Chapter 3

The value added of economic instruments

A range of mechanisms can be used to transfer some of the costs of water resources management activities from the public purse to the beneficiaries of water management, including (see Rees, Winpenny and Hall, 2008, for more information):

- Regulatory levies. These are increasingly being used to recover regulatory costs from the regulated parties. The classical example is water licensing fees – when the fee is set to pay only for the administrative cost of issuing a license to abstract water. Other examples include the pollution control tax in Spain (to pay for enforcement by river basin agencies) or the research charge in South Africa.
- Pollution and abstraction charges or taxes. They are based on the user-pays and polluter-pays principles. They include charges associated with non-tradable abstraction, consumption or pollution permits, and effluent or pollution charges. They aim to recover costs and to internalise negative externalities associated with water abstractions or polluting activities. As a proxy, most charges are set to cover the costs of investment programmes aimed at environmental improvements.
- Payments for ecosystem services. In some cases, downstream beneficiaries pay to regulate or preserve or restore upstream environments (*e.g.* flood management), as they benefit from activities made by others to reduce water consumption or pollution. Upstream land and water users/polluters receive compensation to provide environmental services and avoid damaging practices.
- Permit markets: Markets for abstraction and pollution permits are created to: *i)* facilitate market-regulated water permit reallocation

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

under scarcity conditions; and *ii)* provide incentives for pollution abatement and technological improvements, by allowing polluters who can outperform environmental standards to sell excess pollution rights.

Theoretical and empirical economic analyses suggest that price-based approaches to water conservation are more cost-effective than non-price approaches. In the case of domestic water uses, Olmstead and Stavins (2007) note that the "gains from using prices as an incentive for conservation come from allowing households to respond to increased water prices in the manner of their choice, rather than by installing a particular technology or reducing particular uses, as prescribed by non-price approaches". Therefore, appropriate water pricing can lower financing requirements for water resources management.

OECD countries are gaining experience with abstraction, pollution/effluent charges and other economic instruments – such as tradable water rights or payment for watershed services – to achieve more economically efficient, socially equitable and environmentally sustainable abstraction and allocation among competing uses. This section compiles some of the lessons learned from this experience as regards water management financing.[1] It concludes with a note of caution: economic instruments operate better under specific conditions, which have to be identified and met.

Economic instruments for water management

A wide array of economic instruments is available to manage water. Table 3.1 provides an inventory.

Table 3.1. **Possible economic instruments for water management**

Possible economic instruments	Advantages of use
Marginal social cost pricing, incorporating the scarcity value of water (a combination of user tariffs and abstraction charges)	Signals the optimal time to invest in water infrastructure so that supply is augmented efficiently Reduces demand for water during periods of scarcity
International and regional water markets	Allows trade of water from areas of surplus to increase the water supply in areas of scarcity Allows trade of water from low to high value uses creating incentives to use water efficiently and reduce demand
Buy-backs of water use rights	Secures water for environmental flows and offsets economic losses
Emission permit trading for point and nonpoint pollution	Allows pollution to be reduced from the lowest cost sources
Emission taxes and pollution charges	Creates ongoing incentive for all sources to reduce pollution
Insurance schemes[2]	When premium reflect risks level, insurance schemes can reduce the exposure of economic assets to (flood) risks and provide incentives to locate in low-risk areas.

Source: adapted from Grafton, Q. (2011), *Economic Instruments for Water Management*, paper submitted to the OECD Environment Directorate [ENV/EPOC/WPBWE(2011)13].

Economic theory (Thomas Tietenberg, in particular) suggests that economic instruments work best when they are designed to address one particular objective. It follows that water policies should rely on a combination of economic instruments. The French approach combines seven taxes (see Box 3.1).

Box 3.1. **Eight taxes to manage water in France**

Since January 1st, 2008, French water agencies charge seven types of taxes, defined as follows:

- Tax on water pollution. For households, the tax is based on the annual volume of water billed. For cattle breeders, the tax is based on the size of the cattle. For industries, the tax is based on annual pollution discharged to the environment.
- Tax for modernisation of the waste water drainage system. It is paid by all users connected to a sewerage system and based on volumes of drinking water supplied.
- Tax on diffuse agricultural pollution. It is paid by retailers of pesticides.
- Tax on the abstraction of water resources. Paid by any water user, it is based on annual volume of withdrawals. Rates depend on water uses and water bodies.
- Tax for storage in low water periods (paid by owners of water reservoirs).
- Tax on obstacles on rivers.
- Tax for the protection of aquatic environments; it is a tax on fishing paid by fishermen through unions.

Recently, local authorities have been granted the right to levy a tax to finance urban storm water management.

Source: Bommelaer, O., J. Devaux (2012), "Financing Water Resources Management in France", *Études & Documents* No. 62, January 2012, MEDDTL, Paris; additional information is appended. Centre d'Études sur les Réseaux, les Transports, l'Urbanisme et les Constructions Publiques (French Centre for Studies on Networks, Transport, Town Planning and Public Building, CERTU) (2012), *Taxe pour la gestion des eaux pluviales urbaines* (Tax on urban rainwater management), *Fiche No. 3*, March 2012.

The following sections explore how such instruments are used to finance water resources management.

Abstraction charges in OECD countries

Abstraction charges in OECD countries are often designed to provide funding for water resources management or for watershed protection

activities. However, they seldom reflect water scarcity and tend to be relatively low.[3] Abstraction taxes imposed on groundwater tend to be higher than on surface water. In most cases, charges are collected and retained locally.

The form taken by taxes and fees/charges and the basis for their calculation vary considerably by country and sector. Charges can take the form of a nominal license fee linked to an abstraction permit regime, a volumetric charge varying with abstraction or consumption volumes, or a flat or variable charge linked with other criteria (*e.g.* area of industrial estates).

Table 3.2 builds on the most recent information in the OECD/EEA database on economic instruments for environmental policies. They may therefore not be comprehensive.

In Canada, most provinces levy licence fees to major water users for access to the resource. The provincial licence fees for water are related to the cost of administering the licensing programme. These are regulatory levies and not abstraction charges.

In Germany, abstraction charges have been introduced with the dual objective of decreasing abstractions and raising revenues for use in environmental protection measures. Revenues have been used for nature conservation, protection of ground and surface water, reforestation, soil protection and decontamination. In seven Länder (in Berlin, for example), part of the revenue is earmarked for groundwater protection.

In Portugal, since 2008, water supply and sanitation service providers include abstraction charges in the retail tariffs, dependent on the actual use and the type of user. The proceedings are earmarked to a water protection fund (50%), or finance Basin Water Authorities (ABH; 40%), and the National Water Authority in charge of water resources management (INAG; 10%).

Pollution charges in OECD countries

More countries report the use of pollution charges than abstraction charges. Pollution charges can be linked to different characteristics of the polluter (*e.g.* its sector, processes), the effluents (volume or pollutant concentration), or the recipient water body.

Table 3.3 summarises the characteristics of pollution charges in selected countries for which information is available in the OECD/EEA database (unless otherwise specified). These charges can represent a significant share of the water bill (about one-third of water supply and sanitation bills for households, in the case of France, as an illustration).

Table 3.2. **Abstraction charges in selected OECD countries, 2011**

Country	Levied by	Tax name	Specific tax base	Tax rate	
Belgium/ Flanders	Regional administrations	Groundwater tax	Quantity of used groundwater; varies per user type	0.0603	EUR per m³ groundwater (minimum rate for 2011)
Belgium/ Wallonia	Regional administrations	Groundwater tax	Quantity of used groundwater		
Canada	Province	Water Abstraction Permit Fees	Varies per user type and per type of use		
Czech Republic		Charge for withdrawal of groundwater	Underground water abstraction for drinking water supply	0.0813	EUR per m³.
Czech Republic		Charge for withdrawal of groundwater	Underground water abstractions for other purposes	0.122	EUR per m³.
Denmark		Water charges	Water consumption	0.9734	EUR per m³ on average (2003)
Estonia		Water abstraction charge	groundwater (distinction by aquifer) and surface water		
France	Basin	Charge on water abstraction	Water abstraction		
France	City	Charge on water consumption	Consumption of public potable water		
Germany	Land	Water abstraction charge	for groundwater, surface water; per type of use		
Greece		Charge on irrigation water	Irrigation water		
Hungary		Charge on water abstraction	Water abstractions; varies by water source and region		Effective rate up to EUR 0.04 per m³

Table 3.2. **Abstraction charges in selected OECD countries, 2011** *(continued)*

Country	Levied by	Tax name	Specific tax base	Tax rate
Israel		Water extraction levy	for different uses; per season	
Italy	Regions	Charge on water services	Water services – domestic use	
Japan	Local govt	Charge on abstraction of water from rivers	Quantity of river water abstracted	
Korea	Municipalities	Water use charge	per river	0.1037-0.1102 EUR per m³
Mexico	Treasury	Charge on water use	Per user type, source and location	
Netherlands		Tax on groundwater extraction	Extracted groundwater	0.1826 EUR per m³
Netherlands		Tax on tap water	Tap water delivered to a consumer	0.147 EUR per m³
Poland		Charge on groundwater abstraction	per type of use	0.015-0.0255 EUR per m³
Poland		Charge on surface water abstraction	per type of use	0.009-0.0128 EUR per m³
Slovenia		Payment for water rights	per type of use	
Slovenia		Water abstraction charge	per type of use	
Spain	Province	Charge on water	per type of use	
UK		Abstraction Charges	Water resources	0.005 EUR per m³ on average

Source: OECD/EEA database on instruments used for environmental policy and natural resources management.

Table 3.3. **Pollution charges in selected OECD countries**

Country	Levied by	Tax name	Specific tax base	Tax rate	
Australia	State	Water effluent charge	volume, pollution content (17 types of pollutants)	0.0015	EUR per kg assessable load.
Belgium/ Flanders		Waste water charge	Volume and pollution content	0.8968	EUR per m³ drinking water.
Belgium/ Wallonia		Waste water charge	per type of use and reuse (for manure spreading)		
Canada	Province	Charge on discharge	Volume and pollution content	70.7074	EUR per tonne.
Czech Republic		Fee for discharge of wastewater into groundwater	Pollution content	14.2285	EUR per year. (1 equivalent citizen due to the capacity of the sewerage plant)
Czech Republic		Fee for discharge of wastewater into surface water	Emissions of organic substances	0.6504	EUR per kg.
Denmark		Charge on sewage discharge	Water consumption	2.1989	EUR per m³ on average
Denmark		Duty on wastewater	Nitrate, phosphate or organic content in wastewater	2.6816	EUR per kg.
Estonia		Sewage charge	industry, households	0.9- 4.33	EUR per m³.
Estonia		Water pollution charge	per substance	11731	EUR per tonne.
Finland		Wastewater user charges	Water consumption or waste water volume/quality (larger sources) + fixed components	2.28	EUR per cubic metre (in total) on average in Feb 2011
France	Basin	Wastewater user charges	Water consumption		Varies by municipality
France	Basin	Water effluent charges	Volume of pollutants discharged by industries		Varies by water agency.
Germany	Land	Wastewater charge	Pollution load (noxiousness)	35	EUR per unit of noxiousness.

Table 3.3. **Pollution charges in selected OECD countries** *(continued)*

Country	Levied by	Tax name	Specific tax base	Tax rate	
Greece		Wastewater charges	Municipal and industrial wastewater		NULL
Hungary		Wastewater charges	industry, households	0.11 – 3.43	EUR per m³.
Hungary		Water load charge	per substance	156.7417	EUR per kg.
Italy		Charge on water services	Water services – sewer		a monthly fixed amount defined by municipalities
Japan		Wastewater user charges	Municipal multipurpose septic tanks		Varies by municipality.
Korea		Sewage treatment fee	Municipal wastewater		National average was EUR 0.18 per tonne in 2010.
Korea		Water effluent charges	per substance (18 types of pollutants)	64.8223	EUR per kg.
Mexico		Water effluent charges	Quantity of wastewater in excess of permissible contents of COD and TSS		Varies with the carrying capacity of the recipient body.
Netherlands		Municipal sewerage charge	Discharge of household wastewater		Rates are locally determined per household, differentiated according to the number of members.
Netherlands		Tax on the pollution of surface waters	BOD, COD and heavy metals, for large polluters	31.76	EUR per pollution unit
Norway		User charges on wastewater treatment	The fee reflects the actual cost of wastewater treatment, and must be calculated on the basis of the principle of full cost recovery.		Varies between municipalities
Poland	Region	Water effluent charges	based on temperature, pollution load	0.15	EUR per 1000 m³.
Slovak Republic		Charge for discharging of wastewater	pollution content	4.3206	EUR per kmol.

Table 3.3. **Pollution charges in selected OECD countries** *(continued)*

Country	Levied by	Tax name	Specific tax base		Tax rate
Slovenia		Wastewater collection and treatment charge	Consumption of water		Varies between municipalities
Slovenia		Wastewater pollution tax	Unit of pollution	26.4125	EUR per unit of pollution
Spain	Basin	Tax on wastewater treatment	Pollution content and location		EUR 0.0167*(diameter^2 + 225N) per household per 2 months; N number of dwellings or commercial activities
Sweden	Municipality	Wastewater user charges	Wastewater and drinking water		Varies by municipality; full cost charging.
Sweden		Water pollution fee	Oil spill		18-51 basic amounts + 0.04-0.12 basic amounts per 1 000 litres above 101 000 litres, depending on the size of the ship.
Turkey		Charge on water pollution	Registration of water pollution control charge		
Turkey		Wastewater user charges	Municipal and industrial wastewater volumes		Varies by municipality
United States	State	Wastewater user charges	Water consumption, or discharge toxicity (larger sources)	11.4556	EUR per month for households on average (1994)
United States	State	Annual waste discharge license fees		11.7	EUR per million litres.

Source: OECD/EEA database on instruments used for environmental policy and natural resources management.

Putting a price on water

Putting the right price on water and water-related services encourages people to waste less, pollute less, invest more in water infrastructure and value watershed services. Pricing water can serve four objectives:

- Along with tax incentives and transfers, tariffs on water-related services generate finance to cover investment and operation and maintenance costs.
- It helps to allocate water among competing uses.
- It can manage demand[4] and discourage depletion of water resources.
- Appropriate tariffs ensure adequate and equitable access to affordable water and water-related services.

Efforts are being made in OECD countries to better account for the costs and externalities of water use by households and industrial users (OECD, 2010a). This is reflected in the level of prices (which have increased, at times substantially, over the last decade) and in the structure of tariffs (which better reflect consumption and treatment costs). Water tariffs in Denmark reflect the choice to recover all supply and sanitation costs from users (see Box 3.2).

Box 3.2. **Full-cost water pricing in Denmark**

Since 1992, urban water prices in Denmark have been based on full-cost recovery so that prices cover both economic (through user charges) and environmental costs (through taxes). All urban water users are metered and water prices are charged according to the volume consumed. Since the policy's introduction, water prices have risen substantially; during the period 1993-2004, the real price of water (including environmental taxes) increased by 54% and prices are now among the highest in the OECD. The rise in prices has led to a substantial decrease in urban water demand from 155 to 125 litres per person per day, one of the lowest levels in the OECD. Since water pricing is purely volumetric, there are no social tariffs and the affordability of water services is ensured through separate social policy.

Source: OECD (2008a), *OECD Environmental Performance Reviews: Denmark 2007*, OECD Publishing, Paris. DOI : *http://dx.doi.org/10.1787/9789264039582-en.*

The level of prices for water supplied to farms has risen in OECD countries. Frequently, however, farmers are only paying the operation and maintenance costs for water supplied, with little or no recovery of capital costs of irrigation infrastructure. Water scarcity and environmental costs

are rarely reflected in irrigation water prices. This often results from claims that higher water prices will undercut farmers' competitiveness on global markets. Spain illustrates a move towards a better account of the capital and resource costs in irrigation water (see Box 3.3). Pricing policies for farmers are often combined with other (regulatory) instruments, such as abstraction thresholds and permits.

Box 3.3. **Accounting for capital and resource costs for irrigation water in Spain**

In Spain, water pricing based on surface irrigated is still widespread in gravitation-based irrigation. However, in May 2009, a ministerial order introduced the obligation (to be implemented gradually), to meter all water consumption, regardless of the type of consumptive use, although the obligation may not apply to individual final consumers. The government aims to introduce two-part tariffs, with a surface component to reflect fixed infrastructure costs and a per-unit volume component in irrigation on the basis of this newly introduced obligation. The government also removed the subsidised tariffs for electricity in irrigation, leading to an increase of costs by 60%, which resulted in some irrigation being abandoned. This measure is appropriate as subsidies for energy, by reducing pumping costs, contribute to excessive extraction of water, especially in the case of groundwater, which has proven difficult for the authorities to control. There has been pressure to reduce the impact of the deregulation on farmers' irrigation costs, although the share of irrigation costs to total costs in farming is often modest, especially where water productivity is relatively high.

Source: Fuentes A. (2011), "Policies Towards a Sustainable Use of Water in Spain", *OECD Economics Department Working Papers*, No. 840, OECD Publishing, Paris. DOI: *http://dx.doi.org/10.1787/5kgj3l0ggczt-en*.

Increasingly, wastewater charges are being introduced to cover wastewater management costs. Most countries levy separate charges for sewerage and for wastewater treatment, although in most cases the basis for charging remains water consumption. Only the size of the volumetric rate differs.

The pricing of water supply and sanitation services to industry is a little different to household tariff structures. For example, more countries and regions use decreasing block water tariffs for industry, particularly for large users. The desire to keep large customers that provide substantial local and stable revenues seems to inhibit the use of tariff structures that would encourage less water use. With regard to wastewater management, there is a growing use of separate charges for wastewater collection and for wastewater treatment, with the latter increasingly based on the pollution load of industrial effluents, thus better reflecting actual treatment costs.

Innovative instruments to finance water resources management

There is increasing use of innovative policy tools to finance water management. A variety of water funds aim to secure funding for water infrastructure.

In the US, Clean Water and Drinking Water State Revolving Funds have been instrumental in leveraging federal budgets. For the financial year 2010, the U.S. Environmental Protection Agency (EPA) requested USD 3.9 billion for Clean Water and Drinking Water State Revolving Funds (SRFs) for funding water infrastructure projects. This represents about 40% of the total budget request of USD 10.5 billion, a 157% increase as compared to the previous year. The Clean Water and Drinking Water SRFs provide grants to states to capitalise their own revolving funds. The SRFs generate funding for loans even without Federal capitalisation, as repayments and interest are recycled back into the program. EPA estimates that for every Federal dollar invested, approximately two dollars in financing is provided to the municipalities (USEPA, 2009).

Box 3.4. **Water funds to finance conservation and water supply in Latin America**

Water users pay into the funds in exchange for the product they receive – fresh, clean water. The funds, in turn, pay for forest conservation along rivers, streams and lakes, to ensure that safe drinking water flows out of users' faucets every time they turn on the tap.

Some water funds pay for community-wide reforestation projects in villages upstream from major urban centres, like Quito, Ecuador, and Bogotá, Colombia. In other cases, like in Brazil's Atlantic Forest, municipalities collect fees from water users and make direct payments to farmers and ranchers who protect and restore riverside forests on their land through water producer initiatives.

These "water producers" are being compensated for a service they provide to people downstream in Rio de Janeiro and São Paulo. They receive USD 32 per acre, per year, for keeping their riverside forests standing.

The Water Producer concept was first developed by Brazil's National Water Agency (ANA), which has been partnering with the Nature Conservancy in the implementation of the projects across Brazil.

Source: The Nature Conservancy; see *www.nature.org/ourinitiatives/regions/latinamerica/water-funds-of-south-america.xml.*

China accumulates experience with water funds. Since 1997, all Chinese governments (from national to city levels) are required by law to set up Water Funds fed with at least 3% of each government revenues and 15% of the urban maintenance and construction tax (for cities with major flood control tasks). Some local governments (such as Guandong and Guanxi) allocate also a share of income from land sales and auctioning of development rights (DRC, 2010).

The Nature Conservancy is launching water funds across Latin America, which pay for watershed protection and reforestation, thereby helping to provide fresh water today and into the future (the box explains the operation of the water funds). The Conservancy's growing portfolio of water funds provide a steady source of funding for the conservation of more than 7 million acres of watersheds and secure drinking water for nearly 40 million people.

There are limited but increasing examples of innovative instruments that raise revenues for difficult to fund functions, such as environmental restoration. For instance, in the United States regulation obliges hydropower producers to invest in salmon restoration and they can do so by buying in-stream water rights (using a specialised intermediary such as the Oregon Water Trust).

A similar instrument is implemented in Germany on a voluntary basis: energy consumers ultimately pay for the cost of modernising the stock of hydropower plants as to contribute to achieving water policy objectives (specifically, achieving good ecological status as demanded by the EU WFD). The mechanism used is the structure of feed-in tariffs specified in the German Renewable Energy Law: when hydropower facilities comply with certain criteria (such as ensuring biological continuity of the river, or being built in a location where there are barrages or weirs), they are paid a higher-feed in tariff from electricity distributors, which is reflected in the energy bill paid by the end users. The additional remuneration is paid to hydropower producers for 20 years and varies according to facility size and output – smaller plants are paid higher remunerations per kWh than bigger plants to ensure their profitability; plants producing more than 5 MW are only paid for the increased part of production after modernisation.

An increasing variety of agreements tend to harness beneficiaries to finance water quality measures in agriculture. These are illustrated by voluntary agreements between water supply utilities and farmers to reduce pollution and water treatment costs (see OECD, 2012b). In the EU and the United States, farmers are paid for a variety of environmental stewardship measures, including reducing nitrate contamination. While these have been primarily funded through public budget allocation - implicitly recognising society as a whole as a beneficiary – it is possible to design alternative

funding mechanisms with specific fees or levies on water bills, fees for recreational uses or fisheries and levies on flood plain dwellers, so as to allocate costs more directly to direct beneficiaries.

Box 3.5. **Achieving cost savings through voluntary cooperative agreements**

An approach to reduce costs in the water resources management sector – in particular concerning water quality issues – is the shift from point of use measures to point of source measures. Changing agricultural practices to reduce pollution with fertilizers and pesticides instead of treating water before use is a primary example. One way to induce changes in agricultural practices is the establishment of voluntary agreements between farmers and water companies, whereby the latter are providing advice and financially support farmers for agreed production methods that reduce pressures on water resources. In the context of voluntary cooperative agreements (CAs), both parties are interested in minimising the costs and environmental pressures. Whereas farmers benefit from the modernization of farming methods, the interest of the water companies to support the agricultural sector in the conversion to more sustainable farming practices (*e.g.* intercropping, reduction of fertilisers and pesticides, conversion to permanent grassland, etc.) lies in the prevention of costly remedial measures (such as water treatment, closing wells and conveyance or remote water resources). It can be assumed, that CAs implement the most cost-effective changes in farming practice, as they are tailored to the site-specific conditions and environmental problems in the catchment. As all relevant farmers located in the catchment area are involved, the contracts can contribute to integrated water resources management. In some EU Member States, such agreements are already in place for more than 20 years.

Table 3.4. **Two examples of cooperative agreements in Germany**

Name of the cooperative agreement	10^6 m³/year	Euro/year	Euro/m³
CA “Viersen”			
Groundwater abstraction	5.5		
CA expenditure of the water company		395 000	0.07
Saved costs in water treatment		648 000 to 972 000	0.12-0.18
Economic net benefit		More than 253 000	
CA “Stevertalsperre”			
Water abstraction	100		
CA expenditure of the water company		480 000	0.005
Saved costs in water treatment		1 000 000 to 1 500 000	0.10 to 0.15
Economic net benefit		More than 520 000	

Box 3.5. **Achieving cost savings through voluntary cooperative agreements** *(continued)*

However, the establishment of voluntary agreements requires institutional, but also cultural preconditions. In the UK, for example, CAs are not widespread as water companies do not have the right to pass on costs, such as compensation payments, to consumers through water charges (although their water charges would decrease, once the changes in practice showing effect). Furthermore, UK regulators rely more on mandatory rules to meet the polluter pays principle and have strong reservations against paying polluters not to pollute. In addition, relying on changing agricultural practices instead of treatment processes has different uncertainty. Treating water has the advantage that the compliance with standards (*e.g.* pesticide concentration in drinking water) can be achieved with a high degree of certainty. The preventative approach by employing CAs might be less certain due to unexpected events in the water catchment area. Furthermore, lag times might exist between the time the measures are taken and the time improvements in the aquatic environment are recorded, a problem for areas where immediate action is required to meet statutory drinking water quality or where the limited availability of water resources does not allow for temporary measures (such as closing wells or water blending).

Source: Heinz, I. (2008), "Co-operative Agreements and the EU Water Framework Directive in Conjunction with the Common Agricultural Policy", *Hydrology and Earth System Sciences*, Vol. 12, pp. 715-726.

Aylward (2009) reports on two innovative, voluntary mechanisms of a different kind:

- The Bonneville Environmental Foundation (BEF) launched in 2009 a system of water restoration credits (WRCs). Water users who want to reduce their water footprint can buy water restoration credits. The money raised through the WRCs is used to fund flow restoration projects. One WRC equals 1 000 gallons of water restored to rivers and streams that are certified by the National Fish and Wildlife Foundation as being critically dewatered. Similar to carbon offset payments, WRCs allow purchasing water and environmental benefits independent of the location (so-called offsite mitigation) – as respective mitigation options might not be in place where the damage takes place.
- The "Blue Water Programme", launched in Oregon's Deschutes Basin by the Deschutes River Conservancy and a regulated municipal water supply company, allows customers of the water supply company to add a monthly amount to their water bill to support instream leasing of water rights. While only 2% of the customers decided to support the system, the generated income provides almost 6% of the Deschutes River Conservancy's budget for leasing water rights.

Such a variety of innovations calls for a thorough documentation of the actual benefit and effectiveness, the cost-effectiveness of the measures, and their sustainability. In particular, opportunities for replication and scale up need to be assessed, taking account of institutional and other requisites which drive the capacity of each tool to deliver.

A note of caution: Requisites for economic instruments to deliver

A preliminary assessment by EPI-Water[5] suggests that the track record of economic instruments for water management is ambivalent. Economic instruments are often effective at raising revenues or stimulating economic development (hydropower generation, irrigated agriculture). However, the link with environmental policy can be thin, or ill-defined. When there are trade-offs between financial sustainability and other environment policy objectives, economic instruments are often designed to contribute to the former (EPI-Water, 2012).

The assessment also highlights the linkages between economic policy instruments and the institutions needed to make then work. In particular, water rights need to be properly defined (not only for market mechanisms).

Cost recovery instruments can be complex to administer and their effective management may overwhelm the capacities of countries. Countries should assess whether their governance systems are prepared to manage the proposed system before introducing reforms. It may be necessary to strengthen governance systems, to focus on a limited number of cost recovery instruments, or both.

Similarly, transaction costs can be high, and they should be taken into consideration when considering the design and implementation of alternative instruments to finance water resources management.

Putting a price on water can also hinder revenues of service providers. This is particularly the case when the revenue of utilities (be they public or private) is based on volumes of water sold, or of wastewater treated. However, the impact is not straightforward, as it depends on the elasticity of water demand to price (see a discussion in Box 3.6). Moreover, accompanying measures can be implemented to mitigate the adverse effects on, for instance, the capacity of the service provider to operate and maintenance water systems (which are characterised by high fixed costs). Innovative business models decouple revenues from volumes. Energy suppliers have paved the way, when part of their revenues is generated from high-value services, such as control over total energy costs. Water utilities (for domestic or irrigation uses) would gain from exploring such innovative approaches.

Box 3.6. **Price elasticity of water demand**

Studies abound on the effect of price variations on water demand. As noted by Olmstead and Stavins (2007), there is a critical distinction between the technical term "inelastic demand" and the phrase "unresponsive to price." Inelastic demand will decrease by less than one percent for every one percent increase in price. In contrast, if demand is truly unresponsive to price, the same quantity of water will be demanded at any price.

Meta-analyses indicate that water demand is responsive but inelastic. The noted reference study by Dalhuisen *et al.* (2003) concludes that, globally, price elasticity is -0.41, but varies in many contexts. In a US context, Olmstead and Stavins (2007) assessed that, on average, a ten percent increase in the marginal price of water can be expected to diminish demand in the urban residential sector by about 3 to 4 percent.

Consumers' responses to price variations depend on a series of factors. Price structures and water bills affect elastiticity (combining water supply and sanitation bills allows to display a higher price). It follows that, under price-based approaches, low-income households contribute a greater share of a city's resulting aggregate water consumption reduction than they do under certain types of non-price demand management policies (Olsmtead, Stavins, 2007).

The case of irrigation water deserves particular attention. Israel offers an example where substantial increases in water prices (by 65% between 1998 and 2008; OECD, 2010b) have allowed water consumption to fall, while the quantity of crops produced remained steady. In Spain, there was significant discrepancies in elasticities of irrigation water, based on water scarcity and crop patterns. Elasticity was higher where water is abundant and lower where water is scarce (because water uses are already efficient). Elasticity is low for high value crops. In developing countries, where irrigation water can be very cheap, even significant price increases (in %) may fail to trigger changes in farming practices.

Pricing alone is usually not enough to reach water policy objectives: in France, it was assessed that a marginal price increase by 50% would reduce water demand in a given territory by 10% by 2020, which may not be sufficient.

Source: adapted from Dalhuisen, J.M. *et al.* (2003), "Price and Income Elasticities of Residential Water Demand: A Meta-Analysis", *Land Economics*, May 2003, Vol. 79, No. 2, pp. 292-308; and Olmstead, S.M. and R.N. Stavins (2007), "Managing Water Demand. Price vs. Non-Price Conservation Programs", *A Pioneer Institute White Paper*, No. 39, July 2007.

Notes

1. Complementary analyses on economic instruments for water policies at large can be found in Grafton (2011).
2. For instance, in France, a fund dedicated to flood protection is financed by an additional premium on the package policy for dwellings and on insurance contracts for vehicles. In 2010, this amounted to EUR 154 million, of which 140 were earmarked for flood prevention. Compare with EUR 1 300 million, secured to cover the costs of natural disasters.
3. For abstraction charges, and other economic instruments to reflect resource scarcity, analysis needs to be based on reliable hydrological and economic information, a knowledge base which is often lacking.
4. Empirical evidence however indicates that price elasticity of water consumption is low in the short term. As a consequence, prices can only drive water demand if they increase significantly, which may trigger affordability issues
5. EPI Water is a research project financed by the European Commission under the FP 7 programme. It reviews empirical evidence on the actual performance of economic policy instruments for the management of water resources. The interim report builds on over 30 case studies, in Europe and in selected non European countries.

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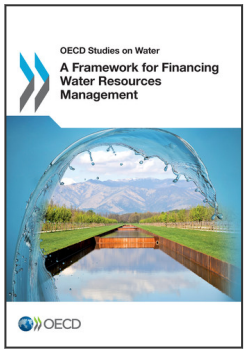

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