the Government of SA to provide some services (e.g. register of interest for salinity offsets in the high salinity impact zones) that will reduce the transactions costs for the prospective participants in salinity offsetting. Governments (or governance bodies more generally) can also be instrumental in improving the performance and uptake of salinity offsets by supporting further research into quantification and management of the uncertainty related to environmental offsets in general, and salinity offsets in particular. Better understanding of the uncertainty, and finding ways how to manage it, will lift the doubt about the environmental effectiveness of offsets that many people still have.

Overall, this report finds that salinity offsets in Australia have been reasonably successful since their implementation. Their very existence is a positive development, and an important addition to the policy mix to deal with future environmental and natural resource challenges.



The Efficient Water Market of the Northern Colorado Water Conservancy District: Colorado, USA (#22)

Charles W. (Chuck) Howe, University of Colorado-Boulder

Introduction

The case study presented is focused on the use of tradable and rentable water permits designed to maximise the efficiency of the use of water resources in Colorado (USA). The State of Colorado is divided into two distinct regions: the eastern, dry plains and the western areas that start with the Rocky Mountains and extend through rugged lands to the western border of the State. Rainfall and snow are heavy on the western side of the Rockies, while the eastern slopes of the mountains (the “East Slope”) and the plains are semi-arid. In order to compensate this unequal distribution of the water resources, a complicated project of water transfer has been designed. The Colorado-Big Thompson Project is the largest trans-mountain water diversion project in Colorado. Built between 1938 and 1957, the C-BT Project provides supplemental water to 30 cities and towns and is used to provide supplemental irrigation to 693,000 acres of north-eastern. In order to efficiently manage the “foreign water provision” ensured by the CB-t project, it was founded the Northern Colorado Water Conservation District (NCWCD). It was established in 1937 to contract with the Federal Government to build the large trans-mountain water transfer project. NCWCD is responsible for the diversion works of the project and for the allocation of water on the eastern side of the mountains.

Definition of the analysed EPI and purpose

The EPI in this case study is the efficient water market that has evolved within the administration of the Northern Colorado Conservancy District. The market described here has evolved through institutional and economic change over more than 60 years, partly by design, partly by trial and error. This evolution has taken place within the framework of western U.S. water law known as the “appropriations (or priority) doctrine”, a doctrine that responded to the semi-arid climate of the region and to the need to move water away from the streams to more remote points of use. These needs contrasted with in the situation in “well watered” regions (especially the eastern U.S., Canada, and U.K.) where the primary uses historically had been for riverside water-powered mills, i.e. non-consumptive uses.

For orderly administration, it is necessary to maintain records of all water rights and their transfers. It is also necessary to enforce the “no injury” requirement at the time of a water right transfer. These functions are carried out by a state agency, e.g. the water courts in Colorado, the Water Commission in Wyoming or the Office of the State Engineer in New Mexico. A large part of the associated costs are imposed on the transferor and transferee, becoming part of the “transaction costs” of the transfer (the other costs are search costs).



Naturally, it is desirable to keep transaction costs to a minimum required by effective administration.

Legislative setting and economic background

In the past, water resources were managed, in the US, following the simple principle of “first in time, first in right”, under which a particular pattern of water use was assigned a priority date according to time of first use. State courts (first in Colorado in 1886) later ruled that these quantified and prioritized water uses constituted property rights that could be bought and sold. It was also ruled that when these water rights were transferred to different uses, the priority of the right was maintained. In the U.S. and Canada, regions that have used other legal frameworks like the old English riparian doctrine are increasingly changing to more flexible rules, e.g. tradable water extraction permits in the eastern U.S. Agricultural water use constitutes over 80% of total use in Colorado and in the NCWCD, both in terms of withdrawals and consumption. The District has pursued educational and demonstration projects to assist farmers in achieving economic water conservation. The adoption of strategies like these and the efficient water right markets allowed to save more than 30% of water in the last years respect to the past.

Brief description of results and impacts of the proposed EPI

The NCWCD is located in the northeastern quadrant of Colorado as shown in Figure 5. The District serves Front Range cities from Fort Collins to Broomfield, the richest farmlands of Colorado in Larimer and Weld Counties and agricultural lands bordering the South Platte River to the northeastern corner of the State

NCWCD contains 1.6 million acres in portions of Boulder, Larimer, Weld, Broomfield, Morgan, Logan, Washington and Sedgwick counties. The District was established as the local agency to contract with the federal government to build the Colorado-Big Thompson Project under the federal Reclamation Program. The project stores water from the Colorado River headwaters in a series of reservoirs on Colorado's West Slope that is transported, via the 13-mile Alva B. Adams Tunnel, through the mountains in Rocky Mountain National Park to the District's seven-county service area on the East Slope

The long term average annual runoff from the mountain water sheds of the region is about 1.1 million acre-feet. The region is semi-arid with average annual precipitation of 13.7 inches. The natural ground cover was a rich growth of drought resistant blue gramma and buffalo grasses. The Colorado-Big Thompson Project is the largest transmountain water diversion project in Colorado. Built between 1938 and 1957, the C-BT Project provides supplemental water to 30 cities and towns and is used to provide supplemental irrigation to 693,000 acres of northeastern Colorado farmland. The complex collection, distribution and power system is comprised of twelve reservoirs, 35 miles of tunnels, 95 miles of canals and 700 miles of transmission lines. The C-BT system spans roughly 150 miles east to west and 65 from north to south



The C-BT Project annually delivers an average of 213,000 acre feet of water to northeastern Colorado for agricultural, municipal and industrial uses

As a result of the active NCWCD market and rapid urban growth, ownership of the District allotments has shifted steadily toward urban users as shown in the first panel of Figure 8. While ownership has shifted, changes in actual use have been less dramatic. Cities typically buy water rights in excess of average needs to protect against drought. In average years, they then rent substantial amounts of water back to agriculture

The long term effect of increases in urban and industrial demand has been to drive up the prices of C-BT allotments

Conclusions and lessons learnt

The existence of a flexible water market motivates water conservation by all users by confronting the user with the real opportunity cost of the water. It can thus overcome the distorting effects of inappropriate pricing policies that are often in place;

The economic impacts of water transfers out of agriculture depend on (1) whether the new uses are in the same economic region and on (2) the economic vitality of the economy of the area or origin. If water transfers are being induced by the growth of new, more valuable economic activity, the transfers reinforce growth. In depressed areas of origin, transfers out of the area reduce activity with little hope for replacement activities.

In the case of transfers out of a depressed region, extra-market compensation may be warranted. When C-BT was built, additional reservoir storage on the West Slope (Green Mountain Reservoir) was included in the design to compensate for reduced streamflows ("compensatory storage"). When out-of-basin transfers occur from economically depressed areas, the buyers frequently negotiate cash payments to local governments to compensate for reduced tax bases.

Cumulative impacts of transfers out of agriculture cause increasingly negative impacts, sometimes approaching a "tipping point" at which agriculturally-related businesses begin to fail.

Recent experimental research on water markets (Goemans, DiNataly et al) shows that the markets for permanent transfers (water rights) and water rental markets interact. Where efficient, expeditious leasing arrangements are available, water rights prices are likely to be reduced since permanent transfers and leases are, to some extent, substitutes.



The role of the Unbundling water rights in Australia's Southern Connected Murray Darling Basin (#23)

Mike Young, University of Adelaide

Introduction

Australia has defined its water entitlement and allocation arrangements in a manner that has made it possible to establish one of the world's most sophisticated water marketing systems. This system is best developed in the Southern Connected Murray Darling System which sits within Australia's Murray Darling Basin.

Initially, irrigators were issued licences to irrigate a maximum area of land. These licences were converted into licences to take up to a defined maximum volume of water each year. As irrigation expanded, two types of rationing systems were introduced. At the entitlement level, two types of licence were introduced

- High security licences – which nearly always received their full allocation; and
- General security licences – which only received a full allocation in wet years.

When it is not possible to give users their full allocation, water is allocated to all licence holders on a proportional basis. Eventually, it was realised that no more licences should be issued and a cap was placed on water use. At the same time that this limit – known as the cap – was introduced a suite of water reforms were put in place to enable water trading. The initial objective of trading was to make water use more efficient and enable it to move to its highest and best use at any point in time.

Initially trading was administratively complex and slow. Gradually, however, experience increased and the benefits of trading became more and more apparent. There have been dramatic increases in water use efficiency and considerable innovation.

One of the key innovations that made it possible to trade large volumes of water efficiently is the introduction of what is now known as “unbundling”. Unbundling involves the conversion of one property right into a bundle of separate instruments each designed to pursue a different objective and, often, operate at different scales.



Rationale for choosing the case study

While it would be possible to present the “Australian” water entitlement, allocation, use control, distribution management and trading system as a case study, for the purposes of this EPI project it is judged more useful to focus on one of the key features of this system. The feature chosen is the “unbundling” of the licensing system. Unbundling is chosen because it demonstrates one of the necessary conditions for the development of market-based approaches to the management of natural resources that can be expected to remain efficient through time and deal equitably and fairly with large numbers of water users.

Definition of EPI and purpose

The underpinning goal of water trading was to increase economic growth by allowing water to be moved to places where it could make the greatest contribution to economic development. The initial argument was that water should be put to its “highest and best use.”

In retrospect, however, Australia has learned that water trading enables efficient and rapid adjustment to extreme water scarcity. The “unbundling” innovation identified in this case study has been critical to the development of this capacity to adjust quickly to water scarcity problems.

Australia began with a water allocation system that issued a single property right (a licence) to a water use. Each licence consisted of a “bundle” of entitlements to use water, conditions about how it may be used, etc. Unbundling involves the separation of this bundle of rights into a number of separate parts.

Prior to the introduction of unbundling, the amount of water used by irrigators was administered using a licensing system that made it difficult to move water allocations for one location. Transaction costs were high. The approach taken was to temporarily transfer the licence from one water user to another, then take the water off the licence and then, after the water had been taken from the licence, the licence was transferred back to the original owner. The process was slow and administratively complex. To this day, this type of transfer is known as a temporary trade because the trade used to involve the temporary transfer of a licence from one person to another.

To simplify this process, a decision was taken in 1994 to allow people to hold water licences without owning any land. In order to facilitate this and increase investment security formal water entitlement registers were established and procedures put in place to enable landholders to obtain permission to irrigate an area of land without knowing where the



water would come from. As reforms progressed further, it was decided to define water licences as shares and issue them in perpetuity.

Separate bank-like water accounts were then set up and structured so that water was allocated to each shareholders account in proportion to the number of shares they held. In parallel with these arrangements, any landholder who wished to use some water in an account needed to have a use approval that authorised the government to deduct water from an account as it was used. Whilst complex, the result was the emergence of extremely efficient water trading arrangements.

In parallel with these reforms, efforts were made to improve system-wide planning processes so that irrigators could make investments with greater confidence.

Legislative setting and economic background

In Australia, the degree of protection from competition in the production of agricultural products is low.

Significantly, in 1994 Australia established a National Competition Policy that sought to use markets as the prime mechanism to make water use and many other services provided by government more efficient. This commitment, nearly 20 years, has forced many changes. Productivity is now much greater.

With regard to the legislative setting used to enable water management

- Each component of the unbundled set of arrangements is defined in legislation and in a suite of plans approved by parliament.
- A key feature of the resultant suite of institutional arrangements is a process that uses the approved plans to manage third party impacts.
- If a third party is aggrieved by a water trade and the trade is in accordance with the rules set out in the plan, the only course of action available for a third party to prevent the trade from occurring is to arrange for the rules in the plan to be changed. There is no opportunity for a third party to prevent a transaction that is consistent with rules set out in the plan.
- An independent regulator is used to minimise opportunities for regions to find ways to impede trades from occurring. A complex set of rules, for example, are used to

define the maximum fee that a person may be charged for trading water from one district and into another.

- As each stage in the development of the current unbundled system of property rights was introduced, a pragmatic decision was taken to begin by defining formally defining each dimension of the emerging system in a manner that mimics the status quo. (This is known as grandfathering.)

Results and impacts of the proposed EPI

The resultant improvement in individual wealth has been an increase in the value of the property right in the vicinity of 15% per annum for well over a decade. This rate of return has been much greater than could be achieved by investing in the Australian share market. There has been a dramatic increase in the technical efficiency of water use and in the development of new technology.

In retrospect, grandfathering has proved critical in gaining acceptance of the new market based system of allocating and managing water use. At each stage in the reform process, the process began by redefining rights in a manner that did not change the status quo.

The introduction of water trading has dramatically reduced the economic impacts of drought. The Southern Connected River Murray System experienced a long dry between 2002/3 and 2008/9. Water diversions during this period declined by around 80% but the gross value of irrigated agricultural production dropped by around 40%.

This, however, only presents the upside of the case. The water accounting and allocations systems used in the Murray Darling Basin lacked hydrological integrity. Water allocations were not reduced as water use efficiency increased and as return flows decreased environmental problems began to emerge. The result was a move from a fully to an over-allocated system that governments are finding it hard to solve.

In addition to a reduction in return flows, surface water trading increased groundwater use and reduced the amount of groundwater that returned to the river. This over-allocation problem worsened as the value of water increased. Seeking to capture this value, landholders also began to divert overland flows that previously reached the river into their storages. In parallel with this governments began to construct salinity interception schemes necessitated by the general increase in irrigation water use that was occurring.

Today, in an attempt to over come the over-allocation problem the Australian government is using the water market they established to buy back water entitlements for the environment.



To date, all entitlement sales to the government have been voluntary. Over the next decade, it is expected that existing entitlements will need to be reduced by 35% to 50% - such is the extent of the suite of unaccounted for innovations that have occurred.

With the benefit of hindsight it can be seen that as the water market has driven up the value of water, the billion dollar cost of fixing this over-allocation problem is much greater than it would have been if robust water accounting arrangements had been put in place before the water market EPI was put in place.

Conclusions and lessons learnt

For water use to be efficient, remain efficient through time, be seen to be equitable and to deliver local and system-wide environmental objectives, there must be as many EPI's as there are objectives. As a bare minimum, there must be an instrument that ensures that water use is efficient on a daily basis and another to ensure that long-term investment decisions are taken in an efficient manner.

In short, this case study finds that the use of economic policy instruments will be more effective if existing property right arrangements and existing instruments are unbundled.

Urban Water Price Setting under Central Administration (#24)

Iddo Kan and Yoav Kislev (The Hebrew University of Jerusalem)

Definition of the analysed EPI and purpose

According to the Israeli Water Law, all water sources in Israel are public property, and as such, the government exclusively administrates water. The objective of this legal regime is to enable the government to correct market failures related to water management; particularly, to internalize externalities associated with water pollution and extraction from common water resources, to control supply by natural monopolies, and to design long-run nationwide investments in infrastructure and extraction from water resources under the scarcity and uncertain natural enrichment characterizing the Israeli climate. Our EPI case study comprises two aspects of this centralized management approach. The first is an institutional reform initiated in 2001, whereby local water and sewage services that were formerly provided by municipal departments, became the responsibility of newly created companies (corporation, in the popular terminology). The rationale of the corporatization process was to improve efficiency by ensuring that municipalities do not use water revenues for other purposes, and utilizing economies of scale by merging water services of adjacent localities. The reform process was expanded in 2006 at the national level were, in order to improve management efficiency, most of the regulations related to water, which were previously divided among a number of ministries, were concentrated in the hand of a new regulatory entity, the Water Authority. The Water Authority has also been made the price setter of all types of water, including the (wholesale) prices of water delivered by Mekorót (a government-owned company) at the municipalities' gates, and the (retail) prices paid by the end-users, urban consumers. The second aspect of our EPI is related to the pricing scheme: urban water prices are set by the regulator subject to the constraints of overall cost recovery at the national and municipal levels, combined with an egalitarian policy; the latter is expressed in identical municipal end-users tariffs. This pricing technique replaced the previous policy, under which costs were partly covered by the government's and municipalities' budgets, and prices were only partially identical -- sewage treatment tariffs and connection fees were not uniform. To enable evaluation of these institutional arrangements and the pricing mechanism based on historical data and projected future trends, we assess the EPI's features in comparison to the ones it has replaced, which therefore constitute our baseline scenario.

Results and impacts of the EPI

The water and sewage corporations are gradually replacing the traditional urban water departments; they are operating under a business-economic model and under the professional supervision of the Water Authority. Each corporation is required to follow a set of rules for operation and maintenance expenses, as well as targets for steady reduction in water losses; this requires investments, which affect the cumulative assets value owned by

the corporations. In turn, the assets value are considered by the Water Authority when setting the prices paid for the water purchased from Mekorót -- higher values may reduce this price; by this means the incentive to invest is formed. Indeed, despite the short time passed since the corporatization was launched, significant improvements in some aspects of the water services can already be observed: The corporations can now recruit workers from outside the rigid employment constraints of the municipal sector. All incomes and costs are earmarked and transparent. Monetary reports of the corporations are standardized and are available to the public through the Water Authority's website. Operation and maintenance of the municipal water system does not depend anymore on the municipality's financial situation, and the corporations are able to approach the capital market for financing their activities; consequently, investments in infrastructures and in advanced technologies for metering consumption and monitoring water and sewage flows have sharply increased.

Yet, more than a few municipalities have refused to join the corporatization process, and for several reasons. The inflow of payments for water and sewage services helped budgetary management and these inflows are lost once services are turned over to the corporations. Moreover, by establishing a water corporation the municipality loses the ability to block water supply as an enforcement tool for municipal tax collection. The outsourcing of services may weaken local democracy; municipalities lose flexibility in defining preferences regarding the allocation of resources among services; it is uncertain that the marginal benefits of water-leakage prevention equal the marginal cost when opportunity costs (e.g., schools, parks) are taken into account. Corporations operate on local infrastructures; hence, there is high likelihood for disputes between them and the local authorities over domains of responsibility.

Regarding prices, in order to combine both cost-recovery and equity, the prices paid by the corporations for Mekorót water are not identical: Corporations whose approved internal cost is high pay Mekorót a low price, and vice versa. In this way, low cost corporations indirectly support the others and a uniform tariff structure is maintained only at the end-users level. However, this mechanism incorporates a structural incentive problem, since it doesn't make sense for a corporation to increase its efficiency; in order to reduce the price, the management of every corporation will attempt to convince the regulator that its costs are especially high. The government for its part will not be able to allow the corporations to accumulate profits, and even less to let them accumulate losses and go under, particularly given the governmental extensive support of the corporatization process; in other words, a regulatory capture may emerge.

The EPI has distributional effects. Most of the governmental income is derived from the high-income sector, it pays the lion share of taxes. As water is an essential commodity, the share of expense on water consumption in low-income households' budget is larger than that of the high income ones. Given these two facts, by abolishing the financial support to Mekorót from the government's budget, and instead setting higher water prices so as to cover Mekorót's costs only through its water sales, the EPI imposes larger burden on the low income sector.

Two types of institutions have influenced the shape of the EPI and its success. The municipalities form the first type, so far they successfully blocked the formation of many regional corporations, and, according to a recent governmental decision, will even increase

their hold and impact on the corporations. The second are political parties representing low-income sectors, who prevented the original intention of the law to set different end-user prices in different urban corporations, in each case to cover locally specific cost, in order to enhance water-supply efficiency.

A direct environmental impact of the EPI is associated with the creation of incentives for improving municipal water infrastructures, and thereby reducing the occurrence of collapsing pipes, water eruptions and sewage discharges to reservoirs, waterways and the sea. In addition, due to the full-costs recovery policy, prices have increased, and thereby reduced municipal water consumption. This, together with reduction in water losses, enables alleviating the pressure on natural water resources and allocating more freshwater to nature. On the other hand, both the corporatization process and the higher water prices entail reductions in watering of private and public gardens. Moreover, less urban water use implies lower releases of treated wastewater for agricultural irrigation.

Conclusions and lessons learnt

The effects of institutional and economic changes are recognized in the long run; it may now be too early to identify and assess the full range of aspects associated with the EPI. We do believe, however, that two lessons can already be learned.

The first lesson learned is associated with the way a reform in EPIs is implemented. Mayors may favour reducing costs by postponing the expensive investments in replacement of non-visible water-supply infrastructures; thus allowing increased water losses. A preventive measure may be to separate financially the water services from the other municipal functions, which doesn't necessitate the establishment of separated corporations. However, in some municipalities in Israel, water and monetary losses are particularly high, due to failure of enforcement which are attributed to cultural and political customs that limit the power of local authorities, and even that of the central government. In such municipalities, corporatization is justifiable for separating between local politics and water services. However, the government did not distinguish between municipalities and has been trying to establish corporations in all of them. The plan was to exploit economies of scale and establish several regional corporations each servicing 20-30 municipalities. But hastily, the government permitted the creation of many single locality corporations. It will now be difficult to merge them into regional entities. Moreover, the mayors of the affected municipalities, who feared losing power, succeeded in forcing upon the government changes that may eventually make the corporations again subject to local political control. They will lose their independence. From the regulator perspective, the lesson can be summarized by the phrase "grasp all, lose all." EPI reformation should take account of unattainable objectives; in this case, "sanitizing" the political factors from involvement.

The second lesson learned is associated with the challenge of designing a pricing mechanism that simultaneously achieves several potentially contradicting targets: costs recovery, creation of incentives for efficiency, and equality. Also here the mechanism was distorted by political pressures. The consequential increase in the burden on the poor sectors stimulates political criticism of the method, particularly when costs increase and therefore prices have to be hiked. Indeed, trying to avoid criticism, the Water Authority recently



refrained from increasing prices, and costs are to be partly covered by the government. It can be concluded that, according to the social norms as they are reflected by this policy making, equality overwhelms efficiency.



Great Miami River Watershed Water Quality Credit Trading Program (#25)

Mark S. Kieser and Jamie L. McCarthy, Kieser & Associates, LLC

Introduction

The economic policy instrument (EPI) discussed in this case study involves nutrient credit trading between point source wastewater treatment plants (WWTPs) and nonpoint sources (agriculture) in the Great Miami River Watershed of Ohio (U.S.). Commonly referred to as water quality trading (WQT) in the U.S., this EPI is a market-based approach to pollution control in which pollutant reductions are treated as commodities.

Definition of the analysed EPI and purpose

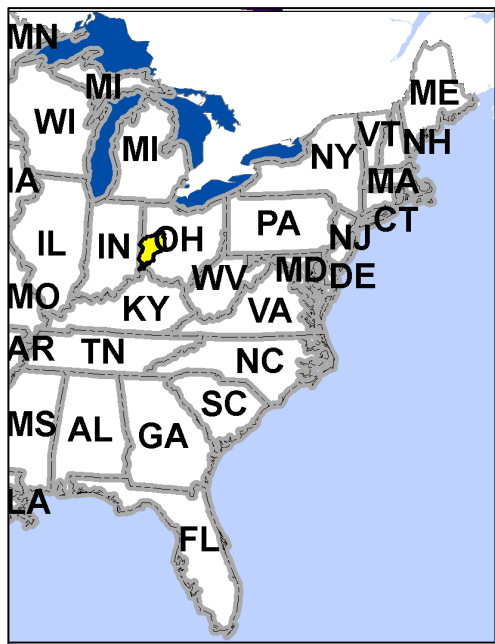
In a WQT market, dischargers that reduce their pollutant loads below required levels can sell surplus reductions, called credits, to other dischargers that need to make reductions to meet compliance requirements but face much higher costs to achieve required reductions. Credit price can be determined via negotiations between the buyer and seller, derived from credit auctions, or can be set by the government or other agency.

The purpose of this case study is to describe how a watershed-based flood control agency in southern Ohio developed a plan for WQT to provide a cost-effective alternative for WWTP compliance. WWTPs will soon face more stringent effluent limits as a result of impending numeric nutrient standards being assigned to rivers and streams receiving treated wastewater. Lessons learned from this case study have substantial merit as an EPI because this program provides an economic framework for applying and using WQT in a regulatory setting. This case study example is also one of the largest and most successful WQT programs in the U.S. to negotiate nutrient credit trades between multiple point source buyers and nonpoint source sellers. Of note is the use of a reverse auction for securing lowest-cost credit contracts. This program was the first of its kind in the State of Ohio. An ex post evaluation of the program was conducted on the first six rounds of reverse auction bidding (out of a total of ten completed to date) for nonpoint source projects (Newburn and Woodward, 2011).

In 2004, ahead of statewide policy or rules for WQT, the Miami Conservancy District (MCD) (a watershed-based flood district with taxing authority) examined opportunities for a point source/nonpoint source WQT pilot program in the Great Miami River watershed (see Map 0.1). The program was designed to improve locally impaired waterways and to provide a cost-effective alternative for WWTP compliance under forthcoming nitrogen and phosphorus standards. Once nutrient standards are in place, municipal, industrial and other permitted point sources will be required to meet more stringent effluent requirements.

Such limits will require significant capital investments and increase annual operation and maintenance costs for these permitted WWTPs.

The intent of the trading program is for agriculture to supply cost-effective nutrient reduction credits in lieu of anticipated point source reductions associated with expensive wastewater treatment plant upgrades. As agriculture is the predominant land use in the watershed, it was originally envisioned that trading opportunities in a water quality market with significant demand will motivate agricultural producers to participate. Robust participation by agriculture in a trading program can overcome common challenges in traditional programs that lack the authority or incentives to engage producers in water quality initiatives. The goal of the program was to establish a unit of credit for nitrogen and



phosphorus reductions generated by agricultural best management practices (BMPs) that reduced nutrient loading to local surface bodies. Cost-effective credits would be sold to downstream wastewater treatment plants looking to offset effluent discharges. The program was developed with pre-compliance incentives to encourage early participation prior to issuance of more stringent WWTP effluent limits. Seven point source buyers representing a total of nine permitted outfalls have participated in the pre-compliance version of this early WQT market. (More than 300 permitted dischargers exist in this watershed.)

As of the case study report, nutrient standards have not been promulgated. Despite this setback, the MCD WQT program has been successful in conducting reverse auctions and funding agricultural producers to implement BMPs that improve water quality. The program has also been successful in getting financial support from point sources even though a regulatory driver for demand has been lagging.

Map 0.1 – Location of the Great Miami River Watershed in southern Ohio, U.S.

Legislative setting and economic background

The MCD WQT framework was approved by the Ohio Environmental Protection Agency (OEPA) prior to the promulgation of statewide trading rules in 2007. The statewide trading rules contain a grandfather clause that authorizes the MCD WQT program to continue using their existing trading framework for a limited time period of ten years. Each of the wastewater treatment plants (WWTPs) purchasing credits through MCD's WQT program have modified National Pollution Discharge Elimination System (NPDES) permits that allow them to purchase credits to meet their effluent limit (or future limit). The WWTPs were given an additional financial incentive because of their early pre-compliance



participation in the WQT pilot program. The incentive is in the form of a more favorable trading ratio in the future after the pre-compliance period.

As part of MCD's effort in developing a pilot point source/nonpoint source WQT program in the watershed, an economic analysis was conducted to examine two requisite conditions for WQT in the watershed. The analysis found that there was an adequate supply of agricultural nonpoint source reductions in phosphorus to meet all of the demand (and most of the nitrogen demand) through application of no-till management practices on 50% of the row crops in the watershed (K&A, 2004). The cost differentials between point source upgrades (approximately \$422.5 million) and trading credits from agriculture (approximately \$37.8 million) were sufficient to support a trading program (K&A, 2004).

MCD's WQT program focuses on those practices which achieve the highest and most cost-effective loading reductions of total phosphorus (TP) and total nitrogen (TN) in relation to the buyer's location in a watershed and point of water quality concern. For the MCD WQT program, these locations are upstream of WWTP buyers. Other federal conservation programs focus more on producers interested in implementing conservation plans and consider numerous conservation benefits of all environmental resources regardless of watershed location of load reduction. These resources include water quality issues in a ranking system that makes awards based on cumulative benefits. While both programs fund BMPs that may result in water quality benefits, trading programs using reverse auctions focus on those BMPs that deliver the greatest water quality benefits per dollar expended.

Brief description of results and impacts of the proposed EPI

In the pre-compliance phase, the main goal for the MCD WQT program to date has been testing and adapting a framework for WQT that will provide WWTPs and other permitted point sources with reliable nutrient credits to comply with future more strict effluent limits in NPDES permits. An economic assessment of the potential cost efficiencies of WQT in the Great Miami River Watershed revealed that the MCD WQT program will provide substantial cost savings in the future when stricter numeric nutrient standards are enforced.

In terms of environmental outcomes, the MCD WQT program has implemented ten rounds of agricultural BMP reverse auction bids. As part of the bidding process, local county Soil and Water Conservation Districts (SWCDs) must calculate the anticipated TP and TN load reduction from proposed BMPs. SWCDs must use state-approved spreadsheet tools to estimate the load reduction. This system provides more consistent load reduction estimates and assurance that the WQT program is environmentally sustainable. Contracted BMPs represent reductions of 339 tons of TN and 130 tons of TP reductions or credits through the first six rounds of reverse auctions. Additionally, the MCD conducts annual water quality monitoring throughout the watershed.

The geographic and social equity of credit distribution throughout the Great Miami River Watershed is affected by the program framework. The MCD WQT program requires point source buyers to purchase credits from upstream sources. This influences the distribution of



eligible producers that can implement BMPs and sell nutrient credits based on the point source buyers in the market. In addition, because cost-effectiveness is one of the main project goals, as opposed to social equity, producers working with more experienced SWCDs tended to have more BMP proposals submitted and accepted than producers working with less experienced SWCDs. Newburn and Woodward (2011) determined that over time, SWCDs that participated in bidding each year could better inform their producers on what cost range to submit in their bids. This led to an uneven distribution of BMP projects selected among the eligible counties in the watershed.

In addition to funding the lowest cost nutrient reductions in the watershed, there were several other benefits of the WQT program that were not directly targeted. Ancillary environmental benefits were realized through nonpoint source nutrient reductions, including: habitat improvement, stream shading/temperature benefits, streambank stabilization, flow velocity stabilization, and floodplain preservation. The MCD WQT program also fostered collaboration and cooperation between many disparate stakeholder groups beyond the pollutant reduction transaction. For example, several cities in the watershed have been working collaboratively with landowners and producers to develop recreational trails in what has been coined "Ohio's Great Corridor". In general, WQT has allowed MCD to leverage additional funds and resources for general water quality management that would otherwise be invested in traditional WWTP technology upgrades. In this way, WQT has achieved the intended water quality benefits and additional ancillary environmental, community quality of life, and watershed management benefits.

Conclusions and lessons learned

Overall the EPI has been relatively successful in meeting the goals of cost-effectively generating nutrient reductions in the watershed. Throughout the process of developing and testing a WQT framework, several enabling and disabling factors were identified. Necessary factors for successfully developing and implementing WQT include the commitment and leadership of a watershed "champion". This champion must engage a multitude of stakeholders and work through a public process to gain the support and buy-in from different stakeholder groups. It is important to take advantage of existing, well-established relationships within the watershed, especially when it comes to getting buy-in and participation from the agricultural community.

Disabling factors for WQT were also identified. The Great Miami River Watershed, like many watersheds in the U.S., lacks a definitive regulatory driver for water quality improvements, especially for point source dischargers. This is due in part to the lagging development of state numeric nutrient criteria. This lack of criteria has led to a great deal of uncertainty in WQT markets and has limited demand.



New York City Watershed Agricultural Program (#26)

Carolyn Kousky (Resources for the Future)

Introduction

New York City gets its drinking water from three watersheds that are grouped into two systems – the Croton system and the Catskill-Delaware (Cat-Del) system. For over a century, New York City did not have to filter any of its water, as these watersheds provided it with what was characterized as the “champagne of tap water.” In the 1980s, it became clear that the quality of New York City’s water was declining and the Environmental Protection Agency (EPA) might mandate filtration under the Surface Water Treatment Rule (SWTR) of the Safe Drinking Water Act (SDWA). New York City preemptively decided to filter the Croton system. Building a filtration plant for the Cat-Del system (90% of the city’s water by volume) was estimated to cost, in 1990 dollars, \$4-8 billion in up-front capital costs and \$250 million annually in operating costs (Appleton, 2006). The city looked for a way around this huge expense and began to explore watershed management.

Following years of negotiation between the city, farmers in the watershed, the watershed towns, and the EPA, a Memorandum of Agreement (MOA) was signed in 1997. Under the agreement, New York City is purchasing critical lands, regulating to some extent land uses, financing a watershed agricultural program, and investing to upgrade infrastructure, such as septic systems and waste water treatment plants. This is costing them substantially less, around \$1.5 billion so far. In July, 2007 the city was granted 10 more years of filtration avoidance from the EPA as the program was working as intended and improving water quality.

This case focuses specifically on the watershed agricultural program (WAP). Under an agreement with farmers, a farmer-run institution, the Watershed Agricultural Council (WAC), was established to develop and implement best management practices (BMPs) on farms whose owners voluntarily participate. The city is financing the operating costs of the WAC and covering all the costs to farmers of adopting BMPs. In this sense, the WAP is an example of “payments for ecosystem services” (PES): the city is paying for the service of improved source water quality. This program has been analyzed by several academics and widely discussed in “gray” literature for its innovation and success. Agriculture is only one source of pollutants to the city’s drinking water, however, and others, especially ex-urban development, continue to pose a threat.

Definition of the analysed EPI and purpose

The WAP was one component of the city’s strategy to protect drinking water quality by improving source water quality. The source for New York City’s drinking water is surface water in the Catskill-Delaware watersheds. The quality of this water was being threatened



by dairy farming, which was growing more concentrated, and by exurban development. The goal of the WAP was to improve water quality in the Cat-Del system (to be achieved in combination with the other watershed management initiatives being undertaken by the city), in order to avoid filtration that could be required by the EPA.

Rationale for this Case Study

This case study is worth close examination for a couple reasons. First, at the time the policy was adopted, the idea of watershed management for water quality improvements and voluntary agreements to manage non-source water pollution were considered nice ideas in theory but unlikely to ever work in practice. New York City proved that these strategies can work on the ground. New York City's policy quickly became a poster child for those interested in ecosystem services. Despite this, the New York City approach has not been as widely replicated as many thought it would be. It thus appears that there were a unique set of circumstances that allowed for a successful policy in New York that may not be as easily copied as appears at first look. Deeper analysis is thus warranted to draw out lessons for water managers.

Legislative setting and economic background

Although drinking water is provided locally, in the United States it is regulated by the federal government, largely through the Clean Water Act and the 1974 SDWA. The SWTR, promulgated under the SDWA, requires filtration of surface water systems unless certain conditions related to water safety are met. Only a handful of local governments in the US have been able to avoid filtration by engaging in watershed protection efforts and New York City is one of them. This saved them the enormous costs of building and running a filtration plant, the cost of which would have easily doubled water and sewer rates for New York residents (Appleton, 2006). The watershed management approach was thus spurred by the desire for cost savings.

As a quirk of history, New York City has the authority to directly regulate the watersheds from which it obtains its drinking water (within a 125 mile radius of the city); however, it met enormous resistance when first attempting to do so. Farmers made clear to the city that regulations would force them to bear significant costs and were angered at this direct hit on profits solely for the benefit of urban-dwellers miles away. The city decided to back-peddle on direct regulations and instead entered into negotiations with the farmers. The end result was an agreement to compensate farmers in the region for upgrades that improve water quality. In addition, the city realized it preferred agriculture to development in the watershed and is working to keep farming in the region viable. The final agreement was voluntary at the level of the individual farmer, but had a required participation percentage, which, if not met, would trigger the city to begin regulatory actions.

A new institution was developed to run the farm program, the WAC, mentioned earlier. It is a locally controlled non-profit. The WAC and the improvements it oversees on farms are funded by the New York City Department of Environmental Protection (DEP), as well as



some funds from federal agencies. Local control was critical to achieving farmer agreement. For farmers struggling economically, not only are they relieved of having to bear the costs of improving the city's drinking water (something argued as highly inequitable), but they are receiving aid for improvements that provide them with other benefits (discussed further below).

Brief description of results and impacts of the proposed EPI

The WAP program has saved the DEP billions of dollars. It has also worked to preserve agriculture in the Cat-Del watershed. Farmers were having a difficult time making a viable living and development pressure was forcing some farmers to sell their land to developers. New York City's commitment to agriculture—environmentally-friendly agriculture—has helped the local economy.

Water quality has been improved. New York City water is constantly monitored by the DEP. Their website notes that the department undertakes 330,000 tests of the water each year from 1,000 locations in the city as well as 230,000 tests in the watershed. Water quality has been high enough that the city has been able to avoid filtration in the 14 years since the original MOU was signed. That said, the issue cannot be considered "solved," as water quality threats remain, particularly from ex-urban development, which is not addressed in the farm program.

Conclusions and lessons learnt

The WAP is heralded as a template other localities should follow by a variety of groups from environmentalists to policy analysts. The WAP proved that voluntary programs can work—at least when everyone has something to gain from the program and supports its overarching mission. The WAP, in conjunction with the city's other efforts in the watershed, has also demonstrated that watershed management can cost-effectively produce high-quality drinking water. This can be done in a working agricultural landscape, and thus, the program has also shown that the economic viability of farming and environmental protection need not be at odds. It is unlikely the city's approach would have worked in a watershed that was much more developed, however. The only other cities in the US that have been able to avoid filtration through watershed management have a substantial portion or all of their watersheds in public ownership. Much of the Cat-Del watershed is forested, 20% is preserved in a state park, and the other development is not very intensive. New York City's policy is thus limited in applicability, as many other communities in the US draw water from heavily developed watersheds. Finally, it is unlikely New York City would have invested the time or resources in watershed management if not facing the unthinkable high costs of filtration if it failed to do so.



Water Budget Rate Structure: Experiences from Urban Utilities in California (#27)

Ariel Dinar Water Science and Policy Center, University of California Riverside

Definition of the analysed EPI and purpose (heading level 2)

The Economic Policy Instrument to be analysed in this report is the so-called The Water Budget Rate Structure (WBRS). A WBRS is basically a tiered pricing system, based on marginal cost pricing that allows the water utility to tailor the rate structure essentially to each household served on the one hand and to secure the recovery of the fixed operational costs of the water utility. WBRS have four purposes: (1) conservation of scarce water resources, (2) financial stability of the water utilities even during periods with very small water consumption, (3) equity and satisfaction of customers, and (4) funding of conservation and environmental programs without raising taxes on customers.

Introduction

Being in a semi-arid climate, California has faced frequent and prolonged droughts. In a typical policy intervention to facing less water to allocate, state agencies and water utilities responded (in the urban sector) by either cutting water allocations to users or by dramatically increasing water tariffs, or both. The prolonged drought of 1986-1991 has resulted in many cases where water utilities went bankrupt, due to the fact that the conservation impact of their water pricing decreased dramatically the demand for water and the stream of revenue to cover their fixed costs. This has led to the introduction of the WBRS in Southern California, but with the improved water situation the pace of implementation was not impressive.

Drought returned to California in 2007, and lasted until 2011. Water use was restricted throughout the State. Local retail agencies established water moratoriums, particularly for irrigation and agricultural water. At the same time agencies experienced significant revenue shortfalls. The same scenario that prompted the 1st water budget rate structure in 1991 was again at play for agencies in California and throughout the US, where drought was affecting both arid and typically wet regions.

Starting 2008, with the slowdown in economic activity in the state of California, water pricing rates had to be adjusted, revenues of water utilities declined, and customers that saved water have faced increased rates again and again.

The impact of the coupled effect of the increased tiered pricing and the recent economic slowdown in Southern California on the demand for water by households culminated in two important phenomena:

1. Complaints on the part of customers about fairness of existing tier rates that do not distinguish between household characteristics, and



2. Sever concerns on the part of the water utilities regarding reduction in revenues that jeopardize the ability of the utility to cover not only its fixed cost but also part of its variable costs.

The WBRS has emerged as a practice that allows water utilities achieve several objectives, mainly obtain high level of conservation without jeopardizing the financial and political stability of the water utility.

Legislative setting and economic background

This EPI is supported by various state legislations, and follows various bills since the passing of (Assembly Bill) AB 325 of 1990. In 2004, AB 2717 passed, which requested the California Urban Water Conservation Council (CUWCC) to evaluate and recommend proposals for improving the efficiency of water use in new and existing urban irrigated landscapes in California. Based on this charge, the Task Force adopted a comprehensive set of 43 recommendations, essentially making changes to the AB 325 of 1990 and updating the Model Local Water Efficient Landscape Ordinance. The recommendation of the bill charges (the State Department of Water Resources) DWR in updating the Model Efficient Landscape Ordinance and to upgrade (California Irrigation Management Information System) CIMIS.

The Water Conservation in Landscaping Act of 2006 (AB 1881) enacted many, but not all of the recommendations reported to the Governor and Legislature in December 2005 by the CUWCC Landscape Task Force. AB 1881 requires DWR, not later than January 1, 2009, by regulation, to update the model ordinance in accordance with specified requirements, reflecting the provisions of AB 2717. AB 1881 requires local agencies, not later than January 1, 2010, to adopt the updated Model Ordinance or equivalent or it will be automatically adopted by statute. Senate Bill (SB) 7 (approved on 12/2009) requires the state of California to achieve a 20% reduction in urban per capita water use by December 31, 2020.

This comprehensive legislative setting provide water utilities with the necessary legal support for the introduction of the Water Budget Rate Structure, by allowing them to implement measures that would lead to conservation while keeping their financial stability and customer satisfaction.

Brief description of results and impacts of the proposed EPI

WBRS has been practiced in more than a dozen water utilities in Southern California since 1991. Irvine Ranch Water District (IRWD) pioneered the WBRS since 1991. Eastern Municipal Water District (EMWD) implemented WBRS in late 2008, and Western Municipal Water District (WMWD) implemented WBRS only in October 2011. Each of these utilities started from a different situation, existing tiered pricing system, composition of customer groups, and water scarcity. All 3 utilities reported of impressive successes, including the one month experience of WMWD. A brief account of the results includes:

For IRWD: (1) 61% reduction in landscape irrigation water use (dedicated irrigation meters); (2) 25% residential water use reduction; (3) Stable fixed revenue recovery; (4) Reduced water



runoff (water quality improvement) (MWDOC-IRWD 2004); (5) Fully funded conservation programs (paid only by water wasters); (6) 85% customer satisfaction (independent customer surveys); (7) re-election of all water board members since 1991, indicating management stability.

For EMWD: (1) water use reductions of 13% (over drought use); (2) revenue increase of 6%; (3) accumulation of capital for funding for conservation programs.

For WMWD there is no sufficient experience for evaluation of results except for results that can be derived from the implementation process that went relatively smooth and trouble-free. Customers had a 98% approval rate of the WBRS prior to its implementation and following a process of discussion as required by the law in California.

Conclusions and lessons learnt

The main conclusion from the long-term experience and the short-term experience with WBRS is that the better the transparency of the rules by which the WBRS will be operated, and the education of the customers and the infrastructure and institutions needed for this EPI the more successful is its implementation in terms of acceptance, and effectiveness. Another conclusion is that the level of success is also a function of the level of detailed information the utility can obtain about the environmental factors in various parts of the service area. In particular, the ability to move from 3 to 50 and 200 climatic zones in the case of IRWD, EMWD and WMWD, respectively, increased the fine tuning of the WBRS and its performance. Finally, having the wholesale agencies in California adopt a water budget methodology to set standards for retail agencies and pricing triggers for excessive water purchases would improve the overall efficiency of the water system in the state of California.

Case Study of China (#28)

Xiaoliu Yang

China's industrial growth has been extremely rapid in the past two decades, with an annual growth rate of about 15% in the 1990s. While this has helped lift tens of millions of people out of poverty, serious environmental deterioration has accompanied this rapid growth.

Prior to 2000, policy instruments in China consisted mainly of taxes and fees and focused mainly on post-pollution management. After 2000, market-based instruments (e.g., discharge permit trading and ecological compensation) attracted more attention but the use of environmental economic instruments is still ad hoc and unsystematic.

Existing policies stress post-pollution management rather than ex-ante reduction and water environment protection. The motivation behind the participation of certain agencies in pursuing environmental economic policies was often self-interest rather than the greater good. This has resulted in a certain level of policy chaos, making environmental economic policies less useful for environmental management and reducing the effectiveness of policy implementation.

China has used environmental economic policy instruments in various forms almost since the start of the initiation of water pollution control policies in the early 1970s, although, even today, they remain supplemental to the command and control system.

Current economic policies to protect water quality include:

- environmental taxes, pollution levies, and wastewater treatment tariffs;
- emissions trading markets (e.g., water pollutant discharge permit trading, watershed water rights trading, and ecological and environmental compensation);
- guaranteed deposits; and
- subsidies and incentives (e.g., subsidies to enterprises for pollution reduction and special subsidies for the construction and operation of municipal WWTPs).

This case study analyses three EPIs in China in depth, namely:

- Pollution charges for industry
- Abstraction charges and Irrigation water pricing
- Phasing out farm input subsidies



Nitrogen Permit Trading in North Carolina's Neuse River (#29)

Andrew J. Yates (University of Richmond)

Definition of the analysed EPI and purpose

This EPI case study analyzes Nitrogen permit trading in North Carolina's Neuse River Basin. This case study was selected to inform the regulation of water quality in the United States under the Clean Water Act. The Clean Water Act covers literally thousands of point sources of water pollution across the United States. Moving from the traditional regulation of these point sources to a properly designed EPI with active trading could potentially generate hundreds of millions of dollars in net benefits to society.

Introduction

The environmental goal of the EPI was to reduce emissions of Nitrogen into the Neuse from municipal waste water treatment plants (WWTP). The EPI was extremely successful in meeting the environmental goal, as actual emissions are 52 percent below the emission target. The economic goal was to minimize the aggregate cost of meeting the emission target by allowing WWTP to trade emission permits. The EPI did not successfully meet the environmental goal for theoretical and practical reasons. The design of the EPI could be improved by restricting trading to occur within zones, rather than having only one single large zone. The practice of the EPI could be improved by encouraging WWTP to make trades. As it stands, very few trades were executed between the WWTP.

Legislative setting and economic background

Under the United States' Clean Water Act, the Neuse River Estuary in North Carolina has been declared a section 303(d) impaired water. In the EPI, the state of North Carolina, in conjunction with the EPA, has crafted a more flexible program than the typical 303(d) regulation. A wastewater plant is given a permit to emit Nitrogen into the Neuse River. This implicitly defines a property right, which the plant may permanently sell or temporarily lease. The trading of these rights is approved by North Carolina statute.

Brief description of results and impacts of the proposed EPI

The EPI met the environmental goal but did not meet the economics goal. Although the EPI did not actually improve economic efficiency, it did generate benefits on several social equity dimensions. In particular, stakeholders report improved public image, information sharing, political representation, and social benefits from participating in the EPI.



Conclusions and lessons learnt

The main lessons learned from the analysis of the EPI are: (1) the cost savings from emissions trading predicted in theory will not be attained in practice unless the stakeholders fully endorse the concept of trading, and (2) cooperation between stakeholders and the various levels of government has the potential to create innovative market approaches to environmental regulations.



The Chilean Water Allocation Mechanism, established in its Water Code of 1981 (#30)

Guillermo Donoso Harris

Definition of the analysed EPI and purpose

The Water Code (WC) of 1981 established that water user rights (wur) are transferable in order to facilitate wur markets as an allocation mechanism. "The objective of the governmental action in this field was to create solid water use rights in order to facilitate the proper operation of the market as an allocation mechanism" (Buchi, 1993, pp 85-87). Thus the WC 1981 was designed to protect traditional and customary wur and to foster economically beneficial reallocation through market transfers (Bauer, 2004; Buchi, 1993; Hearne and Donoso, 2005).

Introduction

The WC 1981 specifies rights consumptive wur for both surface and groundwater, and non-consumptive wur for surface waters. Non-consumptive use rights allow the owner to divert water from a river with the obligation to return the same water unaltered to its original channel. Consumptive use rights do not require that the water be returned once it has been used. Consumptive and non-consumptive wur are, by law specified as a volume per unit of time. However, given that river flows are highly variable in most basins, these wur are recognized in times of scarcity as shares of water flows. This characteristic of wur, which combines volumetric maximum amounts per unit time in times of plenty, with shares in times of scarcity has proven to be appropriate, since the use of a system of use rights defined as pure shares precludes any excess water use for other uses such as environmental objectives since it would lead to full use of water by the current holders of wur (World Bank, 2011). The WC 1981 allowed for freedom in the use of water to which an agent has wur; thus, wur are not sector specific. Additionally, wur do not expire and do not consider a "use it or lose it" clause.

Legislative setting and economic background

The first Chilean text to regulate the use of water is an 1819 Executive Decree which defined the dimensions of an irrigating system, form of sale, and responsibility for water intakes. The 1855 Civil Code was the first instrument to define how "the rivers and all waters running within natural channels are national goods of public use". In addition, it establishes that access to water is obtained by means of water-use rights "*granted by the competent authority*". The concept of "Water-Use Right" was further developed in the 1930 and 1951 Water Codes. The latter code defines water use rights (wur) as follows: "*The water right is an actual right that falls on publicly owned waters and which consists in the use, possession and disposal*".



of such waters fulfilling the requirements and in accordance with the rules prescribed herein.” (Hearne and Donoso, 2005). It is important to note that granted wur do not constitute a transfer of ownership of the water.

The 1967 Water Code, implemented in a more centralized political context, reinforces the concept of water as being within the public domain and changed the legal nature of wur, stressing that these were administrative rights where the State grants the use of the waters, subject to public regulation. During this period, land and water-use rights were expropriated without compensation, and water was to be reallocated in accordance with state planning (Bauer, 1998). However, it is important to point out that the 1967 Water Code was not fully implemented due to lack of institutional capacity and resources during the Allende government (1970–1973).

Following the military coup in 1973, the government introduced neo-liberal economic policies which supported private property rights and free markets. The first step towards the new WC 1981 occurs in 1979 with the Executive Decree 2.603 which recognized customary and historical wur. This decree strengthened the security of private ownership of wur, separating wur from land ownership. The WC 1981 maintained water as “national property for public use,” but granted permanent, transferable water-use rights to individuals so as to reach an efficient allocation of the resource through market transactions of wur.

Brief description of results and impacts of the proposed EPI

Until the 90's, environmental and water management policies did not pay much attention to meeting water requirements for environmental purposes and thus, evidence shows that the totality of river flows was allocated. This has led to the deterioration of aquatic ecosystems in semiarid and arid regions of Chile. This gradually changed with the introduction and continuous improvement of the System of Environmental Impact Assessment (SEIA) in 1994 and with the WC 1981 reform in 2005 which imposed the obligation to establish a minimum ecological flow.

The WC 1981 did not pay much attention to the sustainable management of groundwater because at that time, groundwater extraction was marginal. Recognizing the need to improve groundwater management regulation due to increased groundwater pumping, the 2005 amendment of the WC 1981 introduced procedures to reach a sustainable management of underground water resources. World Bank (2011) concludes that these groundwater regulations have not been fully implemented over time and thus, there exist various problems associated with groundwater management.

Jouralev (2005), based on a survey of the literature on wur markets in Chile concludes that these markets have helped to (i) facilitate the reallocation of water use from lower to higher value users (e.g. from traditional agriculture to export-oriented agriculture and other sectors



such as water supply and mining), (ii) mitigate the impact of droughts by allowing for temporal transfers from lower value annual crops to higher valued perennial fruit and other tree crops, and (iii) provide lower cost access to water resources than alternative sources such as desalination.

Studies have shown active trading for wur in the Limarí Valley, where water is scarce with a high economic value, especially for the emerging agricultural sector (Hearne and Easter, 1997; Donoso, *et al.*, 2001; Hadjigeorgalis, 2004; Zegarra, 2002). Inter-sectoral trading has transferred water to growing urban areas in the Elqui Valley (Hearne and Easter, 1997) and the upper Mapocho watershed, where water companies and real estate developers are continuously buying water and account for 76% of the rights traded during the 1993-1999 period (Donoso *et al.*, 2001). Other studies have shown limited trading in the Bío Bío, Aconcagua, and Cachapoal Valleys (Bauer, 1998; Hadjigeorgalis and Riquelme, 2002). In all of these studies some permanent transactions of water-use rights have occurred. During the 2000s, the market was more active than in the previous two decades, 1980's and 1990's.

Consumptive wur transaction data based on data of the RPA of the DGA, for the period 2005 - 2008 show that there were 24,177 wur transactions of which 92.3% were independent of other property transactions, such as land. The value of wur transactions independent of other property transactions is U.S. \$ 4.8 billion, which on average is U.S. \$ 1.2 billion per year. The average wur price is US \$ 615,623 per wur. Wur prices in the north of the country are greater than in the South, which indicates that the market at least in part reflects the relative scarcity of water.

Increased consumptive wur market activity has generated increased conflicts with downstream users due the existence of wur over return flows. The consumptive wur entitles the holder to totally consume the water taken in any activity. However, in practice, almost all consumptive wur holders generate significant return flows (leakage and seepage water) that are used by downstream customary wur holders. At present it is not known how many regularized or non-regularized customary wur are dependent on return flows. Thus, it is extremely difficult for the DGA to foresee potential third party effects associated with wur transfers that alter return flows.

Despite a legal separation between land and water rights, many Chilean farmers maintain that water and land should not be separated. This traditional integration of land and water has kept many farmers from offering water for sale without also selling the corresponding land.

Conclusions and lessons learnt

A key conclusion of these studies is that water markets are more prevalent in areas of water scarcity. They are driven by demand from relatively high-valued water uses and facilitated by low transactions costs in those valleys where WUAs and infrastructure present assist the



transfer of water. In the absence of these conditions trading has been rare and water markets have not become institutionalized in most valleys (Hearne and Donoso, 2005).

The activity of the markets increased over time due to a slow maturation in the public's knowledge concerning the new legislation. In a sense, the 80s represented a preparatory stage in bringing the new Code into full operation, in social, political and economic terms.

The Chilean wur markets are characterized by a large price dispersion for homogeneous wur (Cristi and Poblete, 2010). This large price dispersion is due, in great part, to the lack of reliable public information on wur prices and transactions. Given the lack of reliable information, each wur transaction is the result of a bilateral negotiation between an interested buyer and seller of wur where each agent's information, market experience and negotiating capacity is important in determining the final result (Donoso, Melo and Jordan, 2011).

The problems that water use rights market have not been able to resolve are: water use inefficiency in all sectors, not only in the agricultural sector, environmental problems, and the maintenance of ecological water reserves.

The elements that have hindered wur market effectiveness are the:

- a) Lack of wur and wur market information.
- b) Lack of regularization of customary wur.
- c) Existence of transaction costs
- d) Lack of a rapid, efficient controversy resolution system.

Finally, 13 key lessons learned are elaborated upon