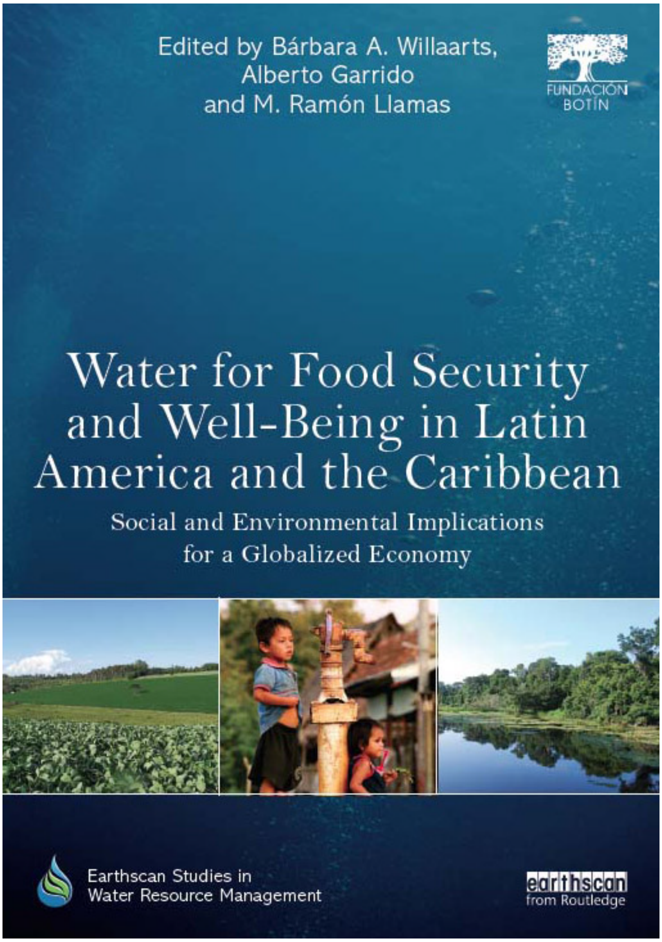

Chapter 13

Economic instruments for allocating water and financing services

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13

ECONOMIC INSTRUMENTS FOR ALLOCATING WATER AND FINANCING SERVICES

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Highlights

- All countries with post-Dublin (1992) new water legislation have implemented more or less sophisticated economic instruments and financial mechanisms to treat water and supply service as an economic good.

- The notion of water as a public resource domain, coupled with the need to increase cost recovery rates, is at the root of the legislative foundations of all economic instruments applied to water.

- The 'polluter-pays-principle' is also a designing principle in all modern legislation, but in practical terms there are numerous difficulties that hinder its application. Environmental taxation has been implemented in some countries, but the revenue collected is still low, and does not act as a true deterrent for polluters.

- There are several examples of advanced water charging in agriculture, which differ amongst crops, irrigation technology and areas. After decades of little or no cost recovery rates in irrigating schemes, some countries, such as Argentina, Mexico, Peru and Brazil, have taken significant steps to make farmers pay for operation and maintenance costs of the infrastructure supplying their water.

- Chile is the sole Latin America and Caribbean (LAC) country with decades of experience in water trade mechanisms. It seems that recently passed laws in other countries have not been developed nor have they enabled trading mechanisms, whereas the 1981 Chilean Water Code and its subsequent amendments had specific provisions defining water rights as tradable. Market prices for water rights are quite high, with the mining sector being one of the major purchasers.

- Payments for ecosystem services (PES), and in particular Payments for Watershed Services (PWS), have seen an important growth in the past years, bringing renewed hopes for a conservation approach that could succeed where other approaches have failed. LAC has led this development and is continuing to develop new initiatives, although strong growth is observed in other parts of the world.

- To be more efficient and effective, PES should be applied according to size, service per unit of land and type of watershed. Most large (national) schemes are government funded through special taxes, and receive funding from multilateral/aid organizations or governments thus threatening the scheme's sustainability.

13.1 Introduction

Principle 4 of the Dublin Statement[1] reads that 'Water has an economic value in all its competing uses and should be recognized as an economic good.' The Dublin Statement also claimed that '[The] Application of the "polluter pays" principle and realistic water pricing will encourage conservation and reuse.'

Economic instruments are used to allocate water resources, manage demand, reduce pollution discharges, finance water service costs and incentivize environmentally positive actions (positive externalities). Water and food security demands that scarce resources should be properly managed and services sufficiently financed. This chapter reviews four kinds of economic instruments, namely, (a) tariffs, levies and charges, (b) environmental taxes (c) water markets and (d) payments for ecosystem services.

As will be reviewed in this chapter, the urban supply sector is undergoing a second round of reforms, after the feverish privatization processes of the late 1990s (see Chapters 8 and 11). The challenges have been well diagnosed: how to expand the networks in order to reach the continuously growing population of cities; to bring drinking water and sanitation services to all neighbourhoods and households whilst at the same time keeping water prices at reasonable levels. Improvements and innovations are abundant, and the LAC region is clearly on track towards improving most indicators (see Chapter 6).

Ferro and Lentini (2013) reported that evaluations of the Interamerican Development Bank (IDB) indicated that to meet the water-related Millennium Development Goals (MDG) in LAC investments amounting in 2003 to US$16.5 billion in drinking water services, 22 billion in sanitation, and 17.7 billion in treatment of serviced waters, totalling 56.2 billion (approximately US$ 200 per person) were necessary.

In the field of irrigation, tariffs always face opposition and have been questioned as effective mechanisms to allocate scarce resources (Molle and Berkoff, 2007). And yet, around the region we have seen numerous initiatives on cost-recovery objectives, which have then evolved towards demand-management instruments. Ensuring adequate and self-sustained operation and maintenance is the main target.

Environmental taxes have been implemented in some countries, and this is one of the policy areas that will require longer implementation processes. Also the region has seen tremendous growth in the use of payments for ecosystem services (PES, see Chapter 14 for an assessment of LAC's ecosystem services).

The chapter also looks at water trading mechanisms. Little or nothing has been truly implemented in the region except in Chile, where trading occurs regularly in many regions and prices vary according to changes in the supply and demand.

1 The Dublin Statement On Water and Sustainable Development (1992).

13.2 Water tariffs

13.2.1 Fees or charges for the use of water resources

Many countries consider that the use of natural resources imposes costs on society and requires conservation and management activities. In order to reimburse the state for these costs of conserving the natural sources, many countries have established charges or fees that all users must pay.

In Mexico, for instance, at least eight categories are defined, whose rates increase when water is scarcer in the region (see Table 13.1). Note that the rate for irrigation is zero in all the regions and that for hydropower or exceeding the concession for irrigation do not vary with the regions' availability.

Table 13.1 Levies for water use for different zones in Mexico, 2010 (US$ cents per m^3, exchange rate Mexican peso/US$ of 2010)

	AVAILABILITY AREAS								
TYPE OF USE	1	2	3	4	5	6	7	8	9
General regime	143.15	114.57	95.46	78.70	62.02	56.07	42.21	11.20	0.00
Drinking water, for consumers greater than 300/l per person	5.67	5.67	5.67	5.67	5.67	5.67	2.64	1.32	0.66
Drinking water, for consumers less than 300/l per person	2.84	2.84	2.84	2.84	2.84	2.84	1.32	0.66	0.33
Agricultural, within the concession	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Agricultural, for units beyond the concession	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01
Spas and Recreational centres	0.08	0.08	0.08	0.08	0.08	0.08	0.04	0.02	0.01
Hydropower	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Fish farms	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02

Source: CONAGUA (2012)

In Costa Rica, different conceptualizations of water charges have evolved since the enactment of the 1942 Water Law. Presently, users must pay a charge called the 'environmentally adjusted water use charge' (*Canon ambientalmente ajustado por aprovechamiento de aguas*), which has two components: (a) an aggregate value which differs on the type of use (hydropower, agricultural, household consumption or industrial), and takes into account cost estimates and marginal valuations; and (b) a payment for the water environmental service. In general, the water charge (canon) in Costa Rica is considered a success story, with benefits identified in (a) the more efficient water allocation mechanism and reduced pressures; (b) the revalorization of the water resources; and (c) stakeholder's participation in designing the instrument (LA–Costa Rica, 2012).

In Chile, since 2005 there has been a 'non-use' fee (*patente de no uso*) that is charged to the users with surplus water rights who do not have the infrastructure required to make effective use of the water. It is calculated differently for consumptive and non-consumptive uses and varies from region to region. The elevation difference between the abstraction point, the return flow point and the length of the non-use period are also taken into account. The main objective of this fee is to 'correct' the distortions that were generated by the initial allocations (Melo et al., 2004)

Brazil's 1997 water law establishes that water be considered an economic good and introduces water fees with the triple objective of communicating the value of water, rationalizing its use and generating revenue for the further development of water resources. The model for setting water tariffs (*cobrança*) has been followed by a somewhat flexible and adaptive methodology (Formiga-Johnson et al., 2007). See Box 13.1 devoted to the basin of Paraíba du Sol in Brazil.

Peru passed the Law of Water Resources in 2009, which was later developed into a detailed regulation including a financial and economic regime. It defines a fee for using water resources, in lieu of the fact that they belong to the Nation's domain. Fees are differentiated by users (Article 177) and then collected revenue is used to fund basins' planning, administration and environmental protection among other goals. Interestingly, users that obtain individual or collective certificates of 'efficient use' can obtain fee rebates and also access water preferentially.

Box 13.1 An integrated approach in the Brazilian Paraíba do Sul Basin (PDSB)

PDSB covers 5.5 million hectares, located in Brazil's economic epicentre, covering the states of Sao Paulo, Rio de Janeiro and Minas Gerais, servicing 180 cities totalling 5.6 million people (8.7 million in the metropolitan area of Rio de Janeiro are outside the basin but are served through an inter-basin transfer). Four elements are identified in order to enable the implementation of a bulk pricing reform in the PDSB: (a) an inclusive and bottom-up negotiation; (b) collected fees would be invested in the basin; (c) a paradigm shift accepting the notion of water as an economic good was to be embraced by key actors in the basin; (d) advanced technical knowledge dating back several decades, so that committee members agreed on the primary problems and the role that bulk pricing would play in solving them.

The approved formula includes three components: a withdrawal component, a consumption component and an effluent dilution component. Upon the first implementation period it was found that the system had some flaws and was due for revision in 2006. There were several drawbacks that were corrected: (a) coping with illegal users; (b) taking the treatment of non-paying users more seriously; (c) solving the asymmetric status of users in different States, given that they were subject to different jurisdictions.

Some lessons can be drawn from this example. First, the formula was simple and had low implementation risks; second, the system had a hybrid approach with market-inspired schemes that preserved the role of the state (ANA and CEIVAP[2]); third, the idea of water being an economic good was deeply ingrained among users and the professional circles in the CEIVAP; fourth, the problems were well-diagnosed, with pollution being the direct one, and a consensus around the most practical means to face them was easily built among users and agencies; fifth, cross-cutting three important states, a federal component was required and essential; sixth and lastly, there were attractive incentives for implementation, including matching funds from the national programme to combat pollution, and revenues were earmarked for specific and visible basin projects. And yet, Ioris (2010) found some weaknesses and reported that, between 2003 and 2006, the charging scheme was responsible for collecting a total of 25.4 million Brazilian reals (US$10.85 million at the exchange rate of 2 July, 2005), which is considerably less than the budget required to restore the environmental quality of the basin.

Source. Formiga-Jhonson et al. (2001) and Ioris (2010)

13.2.2 Irrigation charges and fees

Irrigation schemes charge farmers fees to meet the operations and maintenance (O&M) costs. IWMI, USAID and FAO agreed that attention should be paid to five items (Molle and Berkoff, 2007). First, rational water use should be achieved by careful control of distribution and by allocating water to broadly meet crop requirements, with fees having little or no impact on irrigation performance. Second, the presumable efficiency gains from irrigation tariffs would most probably be realized by the control of supply or some kind or quotas. Third, the most critical financial factor is the level of fiscal autonomy of the irrigation agency, providing an incentive for cost-effective performance. Fourth, cost recovery should be contextualized to factor in irrigators' ability to pay, and O&M activities should be prioritized for cost recovery strategies. Fifth, subsidized users should repay some of the investments, but should not be expected to pay the extra-costs imposed by inefficient or miscalculated investments or overstaffed organizations.

Despite these caveats, it is also true that irrigation water given free of charge would also generate welfare losses, in the form of opportunity cost and externalities. Furthermore, many large countries like Mexico or small countries like Suriname have suffered the abandonment of irrigation infrastructures because of insufficient fees collection and poor cost-recovery rates.

Consider the case of Mexico. Irrigated agriculture is extremely important in terms of both irrigated acreage (more than 5.5 million hectares) and total water use. Since the passing of the Water Law in 1992 and the creation of the National Water Commission, Mexico

2 National Water Agency of Brazil (Agência Nacional de Águas) and Integrated Comittee of the Hydrographic Basin of Rio Paraíba do Sul (Comitê de Integração da Bacia Hidrográfica do Rio Paraíba do Sul).

embarked on a massive policy reform to allocate the water management of its large water districts to the recently created users associations (WUAs). This involved setting up new institutions such as basin agencies, giving WUAs managing capacity to administer both capital assets and water resources, and transferring the financial responsibility of running districts and collecting charges to the WUAs. During the devolution process, water prices increased by 45–180% and government O&M subsidies were removed. Molle and Berkoff (2007), citing other sources, claimed that O&M charges have been quite low (equivalent to 2–7% of the gross product), and that maintenance may be suboptimal in many cases. Garrido and Calatrava (2009) reported significant increases in irrigation water charges upon the implementation of the devolution process.

There are about 3.5Mha under irrigation in Brazil, although 29Mha are estimated to be suitable for irrigation by the National Water Agency (ANA). The Irrigation Law, enacted in 1979, and its regulations provide for the cost recovery of investment and O&M costs of government-supported irrigation projects through water charges to beneficiaries.

There is an interesting case of volumetric control and two-part charging mechanism in the Chancay-Lambayeque in Peru (Vos and Vincent, 2011). The Chancay-Lambayeque irrigation system achieved high performance with on-demand delivery to some 22,000 smallholders in a command area of some 100,000ha. Full cost recovery rates, accompanied by the requirement to pay in advance, reinforced the management and ensured the control of water use and cropping operations. Rates were US$0.003 per m^3 (four soles, the Peruvian currency, for a service module of 576m^3) in 1995, and were adjusted with inflation reaching US$0.005 per m^3 in 2010.

13.2.3 Charges for urban consumers

13.2.3.1 Regulatory frameworks

The design of the industrial structure for water supply and sanitation impinges on the ability to deliver services to the population. Assets are long-lived, allowing investments to be delayed and quasi-rents to be captured once initial investments have been made (Guasch et al., 2008). Fragmented services lose economies of scale, increase transaction costs, make services more expensive, and may facilitate capture by vested interests (Foster, 2005; ADB, 2009). Water supply and sanitation services have decreasing average costs (Krause, 2009) and therefore both efficiency and equity are achieved by selecting optimal size in terms of economies of scale.

Economies of scale lead to natural monopolies that must be regulated to ensure that the market operates as if it were a competitive market in order to achieve the maximum social welfare. Regulation should guarantee that the service is safe, sufficient, regular, physically accessible, convenient, and affordable. In terms of implementing regulation there are differences between, on the one hand, specific contracts, and on the other, comprehensive general, regulation, franchizing and concessions. Almost 90% of water supply and sanitation privatizations in LAC during the 1990s were made through concessions (Estache et al., 2003). More developed countries prefer to grant licences controlled by general regulations of compulsory application, approved by law, and enforced by fully empowered, permanent, professional regulators (Jouravlev, 2005). Chile has embarked on a process of privatization of water supply and sanitation that has been considered a success (see Box 13.2).

Efficiency covers costs while considering equity by facilitating improvements in the quality of services and their expansion to the poor. The Brazilian case has its particularities, as the private sector represents presently around 10% of the total concessions in the country, it has been constantly growing and changes are underway through the growth in the implementation of concessions, and the private utilities association expects to reach 40% by 2023. One of the causes is the lack of investment capacity of municipalities and state-owned companies to maintain and renew equipment. While there are diverse regulation frameworks in LAC, state-owned companies continue to be very relevant, but their main challenges are lack of accountability and regulation (see Chapter 11).

Box 13.2 Privatization of water services in Chile

In the system of water supply and sanitation in Chile, there is a tariff law according to which the Superintendence of Sanitary Services (SISS) periodically conducts studies to set the maximum prices that are authorized to sanitation concessionaires. These rates are set so as to allow each company to cover investment and operating costs and to obtain an agreed return on the investment required to provide the service of production and distribution of drinking water, collection, wastewater disposal and treatment. In order to establish efficiency incentives, water rates are set based on an efficient firm model, so that the values and parameters entering the formulas are not the actual company's, but of a fictitious company called 'business model'. The business model has been a useful tool in regulating utilities in Chile in recent decades. Currently, however, it has shown some problems. One the one hand, the current rates are not a real incentive to reduce water consumption. On the other hand, rates are set for the next five years, independently of potential water shortages, or water abundance which occur with much greater frequency, a variability that is not being captured by the price. Regarding the operation of private water companies, they operate through concessions, which may be overthrown if these do not meet quality standards, flow, or tariff standards.

13.2.3.2 Tariff levels and structures

In a very recent study of 308 large cities around the world, Zetland and Gasson (2012) evaluated the differences in water charges and researched reasons behind these differences. They found that the average water tariff for urban consumers was US$1.21 per m^3 (σ=1.13; max=7.54), whereas the wastewater tariff was US$1.02 per m^3 (σ=1.07; max=5.68). The following factors are identified by Zetland and Gasson (2012) to explain water and wastewater tariffs around the world: (a) labour costs; (b) regulatory price control which aim at minimizing tariffs; (c) public vs. private organizations; (d) water scarcity; (e) the age and condition of infrastructure; (f) subsidization schemes and the type of socially targeted policies.

Ferro and Lentini (2013) recently assessed the pricing policies in the LAC region. They assembled data from fifteen major utilities from Argentina, Brazil, Chile, Colombia, Costa Rica, Ecuador, Panamá, Paraguay, Perú and Uruguay, with a total population served of approximately 100 million people (see Table 13.2).

Table 13.2 **Average monthly bill and average price in the main fourteen water utilities in LA**

UTILITY	AREA OF SERVICE	YEAR	AVERAGE BILL (US$)	AVERAGE PRICE (US$/m^3)
AySA	Buenos Aires + 17 municipalities	2011	4.82	0.17
ASSA	Province of Santa Fe, Argentina	2011	5.87	-
SABESP	Estado de São Paulo (Brazil)	2010	48.43	2.63
COPASA	Belo Horizonte, Minas Gerais (Brazil)	2010	36.09	2.94
Aguas Andinas	Metro Santiago de Chile	2011	38.98	1.77
Aguas de Antofagasta	Antofagasta, Chile	2011	67.69	3.54
EAAB	Bogotá, Colombia	2011	31.82	2.64
ACUAPAR	Cartagena S.A. (ACUACAR) Distrito de Cartagena de Indias, Colombia	2011	32.51	1.98
SEDAPAL	Lima, Peru	2011	27.74	1.01
SEDACAJ	Cajamarca, Peru	2011	12.93	0.94
AyA	Supplier of drinking water and sanitation, Costa Rica	2010	22.72	1.07
EMAAPQ	Quito, Ecuador	2011	19.76	0.72
IDAAN	Supplier of drinking water and sanitation, Panamá	2011	15.54	0.3
OSE	Supplier of drinking water and sanitation, Uruguay	2009	26.27	1.8

Source: Ferro and Lentini (2013)

Increasing block tariffs (IBT) have become commonly used because they fulfill three goals (Olivier, 2010): (a) affordability and fairness, with a highly subsidized first block (subsistence first block); (b) resource conservation (higher consumption is charged at a higher price); (c) economic efficiency, with the higher block corresponding to short-term marginal cost of provision.

Small private operators are often in the business of supplying the poor, using tankers and informal companies selling water to the poor, usually at many times the price of tap water (see Box 13.3). Nauges and Strand (2007) found that average tap water price (PPP corrected) in three Salvadorean cities is about US$0.25 per m^3, and in the marginal quarters in Tegucigalpa, about $US0.4 per m^3. The average non-tap price in Tegucigalpa is US$8.43 per m^3.

The history of the Buenos Aires water concession is now a classical example of mis-management and poor regulatory practice. The domestic supply service was awarded to the Aguas Argentinas Consortium in 1993, when only 70% of the metropolitan area population was connected to the water system and 58% to the sewerage system. In the suburban areas, these percentages were even lower, 55 and 36%, respectively, but almost 100% in the Capital District. Coverage targets specified expansions to the benefit of the poorest households in marginal areas. In 2003, the coverage and sewerage rates lagged behind targets by 47 and 70%. To compensate for the increasing investment costs of servicing new customers, initially estimated at US$1,120, totally out of the price range for the poorest consumers, the regulator approved increasing the rates of existing consumers by 93% from US$17.57 per month in May 1993 to US$33.88 in 2002. Casarin et al. (2007) observed that the concession left 1 million people unserved, and only 50% and 25% of the expansion targets with water connection and sewerage services.

Lima's water system was on the verge of collapse at the end of the 1980s. Severe under-financing, under-maintenance and little or no expansion were all parts of a vicious cycle facing rapidly growing cities in developing countries (Fernández-Maldonado, 2008). A new law to regulate sanitation services opened the door to private capital and created the SUNASS,[3] the regulatory body. In 2006, 3.9 million new customers were added on top of the 3.1 existing ones in 1980, and still 1 million Limeños were left served with trucks selling water at US$2.2 or US$3 per m^3, which was in 2006 nine times more than the socially regulated SEDAPAL's tariff ($0.33 per m^3). After 2006, revenue collected through tariffs was 90% of the costs, and because of the cross-subsidies only 11% of the customers paid more than the cost of provision. Presently, Lima's water problems are still unsolved: more than one-third of the serviced water is not billed, and in 2007 only 13% of its wastewater was treated.

Manaus, capital of the Amazonas state of Brazil, has 1.7 million inhabitants, in addition to another half million in the suburban areas. Drinking water reached 80% of the people in 2004; although access to sanitary networks reached only 7% of the households (Olivier, 2010). An attempt was made to embed a cross-subsidy mechanism so that the wealthiest and industrial consumers would subsidize socially targeted consumers, but failed because not enough revenue was generated in the former two groups. As a result, tariffs for the poorest consumers had to be raised by 31% to ensure that the company would not lose money. Furthermore, the largest consumers had the option to disconnect from the network, taking advantage of loopholes in groundwater regulations. In the Metropolitan Region of São Paulo similar difficulties were found when readjusting the tariffs for the poorest customers, who paid in the early 2000s slightly higher average prices than richer households, and in terms of percentage of disposable income ten times more (Ruijs et al., 2008). According to Ioiris and Costa (2009) the minimal payment for water services (the so-called 'social tariff') was significantly higher in Rio de Janeiro than in other parts of Brazil, which certainly contributed to the high rate of unpaid debt: in CEDAE (Rio de Janeiro) it was R$30 for 15$m^3$/month; DMAE (Porto Alegre), R$7.5 for 10$m^3$/month; and SABESP (São Paulo): R$4.42 for 10$m^3$/month (all 2008 data).

3 SUNASS: Superintendencia Nacional de Servicios de Saneamiento, Peru (www.sunass.gob.pe).

Box 13.3 Social equity: social tariffs

Most large LAC cities have been growing rapidly in the last decades, requiring continuous expansion of drinking water and sanitary networks. Charging the expansionary costs on new customers, generally in marginal areas, would be unaffordable for the poorest households. One difficulty of socially targeted policies is that if social rates are not sufficiently compensated by the revenue collected from regular customers, the water operator may be dissuaded to expand the network to add more marginal consumers.

Most pro-poor policies and arrangements involve one or a combination of the following features:

- A minimum volume free of charge, which in LAC ranges between 4 and 15m^3 per month and per household. The first priced block, that varies between 18 and 25m^3 per month and household, is set at an affordable cost. In Chile, 15m^3 per month is the maximum serviced at subsidized price; in Colombia 20m^3 per month is offered at subsidzed rates; in São Paulo paying the flat rate gives a rate to 10m^3 per month free of charge.
- Consideration of affordable tariffs. Capacity to pay or affordability are dubious concepts for which there is no clear theoretical foundation. Various authors and organizations have defined various thresholds in percentage terms of the household's income (5%, by The World Bank; Vergès, 1%; PNUD, 3%; IAD, 5% for the poorest households). The findings are that in Campinas, Brazil, charges are below 2%; about 5% in LAC cities with no pro-poor provisions; 1.8% in Arequipa, Perú; 9.8% in Cost Rica, whereas in cities with pro-poor provisions, it ranges from 0.9% in Ceará, Brasil, and Trujillo, Perú to 8.4% in Bogotá, Colombia. In Chile the goal is to keep the water and sanitation bill below 3%.
- An increase in the flat rate accompanied with a reduction of the volumetric rate, increasing the billing frequency, reduced or limited service as opposed to disconnection for non-paying customers, and a control over sumptuary consumption (car washes, swimming pool).

Source: Ferro and Lentini (2013)

13.3 Economic instruments applied to water quality management

In addition to command-and-control (CAC) instruments, two types of economic instruments (EI) have received the most recent attention: discharge fee programmes, which charge plants for each unit of pollution emitted, and marketable permit programmes, which assign plant emissions allowances that they may trade with other plants. Caffera (2010) claims that the experience in the region with economic instruments in pollution control is limited to three programmes: Santiago de Chile's Total Suspended Particles' Emissions Compensation Programme (ECP) of 1992 and its extensions to industry emissions of

Nitrogen Oxides and Particulate Matter in 2004; Colombia's 1997 Discharge Fee for Water Effluents' contents of Biochemical Oxygen Demand and Total Suspended Solids; and Costa Rica's 2009 Environmental Fee for Water Discharges of Chemical Oxygen Demand and Total Suspended Solids.

Colombian Law 99 of 1993 established the legal foundation for a national discharge fee programme. While the programme was plagued with difficulties and serious non-compliance in the first five years after 1997, BOD and TSS discharges dropped significantly following the initiation of the program in 1997 (Caffera, 2010). This could have resulted from the economic incentive and efficiency properties of the new discharge fee programme or because of the improved permitting, monitoring, and enforcement of both the new discharge fees and existing emissions standards.

In reviewing, the Colombian discharge fee, Caffera (2010) indicated that its main problem was the broad non-compliance by municipal sewerage companies. Because emissions of these sources did not decrease, the environmental quality targets were not met, and the fees never stopped increasing. In view of this, a new decree (Decree #3100), was enacted (later modified by Decree #3440 of 2004), which introduced the following changes: (1) it mandated the regional and municipal authorities to establish (a) individual targets of pollution reduction for municipal sewage companies and sources whose loads are more than a fifth of the total loads received by the water body, and (b) group targets for the rest of the sources, according to the group's type (industrial branch, etc.); (2) it mandated the regional and municipal authorities to ask the municipal sewage companies to present a Plan for Pollution Management in accordance with the pollution reduction target; (3) it changed the method by which the fee is adjusted. However, Caffera (2010) wrote 'it is obvious that the changes sought to leave the municipal sewage companies and large polluters outside the fees' program, changing a monetary incentive to invest in pollution abatement by a prescriptive-type pollution abatement plan' (p.13).

Inspired by the Colombian programme, Costa Rica implemented an Environmental Fee for Discharges which puts a price on each kilogramme of COD and TSS discharged. The Costa Rican programme also faced implementation difficulties. It was challenged in court by the sugar cane industrial-agricultural union, on the basis that the fee was a tax, something that could only be decreed by the congress, the appeal was ruled against by the Supreme Court. The Ministry of the Environment approved a new decree (#34431) in 2008, which changed the amount and structure of the fee. Other implementation difficulties were related to the lack of trained personnel, of databases, and of monitoring equipment. The collection of fees was estimated to be only 80% of the total potential and as such prevented the purchasing and installation of treatment plants and monitoring equipment. Costa Rican regulators found that the most difficult sources of pollution originate from public utilities providing water services such as sanitation, drinking water, and irrigation.

In Chile the Decree #70 of the Ministry of Public Works established in 1988 that water utilities can charge for water provision but also water collection and disposal services. At the time very few cities had isolated collection and treatment services. But since the investments required to provide these services can be included in water tariffs once they are operational, water utilities now collect and treat almost all urban water. Water discharges from other sources are still regulated through traditional command and control methods (Donoso and Melo, 2006).

13.4 Payments for environmental services

Some of the goods and services provided by ecosystems are traded in markets, but others are not. In the latter case some or all of the costs of providing, and the benefits of using, these goods and services are not transmitted through prices, what economists call an externality. The main idea behind payments for environmental services (PES) is to establish the incentives lacking due to the existence of an externality, by putting in place a mechanism that compensates suppliers/producers and charges beneficiaries of the ecosystem service. This section introduces the concept of PES, which is further developed and expanded upon in the next chapter (14).

While different approaches that use market-based mechanisms have been labelled as PES, more recently the concept has been narrowed down. For example Wunder (2005) defines PES as '(1) a voluntary transaction in which (2) a well defined environmental service (or a land use likely to secure that service) (3) is "bought" by a (minimum of one) buyer (4) from a (minimum of one) provider (5) if and only if the provider continuously secures the provision of the service (conditionality)' (p. 3). An alternative and less restrictive definition is proposed by Porras et al. (2008), and considers only three criteria: that an environmental externality; is addressed with a payment, is voluntary in the supply side, and has conditionality.

As Chapter 14 explains, several payment mechanisms can be used including in cash or in kind transfers between governments and landowners, tradable development rights, voluntary contractual arrangements, and product certification and labelling (MEA 2005). The former ones are the most common in schemes that conform to the current PES definition. PES could deliver environmental and social co-benefits. The payment component of PES schemes, on the other hand, could have a relevant role in poverty alleviation (Pagiola et al., 2002).

Landell-Mills and Porras (2002) identified sixty-one watershed initiatives, twenty-two of them in LAC, but only eleven where in a pilot or mature stage of development and were still ongoing by 2006 (Porras et al., 2008). Of these projects, six are implemented at a national level in Colombia, Costa Rica, El Salvador, Guatemala and Mexico. There are also some regional initiatives that are replicated in several countries, like the Regional Integrated Silvopastoral Ecosystem Management Project (RISEMP) in Colombia, Costa Rica and Nicaragua, funded by the Global Environmental Fund (GEF) and the World Bank (WB), and the Programme for Sustainable Agriculture on the Hillsides of Central America (PASOLAC) in El Salvador, Honduras and Nicaragua, funded by the Swiss Agency for Development and Cooperation (SDC). More recently, Bennet et al. (2013) identified 205 active programmes in 2011 worldwide, twenty-eight of them in LAC (Ecuador, Colombia, Brazil, Mexico, Costa Rica and Bolivia). These authors also report that initiatives in this region are putting more emphasis on building social capital and more frequently use payments in-kind. Table 13.3 presents a summary of some of the most significant Payment for Watershed and Water-related services (PWS) initiatives in Latin America.

Table 13.3 PES schemes for watershed protection and water-related ecosystem services in LAC

NAME	COUNTRY	ACTIVITY PAID FOR	SERVICE	SELLER	SCALE	SPATIAL EXTENT (hectares)	YEARS	AMOUNT TRANSACTED IN 2011 (million USD)
RISEMP	Colombia, Costa Rica, Nicaragua	Biodiversity, carbon, watershed	Restoration (silvopasture)	NGOs, Intern. Org., States	International (3 countries)	3,500	2002–2008	393.8
Pimampiro	Ecuador	Watershed	Conservation/ minor restoration	Municipal government	Local	496	2000–present	4.6
PSA program	Costa rica	Carbon, watersheds, biodiversity, landscape	Conservation/ minor restoration	Public sector, Intern. Org.	National	270,000	1996–present	340
PSA PROGRAM	Mexico	Watershed	Conservation and restoration	Private and communities	National	600,000	2002–present	82.5
Los Negros	Bolivia	Watershed, biodiversity	Forest and paramo conservation	Farmers	Local	2,774	2003–present	8.0

Source: adapted from Wunder et al. (2008). Notes: RISEMP ended in 2008, and the amount transacted is estimated from Pagiola et al. (2004) an is an average for the duration of the programme. For Pimampiro, the amount transacted is calculated from Patanayak et al. (2010). For the rest of the programmes the amount transacted from Watershed Connect website.

Martín-Ortega et al. (2012) reviewed thirty-nine PES programmes in LAC, which have been summarized in Table 13.4. There is a great variety of approaches and partnerships, but most focus on forests' and land conservation to protect watersheds.

The next chapter (14) will also review PES, jointly with biodiversity markets, REDDs and CDMs and other instruments.

13.5 Water markets as a water allocation mechanism: the case of Chile

With increasing water scarcity and decreasing supply augmentation options, water managers and policy makers see interest in implementing market allocation systems (Rosegrant and Gazmuri, 1995; Easter et al., 1999; Saleth and Dinar, 2004). Efficiency and activity of water markets (WM) are intrinsically linked to the design of institutional and physical water systems (Bjornlund and McKay, 2002).

With WM the price of water rights (WR) reveals the opportunity cost of water, creating incentives to use water efficiently and employ it in its most productive use. WM are expected to lead to a socially optimal and efficient allocation by inducing two key changes. First, water is transferred from low-value users to high-value users. Second, WM

Table 13.4 **Main characteristics of water-related PES programs in LAC**

ASPECT	DEFINITION
COUNTRIES	10 in Costa Rica; 6 in Ecuador; 4 in Bolivia, Brazil, Colombia and Mexico; 2 in El Salvador and Nicaragua; 1 in Guatemala and Honduras
CONTEXT	Local specific component, 92.1% National components only, 26.3%
ENVIRONMENTAL ASPECT	42.1% Undefined Among the remaining 57.9%, 77.3% targeted deforestation and land cover; 31.8% water pollution; 22.7% water overuse
STAKEHOLDERS	40% a leading national NGO 23.7% Municipality 18.3% Governmental 16% Semi-autonomous agencies
INTERMEDIATION	78.9% use intermediary 21.1% direct transaction between buyers and sellers.
AGENTS INVOLVED	96.4% landowners and farmers
PAID ACTIONS	73.7% have more than one action, with a majority focusing on forest conservation and reforestation for water catchments 23.7% forest management
TARGETS	91.3% Aim at improving water supply 53.3% Aim at improving in-stream supply (water flow regulation for hydropower)
DIFFERENTATION	42% include some kind of differentiation (from 2 to 12, average 2.14), according to: 74.8% type of activity 23.9% type of forest or land feature
EVOLUTION OF SCHEMES	42.1% include several transformation stages

Source: Martín-Ortega et al. (2012)

generate greater investments in water conservation technologies due to the trade induced price increase (Chong and Sunding, 2006).

However, WMs can also result in third-party effects, speculative behaviour in water trade, social and environmental externalities. The Chilean government introduced a tax for holding unused water rights as a reaction to speculative behaviour and WR hoarding, which did not inhibit but did distort the market (World Bank, 2011). In Chile, trades need to be registered and approved by Water User Associations (WUA) so as to reduce negative third-party effects caused by return flows (Donoso, 2006).

Once initiated, markets ideally evolve towards maturity. In a mature market, allocation and productive efficiency of water are maximized (Bjornlund, 2002). Researchers assess market maturity in different ways, such as by the number of transfers or by price dispersion. Frequent transfers and small price dispersions indicate mature markets. However, if water rights are initially allocated to high value uses, few transactions are required for a mature market (Easter et al., 1999). Price dispersions can also be caused by geographical flexibility and reliability of infrastructure of irrigation canals (Hadjigeorgalis, 2004; Donoso et al., 2012), commodity prices (Challen, 2000) and quantities traded (Bjornlund and McKay, 2002), leaving both measures open to improvement.

Since the establishment of the water allocation mechanism based on a market of WR in Chile, a series of empirical and theoretical studies have been carried out to determine: the existence of a WM, the market activity measured through the number of transactions; WM efficiency; bargaining, cooperation, and strategic behaviours of market participants; and marginal gains from trade.

Several authors (Cristi and Trapp, 2003; Quentin et al., 2012) find evidence that markets are more active in those areas where water is a scarce resource with a high economic value. These studies indicate that the market mechanism has, in general, represented an efficient water allocation system. This is the case of the Limarí Valley, where water is scarce with high economic value, especially for the emerging agricultural sector. Inter-sectoral trading has transferred water to growing urban areas in the Elqui Valley and the upper Mapocho watershed, where water companies and real estate developers are continuously buying water and account for 76% of the rights traded (Donoso et al., 2012).

Table 13.5 presents WR transaction data based on data of the Dirección General de Aguas (DGA), for the period 2005–2008. The results for this four-year period show that there were 24,177 transactions of which 92.3% were independent of other property transactions, such as land. The value of transactions independent of other property transactions is US$4.8 billion, which on average is US$1.2 billion per year. The average WR price is US$215,623. WR 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. WR prices present a high coefficient of variation of 465. However, price dispersion is lower in the more active markets.

A key conclusion of these studies is that WM are driven by demand from relatively high-valued water uses and facilitated by low transactions costs in those valleys where WUAs and infrastructure assist the transfer of water. Market functioning differences are explained by scarcity, the distribution infrastructure and water storage capacity, and the proper functioning of WUAs. More frequent transactions in the 21st century than in 1980s and 1990s indicate a degree of maturity in the public's knowledge concerning the new legislation and possibly a growing demand for water.

Analysing WM in Chile, Jouravlev (2005) concluded that they (i) facilitate the reallocation of water use from lower to higher value users, (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.

By analysing the effect of WM, it can be seen that numerous problems have been resolved through their implementation. The use of such an allocation mechanism has allowed users to consider water as an economic good hence internalizing its scarcity value; constitutes an efficient reallocation mechanism which has facilitated the redistribution of rights already granted; has permitted the development of mining in areas in the semi-arid

Table 13.5 **Water rights (WR) transactions and prices for the period 2005-2008.**

	TOTAL TRANSACTIONS of WR	TRANSACTIONS OF WR INDEPENDENT OF OTHER GOODS SUCH AS LAND	WR TRANSACTION VALUES (ONLY WR TRANSACTIONS INDEPENDENT OF OTHER GOODS) (10^6 US$)	AVERAGE WR TRANSACTION PRICE (US$)
I	568	564	20	36,121
II	153	131	216	1,652,519
III	16	15	8	530,933
IV	3,489	3,448	550	159,615
V	3,191	2,839	517	182,029
RM	4,804	4,226	2,312	547,095
VI	2,315	2,010	509	253,367
VII	6,518	6,159	622	101,059
VIII	2,330	2,162	29	13,432
IX	494	487	8	16,805
X	225	223	23	103,390
XI	68	68	0	2,588
XII	6	6	0	20,200
Total	**24,177**	**22,338**	**4,817**	**215,623**

Source: World Bank (2011)

northern region of Chile by buying water rights from agriculture; has resolved problems associated to water deficits derived from a significant increase of water demand caused by the significant population growth in the central region of Chile and additionally has helped to solve water scarcity problems above all in instances when a rapid response has been required (Donoso, 2006; World Bank, 2011).

The problems that WM 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 flows. A major challenge of WM in Chile is how to ensure optimal water use without compromising the sustainability of rivers and aquifers. The sustainability of northern rivers and aquifers is at present jeopardized due to the over-allowance of WRs by the DGA. On the other hand, increased consumptive WR market activity has generated increased conflicts with downstream users due the existence of WR-defined over return flows.

Research in Chile on the impact of water markets on small farmers has been limited and no reliable conclusions have been reached to date. Some critics contend that small farmers have not regularized their rights, risking losing them, and in other cases have sold their water rights thus losing their means of subsistence. But Hadjigeorgalis (2008) shows that the WM in the Limarí basin has been successful in moving water and water rights from low- to high-valued uses and that resource-constrained farmers use temporary WM as a safety net. She did not find inequity with respect to offer prices; resource-constrained farmers receive the same offer prices as wealthier ones. The Limarí watershed has the most complex irrigation reservoirs system in the country, which has allowed the spontaneous development of a spot market for water volumes. Although this market has represented an important 'pressure valve' to withstand dry years, it also faces efficiency challenges that need to be addressed (Alevy et al., 2011).

While the institutional replication of the Chilean WM may seem like an option for LAC countries faced with increasing water scarcity and decreasing supply augmentation options, the contextual uniqueness of each WM makes the establishment of universal rules for replication difficult (Shah, 2005).

13.6 Implications for improving water and food security

The implementation of economic instruments provides revenue to finance water services and should provide incentives to agents to act more responsibly. Urban tariffs are the fundamental source of revenue to expand coverage of drinking water and sanitation. It seems that a significant part of the investment costs that are required to meet the water MDGs in the region cannot be funded by the targeted households. And yet, it is clear that implementing adequate tariff structures is essential to make progress and bridge the gaps reported in Chapter 6. Improved sanitation, will not only reduce the prevalence of many water-borne diseases, but also improve the ecological status of numerous important rivers and waterways.

As discussed in this chapter, pollution charges are meant to deter contaminants' discharges and generate revenue to fund monitoring and mitigation actions. The cases of Colombia and Costa Rica show that large and medium-size cities are among the heaviest pollutants. A vicious cycle commonly prevails not only in LAC but in virtually all countries where urban tariffs are below US$1.5 per m^3. Below this level proper urban water treatment and secure drinking water supply in adequate conditions are barely possible. Improving water security indicators has a large cost (aproximately US$100 per person and year, including drinking water supply and sanitation).

Therefore, three aspects converge and have implications for improving water security indicators: (a) a balanced and efficient tariff regime for urban water, accompanied by pro-social provisions; (b) better implementation of pollution charges and the polluter-pays-principle; and (c) payments for ecosystem services and watershed conservation. All three of them complement each other, but it seems that in LAC there is a long way to go in terms of sanitation and urban and industrial wastewater treatment. For the moment, PES are very limited to avert the consequences of urban and industrial growth, and are focused only on areas of high ecological value or headwaters of specific rivers.

Irrigation water prices are essential to increase food production sustainably. Billions of dollars of investment in irrigation have been wasted as a result of insufficient and poor maintenance of infrastructure. Adequate pricing of irrigation water is also essential to ensure that water resources are not wasted or assigned to low-value crops. Investment in irrigation, new and that in need of rehabilitation or technical improvements have been estimated at US$95 billion cumulatively up to 2050 (Schmidhuber et al., 2009), or US$ 7 billion up to 2030 (Faurès, 2007). These represent huge investments that may need proper tariff mechanisms and financial structuring. More stable food production will surely result from it, improving also food security indicators.

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