Chapter 7

Promoting Wise Use of Water: Application of economic instruments

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Yatsuka Kataoka and Sangam Shrestha

1. Introduction

Global water consumption has doubled every 20 years along with population growth, urbanisation and expanding economic activities and this increase has resulted in intensified pressure on water resources. The world is also facing the dilemma of the lack of access by the poor to safe water drinking water. There are 884 million people, or 13% of the world population, who do not have access to safe drinking water (WHO and UNICEF 2010). If the current trends of water demand continue, water shortages will become even more intense—approximately half of world's population will suffer from high water scarcity in 2030 (UNESCO-WWAP 2009). Coupled with this, climate change has emerged as a driving force in increasing stresses on water resources by changing the physical condition of water resources and water consumption patterns, which could account for about 20% of the increase in global water scarcity (UNESCO-WWAP 2003).

Historically, people coped with water shortage problems by developing water storage facilities and supplying more water. However, development of new water sources[1] is not economically or environmentally feasible in many cases. Moreover, water is a finite resource and therefore it is necessary to promote sustainable consumption to address water stress rather than strengthening water supplies. Sustainable consumption has been explained in chapter 1 of this White Paper, and in this chapter, sustainable water consumption is defined as follows:

Chapter Highlights

Water stress is a critical issue globally, in particular in developing Asia, where many people live without access to safe water. In addition to long-standing socio-economic factors such as population growth, climate change has intensified concerns over water stress. This chapter addresses the following points in the discussion on promoting sustainable water usage, in particular by using economic instruments as policy tools.

- To cope with the escalating water stress, sustainable water consumption in all water use should be promoted rather than focusing on new water development.
- Cases in which economic instruments (EI) are applied in Asian countries show that EI alone cannot promote sustainable consumption.
- EI does not automatically prevent the poor from accessing safe water, but it is a necessary instrument in providing them with appropriate financial support such as subsidised connection costs.
- To apply water pricing effectively, clear water use rights, proper metering systems, and improved credibility of water supply services (e.g., stable supply hours, quality of water supplied) are examples that make EI workable.
- Current sectoral management is a barrier to reflecting the true economic value of water. The concept of integrated water resources management should be promoted.

- minimising wasteful water use in all sectors, while meeting basic human needs;
- maximising water productivity in agricultural and industrial production;
- minimising the direct environmental burden while using water;
- fostering economically efficient allocation of water—giving priority of water use to higher value uses, but with due consideration of environmental and social impacts caused by reallocation of water uses.

There are various ways to change water consumption behaviour, such as laws and regulations, education and communication campaigns. Among these, economic instruments, such as water charges and taxes, are considered to be one of the most effective tools in promoting water saving practices. They are also recognised as useful tools for cost recovery of water services, rendering it more sustainable. These economic tools can be more efficient than command and control type of regulations and give users more flexibility to adapt. However, there are various barriers to the implementation of economic instruments such as users' unwillingness to pay and undefined water user rights. In addition, there is a suspicion that the introduction of economic instruments may increase the cost of water and keep the poor from accessing safe water supplies.

Recognising the importance of, and concerns regarding, economic instruments, this chapter examines some practical cases of applying economic instruments to determine the dominant factors for success and failure. Through the lessons learned from these cases, some suggestions for effective application of economic instruments and their role in promoting sustainable consumption of water resources are drawn.

2. Freshwater resource availability and trends of water demand in Asia

2.1 Freshwater availability

In Asia, some 60% of the global population depends on 36% of the water available on Earth (WWAP 2003). Many countries in the region are already suffering moderate to severe water stress[2] as shown in the following table (WWF 2008). Population growth is considered to be a driving force which intensifies water stress.

Table 7.1 Countries in Asia and the Pacific with moderate to severe water stress

Moderate water stress (20-40%)	China (20.07%), India (33.39%), Japan (20.61%), Republic of Korea (26.09%), Sri Lanka (24.74%), Thailand (20.65%), Kazakhstan (31.79%)
Severe water stress (more than 40%)	Pakistan (75.5%), Uzbekistan (115.44%), Turkmenistan (99.46%)

Source: WWF 2008

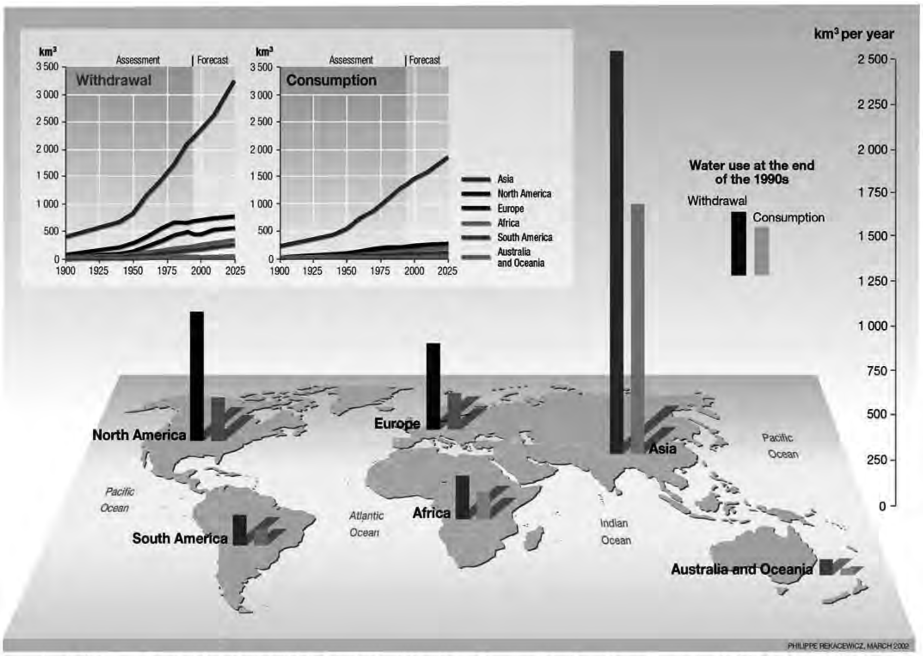
In addition to population growth, climate change is considered to be a factor in the availability of water in the region. Compounding effects will accumulate due to climate change, population growth, and increasing demand as a result of higher living standards which will result in a decrease of water availability over the next few decades in the large river basins in the region (IFAD 2009). This echoes the sentiment expressed in the opening chapter of this White Paper—as success is seen in poverty alleviation and living conditions improve, attention must be paid to what path these improved lifestyles will take. Will they develop sustainably or will they compound the challenges presented by global climate change by increasing populations in areas already under severe water stress, thereby presenting even greater challenges for all levels of society, including those still in poverty? With proper coordination and a policy mix appropriate to the context as described in this chapter and the rest of the paper, sustainable water consumption may be an achievable reality.

2.2 Water consumption trends

In terms of consumption, Asia accounts for the most water consumption in the world (Figure 7.1). In 2000, about 57% of the world's freshwater withdrawal and 70% of its consumption took place in Asia (UNEP 2002). According to the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), water resources in the region are being unsustainably extracted—annual water withdrawal in countries such as Uzbekistan and Azerbaijan has already exceeded the renewable water available; India, Pakistan and Sri Lanka have experienced a rapid increase in water extraction; and the speed of water extraction in China was exceptionally high compared to rates in the late 1980s and early 1990s, which may be driving them to the tipping point faster than previously forecasted (2008).

On the other hand, as Figure 7.1 shows, Asia also has the largest gap between withdrawal and consumption of water (UNEP 2008). This means that the region has high potential to save water by promoting sustainable consumption.

Figure 7.1 Global water withdrawal and consumption



Source: Igor A. Shiklomanov, State Hydrological Institute (SHI, St. Petersburg) and United Nations Educational,Scientific and Cultural Organisation (UNESCO, Paris), 1999; *World Resources 2000-2001, People and Ecosystems: The Fraying Web of Life*, World Resources Institute (WRI), Washington DC, 2000; Paul Harrison and Fred Pearce, *AAAS Atlas of Population 2001*, American Association for the Advancement of Science, University of California Press, Berkeley.

Source: UNEP 2008

Agricultural water demand

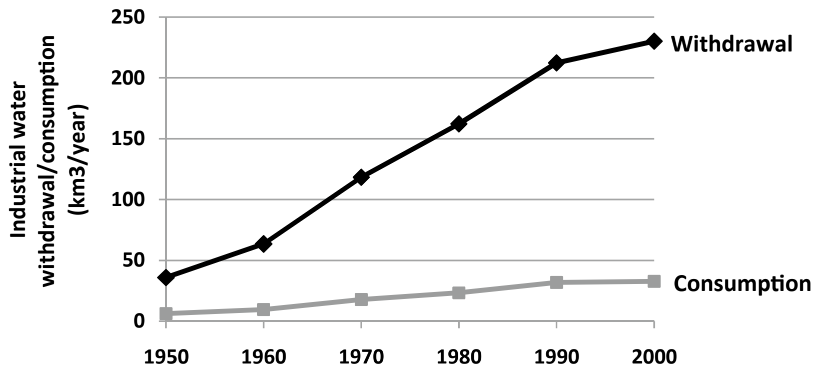
Water usage in Asia and the Pacific is primarily for agriculture, accounting for 79.2% of total withdrawals in 2002 compared to 13.1% for industrial use and just 7.7% for domestic use (UNESCAP 2008, 197). However the majority of irrigation systems are inefficient which results in significant water wastage (Revenga 2000). In addition to inefficient irrigation techniques, the low price of agricultural water, which is often due to subsidies, is considered a factor which sustains inefficient use and does not encourage adopting water-saving technology such as drip irrigation (*ibid*).

Industrial water demand

After agriculture, the industrial sector is the second largest water user in the region. Industrial water use is increasing in many countries of Asia and the Pacific due to rapid economic growth. Between 1992 and 2002, China and Viet Nam more than tripled their industrial water use; while in Asia-Pacific in 2002 the average share of water withdrawal for industry was 13.1% (UNESCAP 2008). Except for a few countries in North and Central Asia where the share has fallen slightly, the proportion of water withdrawal by industry is rising in all sub-regions (*ibid*).

There are large gaps between water withdrawal and consumption in the industrial sector (Figure 7.2). It is worth encouraging effective consumption of water in the industrial sector by introducing water saving technologies and changes in production processes.

Figure 7.2 Industrial water withdrawal and consumption in Asia, 1950-2000

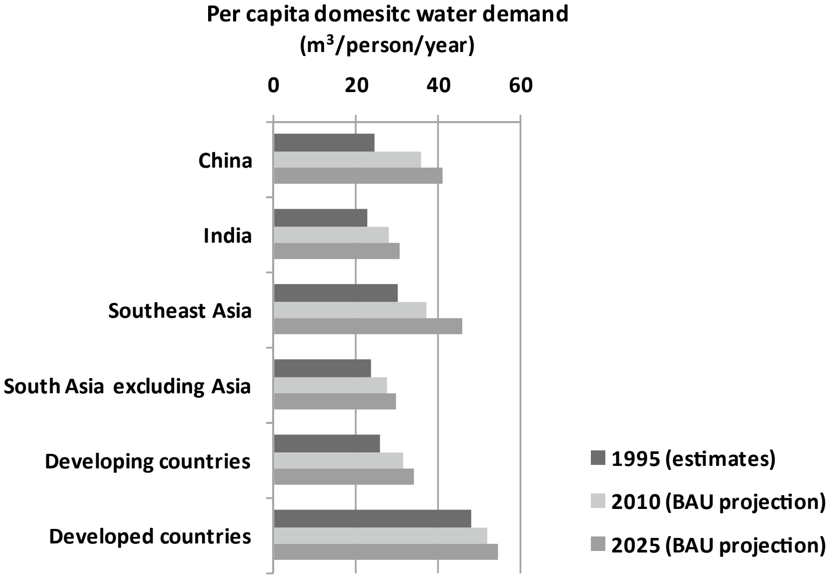


Source: UNESCO-WWAP 2006

Domestic water demand

Household water consumption in Asia is rising rapidly due to population growth, urbanisation and increase in living standards. By 2025, as shown in Figure 7.3, the per capita domestic water demand is projected to increase significantly.

Figure 7.3 Increase of per capita domestic water demand in Asia[3]



Source: Based on Rosegrant et al. 2002

Domestic water demand varies greatly according to location, climate, and socio-economic variables and is often found in the economic literature on the subject to be related to such factors as family size, quantity of water-using appliances, income and weather, with water use having an inverse relationship with rainfall and a direct relationship with temperature increases. (PRI Project 2004).

As for gross water consumption, it is worth addressing the increase of bottled water consumption. Three of the top consuming countries in the world are in Asia; with compound annual growth rates (CAGR) of 15.6% for bottled water consumption in China between 2003 and 2008 and 5.2 billion gallons of bottled water consumed in that same time period, Chinese bottled water consumption added up to 9.9% of total global industry volume (Rodwan 2008, 16).

In terms of resource efficiency, bottled water consumption is not a sustainable solution to water stress due to the energy used and resulting emissions, in addition to the amount of water used to produce a bottle of water being greater than the amount contained within the actual bottle. According to the Pacific Institute's study on bottled water consumption in the U.S., it takes three litres of water to produce one litre of bottled water. In terms of energy consumption, production of the plastic bottles for bottled water consumed in the U.S. in 2006 consumed the equivalent of more than 17 million barrels of oil, while bottling the water resulted in 2.5 million tons of carbon dioxide emissions, not including transportation (Pacific Institute 2006). However, in most cases, the price of bottled water, which is much higher than tap water, consists of the cost of production, packaging, transportation, retailing and advertising and marketing; it does not include the cost of water itself. Considering environmental loads of bottled water consumption, we need to re-think the use of bottled water.

3. Economic instruments as a tool to promote sustainable water consumption

Economic instruments (EI) have been used for many years as a tool to promote sustainable water demand management, as well as to attain a number of different objectives, such as a cost recovery measure for water infrastructure.

However, the actual implementation of economic instruments such as water charges is not an easy task for various reasons. Some governments hesitate to impose water charges on the agriculture and industrial sectors because they are afraid that water charges would hamper these sectors, and in turn, result in lower economic benefits throughout the country. People protest charges on water use as most consider water a free resource that should be accessible at little to no cost, since the access to water is a basic human need. In most developing countries, the lack of proper systems to impose water charges is also a major challenge in the introduction of economic instruments. Examples of implementation barriers for economic instruments include undefined rights related to water, insufficient measurement of water use and lack of reliable collection systems.

The following section will illustrate cases in which economic instruments have been applied and discuss how economic instruments can promote the sustainable consumption of water in general with the objectives of minimising water waste; maximising water use efficiency; maximising water availability by limiting the degradation of water supplies; optimising water allocation to competing users, including the environment; and limit access to sustainable levels.

3.1 Municipal water supply charges

Increase of water charges for public water supply as a tool for water demand management—Singapore

Municipal water tariffs are considered as a measure to recover maintenance and operation costs and also as an incentive to change the behaviours of consumers. In Singapore, the Public Utilities Bureau (PUB), the water authority, succeeded in reducing water consumption by implementing various measures with emphasis on water pricing. Reflecting the country's pricing policy that promotes the full cost recovery of water production and distribution and water saving to cope with water scarcity, the water tariff structure includes the following components: water tariff, water conservation tax (WCT), sanitary appliance fee and waterborne fee (WBF).[4] From 1997 to 2000, the water tariff was revised step by step, in particular for the domestic sector (Table 7.2).

Table 7.2 Water tariff structure change in Singapore in 1997 and 2000

Tariff categories	Consumption block (m^3/month)	Before July 1997			July 2000		
		Water tariff (S$/$m^3$)	% of WCT	WBF (S$/$m^3$)	Water tariff (S$/$m^3$)	% of WCT	WBF (S$/$m^3$)
Domestic	1-20	0.56	0	0.1	1.17	30	0.3
	20-40	0.8	15	0.1	1.17	30	0.3
	Above 40	1.17	15	0.1	1.40	45	0.3
Non-domestic	All	1.17	20	0.22	1.17	30	0.6
Shipping	All	2.07	20	--	1.92	30	--

Note 1: Water tariff and water conservation tax (WCT) are subject to governmental tax.
Note 2: 1 SGD 1 is approximately USD 0.7 (Price on 23 March 2010).

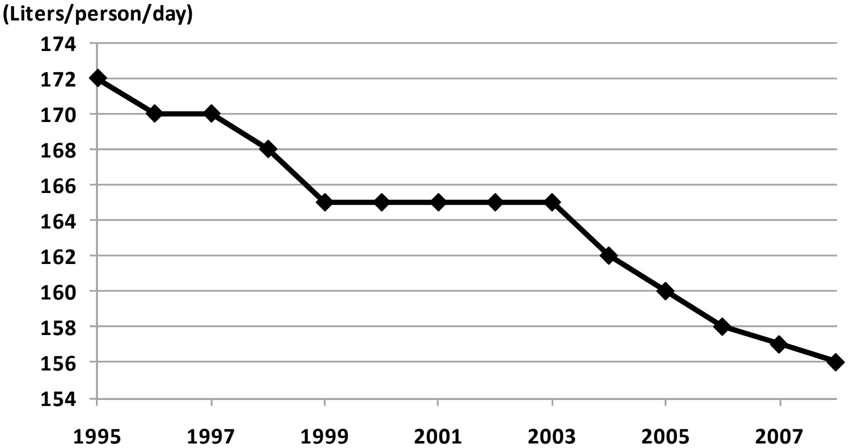
Source: Tortajada 2006

WCT was introduced to encourage water conservation efforts by users and revenue is basically used for governmental water conservation programmes, i.e., research and development to identify innovative and more efficient ways of water treatment and distribution and construction of new water supply sources to meet future water demand (Tan et al. 2009, 166). Because of the nature of the tax, WCT is channelled into the government consolidated fund managed by the Ministry of Finance, while the water tariff is allocated to PUB for operations (*ibid*).

Together with water pricing for water demand water management, the Singapore government adopted other complementary measures; for example, the instalment of water saving devices such as flow regulators became mandatory for the non-domestic sector and common areas in all private residential apartments. The maximum flow rate was designated for different water uses and penalties imposed on violators who exceed the maximum flow rate. To ensure the appropriate application of water saving devices and metering, PUB staff occasionally conduct inspections at sites where water saving devices have been installed (Kiang 2008).

As a result of these efforts, in 2008, each person in Singapore used 156 litres of water a day—16 litres (or 9%) less each day than in 1995 (Figure 7.4). Further, Singapore has targeted to reduce per capita domestic water consumption to 155 litres per day by 2012 (MEWR 2006, 9), 147 litres per day by 2020 and 140 litres per day by 2030 (IMCSD 2009).

Figure 7.4 Potable water consumption per capita/day (1995-2008) in Singapore



Note: Data from 1995 to 1998 is based on Tan et al. 2008. Data after 1999 is based on PUB Singapore 2009.

Source: Tan et al. 2008; PUB Singapore 2009

Together with increases to the water tariff and instalment of mandatory water saving devices, the Singapore government provides direct and targeted financial assistance for lower income households in the form of Utilities Save (U-Save) rebates rather than direct subsidies for water. The rebate is credited to the household's utilities account by the bill collector, Singapore Power Services, Ltd. (SP Services). The household can use the credit to pay monthly utility bills, which include electricity, gas and water. An explanation is given on the Singapore Ministry of Finance website stating that if the rebate is not used completely within one month, the household can still use it in subsequent months, giving an incentive to conserve water and energy. The amount of the rebate depends on the type of public housing, with families living in smaller apartments receiving higher rebates. In 2009, SGD 125 million in U-Save rebates were given to households (Ministry of Finance Singapore 2009).

The above example shows that increasing water tariffs can promote less water consumption by individual water users through a combination of control measures. There are also examples in other countries where increases in water tariffs contributed to a reduction in water consumption. For example, the decline of per capita water use in the early 1970s in Finland coincided with an increase in the water tariff combined with implementing a wastewater treatment charge (Rajala and Katoko 2004). In Denmark, household water consumption decreased by 25% from 1989 to 2001, a period during which the price of water increased by 150% through a combination of taxes: water supply taxes (12%), green taxes (14%), variable taxes (9%), fixed waste water charge (2%), and the state wastewater tax (2%) (European Communities 2004, 18). In Spain, increased water tariffs in 2005 contributed to a significant reduction of water consumption in the domestic sector in 2006. In Madrid, water consumption decreased by about 7% with a 15.6% increase in water price (Global Water International 2008). Johnson et al. found that domestic consumption decreased by 30% in Bogor, Indonesia as a result of price increases (2001).

On the other hand, there are some examples that water tariff increases do not always have an impact on the water consumption behaviour of users. For example, an analysis of the correlation in decreases of water consumption observed in the 1990s in the Tokyo Metropolitan area shows that the recession of the Japanese economy seems to have had more of an impact, rather than the increase of water tariff in 1994. The analysis also shows that the increasing trend of water demand never wavered during the significant economic development period of Japan in the 1970s despite a 160% water tariff increase implemented during the same period (Takizawa et al. 2005). As this case shows, water consumption may also be affected by the social-economic background of the society, and not solely on changes in water charges.

Adequate pricing scheme introduction leads to upgraded water service—Cambodia

The water system in Phnom Penh, the capital of Cambodia, deteriorated and lost its supply capacity by the early 1990s. Most users did not have water meters, and therefore were not appropriately charged for water use. There were also a number of illegal connections, and the rate of water loss (non-revenue water) was as high as 72% (ADB 2007). This destructive situation has been improved with intensive reform of the municipal water supply scheme, including the introduction of an adequate pricing system.

The change started with government policy changes in water management. In the 1990s, the Government of Cambodia introduced the National Water Policy in which water was recognised as an economic good. The policy stated that a financially viable and socially sensitive tariff structure would be required to implement sustainable water management practices. In response to this policy, the water tariff structure was revised in 1994, 1997 and 2001. The tariff was calculated after considering the total expenses of Phnom Penh Water Supply Authority (PPWSA), including operation and maintenance costs and the depreciation cost of all its assets. The Prime Minister at that time strongly supported and publicly proclaimed in 1997 that every person and institution must pay their water bills promptly to ensure good service delivery.

Table 7.3 Water tariff structure of PPWSA in 1996 and 2002

Tariff categories	1996		2002	
	Block volume (m^3/month)	Water tariff (Riel/m^3)	Block volume (m^3/month)	Water tariff (Riel/m^3)
Domestic	0-15	300	<7	550
	16-30	620	8-15	770
	31-100	940	16-50	1,010
	>100	1,260	>50	1,270
Government	Flat rate	940	Flat rate	1,030
Commercial/ Industrial	<100	940	<100	950
	101-200	1,260	101-200	1,150
	201-500	1,580	201-500	1,350
	>500	1,900	>500	1,450

Note: Riel (KHR) is equivalent to USD 0.00023 (Price on 23 March 2010).

Source: Araral 2008

In the water tariff revision, the cross-subsidy rate to domestic users was lowered by reducing the difference between water tariffs for domestic and commercial/industrial sectors to increase equality among sectors (Araral 2008). As a result of the changes in the tariff structure, PPWSA could take in adequate income and become financially self-sufficient.

Reform of the institutional culture of PPWSA was also implemented to ensure disciplined and honest behaviour from the PPWSA staff. Higher salary, promotion system based on performance evaluation, and welfare system (e.g. retirement system) were introduced as the incentives for better performance (PPWSA 2008).

The reform in the pricing system and institutional culture of PPWSA was implemented in conjunction with improvements in water delivery, including the quality of water. In 1996, the PPWSA started to rehabilitate its water distribution network with support from the Asian Development Bank (ADB), World Bank and the governments of France and Japan; the rehabilitation process was completed by 2002. The public was also encouraged to report all leaks, which were promptly repaired.

To phase out illegal connections, inspection teams comprised of PPWSA staff were set up to search for, find and eliminate illegal connections. As a result, the number of illegal connections discovered in one year dropped from 300 cases in 1993 to 5 cases in 2004 (Araral 2008).

With all these measures, PPWSA was highly successful in improving their services (Table 7.4), and unaccounted water was only about 6.2% in 2008, in comparison to 1993, when it was about 72%. This is considered an exceptional case as the unaccounted water in Phnom Penh decreased by 91% in only 15 years. PPWSA accomplished a 100% supply coverage rate, which included about 120 urban poor communities. To facilitate water connection to these families, PPWSA provided subsidies for water tariffs and connection fees. After connection to PPWSA water supply, the poor could access water at lower prices than water they bought from private vendors. According to ADB, water provided by private vendors cost KHR 1,000/day, whereas PPWSA water costs were about KHR 5,000/month (2007).

Table 7.4 Performance improvement of PPWSA service

Indicator	1993	2006
Production capacity (m^3/day)	65,000	235,000
Coverage area (%)	72	6
Supply duration (hr/day)	10	24
Number of connections	26,881	147,000
Metered coverage (%)	13	100
Collection ratio (%)	48	99.9
Non-revenue water (%)	72	6
Total income (billion riels)	0.7	34
Operating expenditure (billion riels)	1.4	9.4

Note: Operating expenditure data is from 2004 (Araral 2008).

Source: ADB 2007; Araral 2008

3.2 Water charges to water abstraction

Charge to groundwater consumption to mitigate overexploitation—Thailand

In the metropolitan region of Bangkok groundwater started to be exploited in the late 1960s, primarily to supplement surface water for municipal water supply. As economic development progressed in the region, individual use of groundwater increased, especially in the industrial sector. As a result, groundwater has been over-exploited and the region has faced considerable land subsidence problems since the late 1970s.

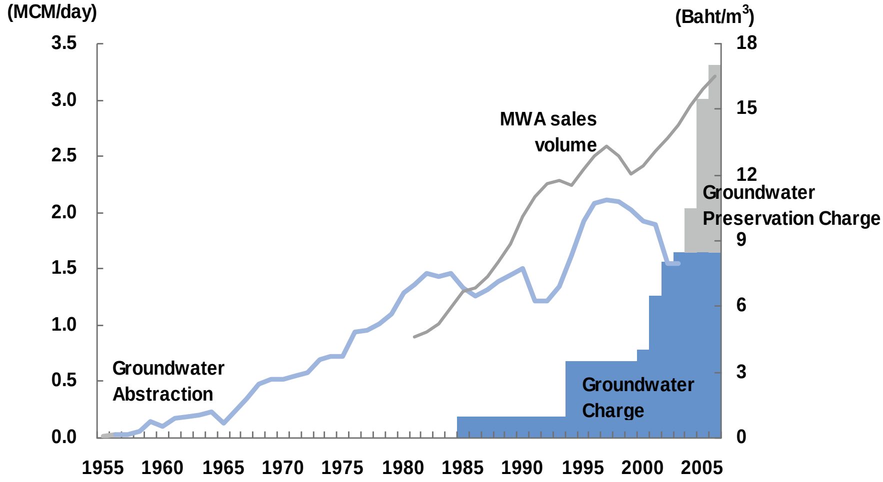
To cope with the overexploitation of groundwater, the Thai government introduced the Groundwater Act in 1978 and implemented several measures. The first charging scheme for groundwater abstraction was introduced in 1985 and targeted groundwater use in the Bangkok metropolitan region, except for Nakhon Pathom and a part of Samut Sakhon. There was not much effect on the reduction of groundwater abstraction in part because the rate was cheaper than other water sources, in particular water provided by municipal supply, which has surface water as its source. Insufficient water supply to meet increasing demand was also a reason behind the ineffectiveness of the groundwater charge (IGES 2007).

As a result of the government policy, groundwater use for municipal water supply and government offices was reduced step by step, however, groundwater continued to be abstracted, especially by the industrial sector. To further reduce groundwater demand, the groundwater charge increased gradually from THB 3.5/m^3 in 2000 to THB 8.5/m^3 in 2003. In addition to an abstraction charge, a groundwater preservation charge was introduced in 2004 in the areas designated as critical areas. The preservation charge started at THB 3.5/m^3 and increased to THB 8.5/m^3 in two years. An innovative point of the preservation charge is that it is earmarked for research and groundwater conservation activities by the Groundwater Act (IGES 2007).

Through the introduction of the groundwater preservation charge, groundwater users in critical areas had to pay more than the water supplied from the municipal water supply system. To persuade industries to reduce groundwater consumption and pay the charges, the Department of Groundwater Resources (DGR) made visits to individual industries. In areas where municipal water supply was not yet available, DGR recommended that industries should promote conjunctive use of surface and groundwater to mitigate excessive exploitation of groundwater.

Figure 7.5 shows that abstraction of groundwater has rapidly decreased while land subsidence has been partly mitigated through a strategy of combining a strict pricing system with expansion of municipal water supply.

Figure 7.5 Groundwater abstraction and groundwater charge in Bangkok



Source: IGES 2007

3.3 Control of agricultural water consumption with economic instruments

Reduction of water consumption with removal of subsidies on shallow tube well installation associated with water price rise and cropping patterns—Nepal

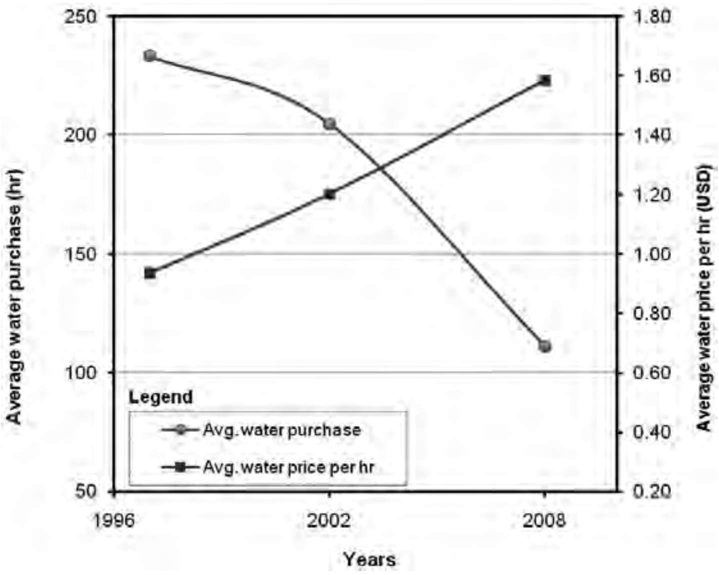
In the Southern Plain region of Nepal, the Government of Nepal has implemented the long-standing, highly subsidised shallow tube well (STW) development programme. The subsidy was designed to promote and expand year-round irrigation for small farmers and also had been somewhat successful in expanding the irrigated area.

The subsidy for STWs started in fiscal year 1982-83 through a lending programme of the Agricultural Development Bank of Nepal (ADB/N). The subsidy was provided only for the installation of STWs, and separate subsidy rates were applied to group STWs and individual STWs. The highest subsidy rates for group STWs was 85% in fiscal year 1994-95 and 50% for individual STWs in fiscal year 1992-93. From 1996, the amount of the subsidy was gradually reduced and was finally phased out in fiscal 1999-2000 for individual and in fiscal year 2000-01 for group STWs. (Awasthi and Adhikary 2004). After phasing out the subsidy, groundwater use has been reduced in many districts of the Southern Plain region due to the decrease in STW installation rates and increases in the price of water. Similarly, it has also been found that many farmers had changed their cropping pattern from low value to high value crops due to the water price increases.

A case study was conducted by the Institute for Global Environmental Strategies (IGES) in September 2009 to examine the impacts of the elimination of subsidies for STW installation, including the impacts on groundwater price and cropping patterns. Three villages in the Dhanusa district of Nepal, namely Bateswar, Bhuchkarapur and Shantipur were selected as case study areas since groundwater is the sole source of water for irrigation, and therefore it is easy to see the impacts of subsidy removal. In the case study, a total of 95 farmers who are engaged in selling and purchasing groundwater for irrigation purposes were interviewed using structured questionnaires.

In the villages, with the phasing out of subsidies, no additional STW were installed. A number of existing STW were also out of order. A by-product of this situation is a decrease of groundwater extraction, which has resulted in a decrease of the water available for irrigation. The decrease in water available in turn resulted in an increase in the price of water in informal groundwater markets, in which farmers who have large land holdings sell groundwater extracted by using STW to farmers with small land holdings. Figure 7.6 shows changes in amount of water sold (hours) and their respective price in three different periods, i.e., during the subsidy (1997), after phasing out of the subsidy (2002) and the recent year (2008). It clearly indicates that groundwater purchase (consumption) decreased after halting STW installation associated with the increase of groundwater price.

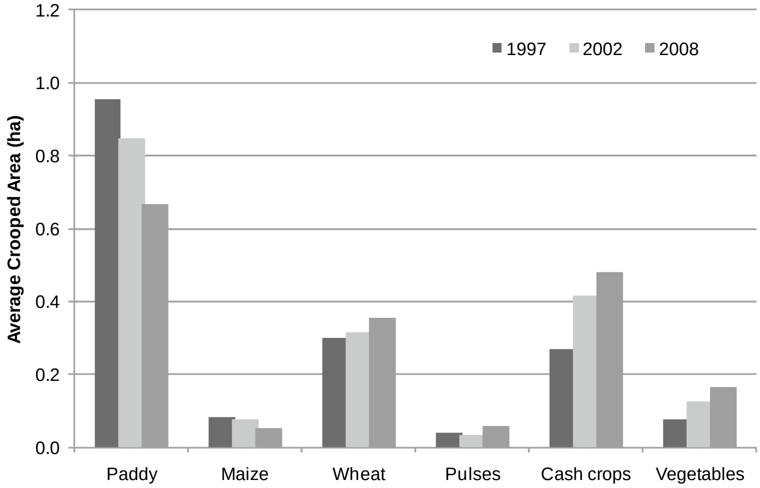
Figure 7.6 Trends of average water purchase and average water price per hour in three different years



Source: Authors (based on the result of field survey conducted by IGES in September 2009)

Farmers had also changed their cropping patterns with the increase in the price of groundwater available for irrigation. It was observed that paddy areas generally decreased in size and the area available for cash crops (sugarcane), wheat, pulses and vegetables increased in size (Figure 7.7). The reason for this change in growing crops was mainly because many farmers could not afford to pay for higher groundwater price shifts for alternative crops, which can command higher market prices while using less water.

Figure 7.7 Changes in cropping area in three different years



Source: Authors (based on the result of field survey conducted under IGES in September 2009)

3.4 Water trading scheme to maximise beneficial use of water

Water trading is defined as "transactions between a buyer and a seller involving water access entitlements or the water allocations assigned to water access entitlements" (ABS 2006). Water trading is in practice around the world—in the western region of the U.S., in South America in Chile, in South Africa and Australia and even in Spain's Canary Islands. In addition, informal water trading schemes exist in other countries, such as those in South Asia, for example.

The aim of water trading is essentially to maximise the benefits of water use by promoting reallocation of water access entitlements to higher-value uses (MDBC 2006). In general, water trading can be categorised into two types: permanent water trading and temporary water trading. Permanent water trading is the movement of water access entitlements from a seller to a buyer in which ownership or responsibility of the entitlements change. In temporary water trading, water access entitlements are sold and bought for a limited period agreed between a seller and a buyer.

The leading case of water trading in Australia

Australia is a country with low water availability because of its seasonal and geographical variability of the resource. Because of water shortages, water use in the agricultural sector, especially in cotton and rice irrigation, decreased, which resulted in a reduction in the total gross value of agricultural production in the country (NWC 2007). To cope with the critical water scarcity condition, the federal and state governments have been promoting water policy reform since the 1990s in which the application of economic instruments, including water trade, was identified as one of the key elements of the reform. The water trading scheme in the country is quite sophisticated, and this sub-section introduces some key points in the development and implementation of the country's water trading scheme by referring to the experiences of the development of the interstate water trading scheme in the Murray-Darling Basin (MDB), where the first interstate water trading occurred.

The separation of water access entitlements from land: Since water trading is the trade of water access entitlements, water access entitlements should be separated from land property. To facilitate water trading of water entitlements, state governments revised their own legislation on water based on the new water policy framework[5] agreed in 1992 by Council of Australian Governments (COAG).[6]

Organisational development for interstate coordination: In principle, state governments have responsibility for water management, such as water development and allocation. Therefore, coordination among the state governments is an important element for promoting interstate water trading. In the case of MDB, the Murray-Darling Basin Agreement was concluded in 1987 among the state governments of New South Wales, Victoria, and South Australia and the Commonwealth (the federal government). In 1992, the state government of Queensland joined the renewed agreement.[7] The objective of the agreement was "to coordinate effective planning and management of equitable, efficient and sustainable use of water, land and other environmental resources of the Murray-Darling Basin." Under the agreement, the Murray-Darling Basin Commission (MDBC) was established as an implementation body for basin level activities. Through the Water Act of 2007, MDBC was replaced by the Murray-Darling Basin Authority (MDBA). MDBA is responsible for planning and carrying out water management at the basin level (MDBA 2009). The Basin Plan prepared by MDBA includes the development of water trading rules for further promotion of water trade in the basin (*ibid*).

Environmental concerns in water trading: Environmental concerns are reflected in the trading scheme. In MDB, total water diversion volume in the basin is capped at the levels in 1993-1994, aiming to protect the river environment and also "to achieve sustainable consumptive use to meet ecological, commercial and social needs" (Murray-Darling Basin Ministerial Council 2006). This rule, called "The Cap," was introduced in 1995 and became permanent in 1997. The Cap became a factor in promoting water trading in the region since no additional water can be developed or diverted.

Water trading schemes are also used for environmental conservation purposes. Through the Living Murray Program which aims to restore the Murray River, MDBA offered to buy water entitlements from current water access entitlement holders in South Australia and Victoria (MDBA 2009).

Current and future issues in water trading in Australia: To further promote the water market and water trade, a National Water Commission (NWC) report on water markets indicated out several points that need further improvements to promote water trade in the country (NWC 2009). Such points include but are not limited to:

- Separation of individual water access entitlements from group or bulk entitlements (e.g., water access entitlements irrigation trust holds);
- Separation of different elements of water entitlements such as water delivery rights and water access rights, which enable water trading between different beneficial uses (e.g., irrigation users and urban users);
- Delay of water plans of state governments that resulted in delay of introduction of water trading;
- Promotion of timely processing to reduce the cost and improve effectiveness of water trade;
- Third party's effects of water trading, such as the impacts related to water loss during transmission (e.g., evaporation) into water trading schemes to avoid third-party effects;
- Measures to cope with indirect impacts of water trade such as community decline.

Water trade in Australia has been increasing rapidly although most are temporary and at the intrastate level. However, it is expected that interstate water trade will expand by addressing the barriers identified above.

Water trade development for sustainable water management—China

Water trading between Dongyang and Yiwu, two cities located in the Jinhua River Basin in Zhenjiang Province, can be looked upon as a successful case of water trading in China. Dongyang, which is located in the upstream of Yiwu in the Jinhua River Basin, has plentiful water resources—88% more per capita than in Yiwu (MWR and DEWHA 2006, 107). To cope with the critical water situation in Yiwu, the first water trading contract in the country was signed between the two cities in 2000. Yiwu bought about 50 million m^3 of water per year at price of RMB 4 ($0.57) per cubic meter from Dongyang (Liu 2008). In addition, Yiwu pays RMB 0.1 per cubic meter for the management and operational cost of the reservoir based on the actual water supply amount. Yiwu was able to cope with serious droughts even without having its own water storages, whereas Dongyang was able to utilise the funds for operation and maintenance of existing reservoirs and water infrastructure by continuing to sell water to Yiwu.

Zhangye located in the Heihe basin shows another example of water trading. In 2002, Zhangye was designated as the first pilot site for the development of a “water saving society”[8] by the Ministry of Water Resources. Under the pilot project the local government of Zhangye allocated water resources to each irrigation unit based on the actual irrigation area of each household in 2000, issued “water right certificates,” and distributed “water tickets” based on the certificates. Water tickets are issued every year. Under the water ticket system, farmers can sell their tickets without restrictions and also request the water users association or local water administration to coordinate the buying and selling of the tickets (MWR and DEWHA 2006). Through the water ticket system, irrigation water use efficiency improved—the total water use for irrigation in 2004 declined about 10% in comparison to the figures in 2000 (Luo 2009).

Water trading is practiced in other areas of the country including the northwest, west central region, and the Beijing and Hebei watersheds. The projects are either local initiatives in response to acute water crises such as the situation between Dongyang and Yiwu, or to promote water saving by the central government, as in Zhangye (Liu 2008).

The water trading system is a promising option to promote rational use of water resources, which will help mitigate the critical water shortage problems in China. In 2008, the state government introduced the “Interim Measure for Water Quantity Allocation” with the aim to address the nationwide growing scarcity of water, water pollution and increasing water demands. This legislation provides a framework for the allocation of water use rights across the areas under the jurisdiction of the central government (Liu 2008).

In the implementation stage, however, there are various barriers. A weak definition of water user rights to be traded, lack of risk-management system where water rights are unfavourably affected, and the absence of operational rules are considered as examples of barriers to future water trading. In the case of the Dongyan-Yiwu water trade, water right systems and other settings have not been developed after the initiation of water trading. An analysis by MWR and DEWHA came to the conclusion that the case rather promoted water rights development in the area (MWR and DEWHA 2006). It also found that the success of water trading was brought about as a result of social-economic development that facilitated social acceptance of market-oriented water rights and allocation. Considering many other areas of the country are not ready to employ market-based approaches, the approach taken by Yiwu is not always applicable to others.

The temporary transfer of water rights using the water ticketing system in Zhangye is more applicable to other areas of the country and could also promote water saving in the agricultural sector. The following points for improvement were raised to further improve the system: clarification of ownership of water abstraction permits and responsibility of the irrigation district management agency, which may play a key role in the ticketing system; flexible water supply arrangements that allow farmers to change crops; and mechanisms to reflect farmers' interests in water allocation (MWR and DEWHA 2006).

3.5 Necessity of an integrated approach of water management for pricing

Japanese case

In Japan, water demand tends to decrease due to various factors such as decline of population, increase of water recycling and reuse in industrial/commercial sectors, and less water consumption by industries due to the impact of economic recessions. Because of the decrease in water demand, revenues from municipal water supply scheme tend to decline in many cities. In addition to these factors, increases in private groundwater use have emerged as a factor that will affect the revenue of municipal water supply schemes in several years.

In principle, groundwater is considered to be a private domain in Japan and therefore, there are no specific measures to control groundwater abstraction except in areas which have experienced severe land subsidence problems caused by overexploitation of groundwater in the past, or in areas where groundwater is used as the main source of water. Registration of groundwater abstraction exceeding specific amounts is often mandated by municipal governments, but there is no strict control for groundwater abstraction.

In recent years, it has been reported that groundwater abstraction by the industrial and commercial sectors has increased and has caused a significant loss of revenue for the municipal water supply scheme in some cities. A survey of 137 municipal water supply schemes conducted in 2008 shows that 15% lost more than JPY 1,000 million/year in revenue because some industries/commercial sector are changing their main source of water to private groundwater abstraction (JWWA 2009). One of the reasons for the increase in private groundwater abstraction is that the cost of groundwater treatment has become more inexpensive due to technology advancements, and the cost of groundwater abstraction and treatment is now less expensive than municipal water. Industries and commercial sectors which have changed their main water source to groundwater are the largest consumers of water who pay higher tariffs under the increased block tariff (IBT) structure. It is a concern that municipal water supply schemes cannot sustain their services if more large water consumers change their main source of water to groundwater. To cope with this issue, there are some municipal water supply schemes which have revised their tariff structure and decreased tariffs for large users.

The implication of this case can be summarised as follows:

- In principle, direct groundwater abstraction is charged in consideration of the value of the resource. However, the current water management system in Japan leaves groundwater as a private domain of land owners, and therefore, authorities are unable to impose charges for abstraction, while surface water is designated as the public domain under the River Law. Groundwater should be managed as part of the public domain and as an integral part of water resources.

- Revenue from municipal water supply schemes relies on large water consumers under the current IBT scheme. It is important to reconsider the current tariff scheme and minimise the risks identified in this case. Narrowing the gap of tariffs between small and large users is an option that could promote more equal burden sharing of operation and maintenance costs among users.

4. Lessons from the cases

Most cases in this chapter show that economic instruments are effective in promoting sustainable consumption of water. On the other hand, these cases also show that economic instruments cannot solely change water users' behaviour and that successes are situational.

In cases in the public water supply sector, substantial increases in water tariffs for municipal water supply affect the demand for water to some extent in both developed and developing countries. In both the successful cases in Singapore and Cambodia, the increase or introduction of water tariffs was a strong pillar used to promote changes in water consumption behaviour of consumers. In both countries, the application of economic instruments was strongly supported by the governmental policies that clearly stated the economic value of water resources and the necessity of water conservation. Proper water metering systems were also a contributing factor to the successful application of economic instruments since water meters give users of public water supply reliable information on the actual amount of water they are using.

These cases also show that increases in water price are not only the factors that contribute to the promotion of sustainable water consumption. In the case of Singapore, the mandatory installation of water saving devices was also a factor. In the case of Cambodia, the overall improvement of water supply services could facilitate adequate water supply.

The case of the Thai groundwater charges shows that the industrial sector was responsive to the increase in water charge. However, the reduction of groundwater demand in industries could not be attained without alternative water sources (municipal water supply in this case). The combination of the increase in charges related to groundwater abstraction and supply of water from other water sources led to the success of this case. In the case of Thailand, the introduction of the water preservation charge should be noted. The charge would contribute not only to a reduction in groundwater abstraction volume as an additional charge, but also to promote groundwater conservation activities by using the revenue exclusively for groundwater conservation purposes.

The direct charging of water to the agriculture sector may result in strong political backlash. In many countries, agricultural water use is not charged or is highly subsidised. To promote sustainable water consumption, the introduction of economic instruments in the agricultural sector should be considered. For example, the removal of subsidies for shallow well construction in Nepal encouraged farmers to consume less water and to consider water efficiency in production by producing higher value crops. Water trading in Australia illustrated a good example of the reallocation of water use to higher value products, although the introduction of water trading requires much effort to create an enabling environment, such as the establishment of water access entitlements, coordination of relevant governmental sectors and water users, and changes in legislation. In the case of water trade in China, the identification of actual water uses and clarification of water rights (water access entitlements) would be major barriers to the introduction of water trading.

Finally, the Japanese case outlined the importance of integrated management of surface and groundwater. Since economic instruments are often designed for single water sources (e.g., for public water supply, surface water, and groundwater), a comprehensive picture of all water resources available in the target area is missing.

4.1 Consideration of the poor in applying economic instruments

In introducing or implementing economic instruments, consideration of the poor is one of the biggest concerns. However, as the Cambodian case shows, the introduction of water tariffs does not always prevent the poor from accessing water. Water tariffs for municipal supply are often lower than the water purchased from private vendors on which the poor without connections to public water supply depend. However, this does not mean that there is no need for financial support for these populations. Support for water connections and/or subsidies for a portion of water tariffs should be provided considering the local economic and social conditions.

In many water supply schemes in the region, the burden on low income groups was also reduced by providing quantity based cross-subsidies in the forms of IBT, which is often introduced as a target-subsidy system with governmental financial support. In the IBT structure, excess costs generated from revenues from some customers offset the cost of subsidies. For example, high-volume water consumers pay more for water and subsidise smaller water users, and higher tariffs to non-domestic users, especially industries, subsidise residential water users. For example, industrial water users pay around five times more than residential water users (Komives et al. 2005). However, in practice, water consumption is not adequately metered and therefore there are substantial non-paying or less-paying customers who are subsidised by those who pay water bills. In case of the Japanese municipal water supply charge, the water consumption patterns of large users have quickly become a concern in relation to the income generated by the municipal water supply, which shows a vulnerability of IBT from the viewpoint of cost recovery. Komives et al. pointed out that rather than subsidise water charges, it is better to subsidise water connections that the poor cannot afford (2005).

U-Save in Singapore is a direct subsidy for utility services provided by the government and clearly targets lower income families. However, the system is beneficial in motivating users to save water since they receive larger rewards by conserving resources.

5. The way forward for sustainable water consumption

Asia consumes more water resources than any other regions in the world, but per capita water use is still low in comparison to the world average. Increased water demand will continue in line with population growth and economic expansion, and water stress will intensify, especially in dry seasons. Considering the limits of water availability, the importance of demand side management (reduction of water consumption) in water management will rise even more.

Economic instruments are recognised as effective tools to motivate or encourage water users to consume water efficiently. There are some good practices in the region as shown in this chapter, but success rates are rather low. In many countries, water is still consumed as a free good and there are few incentives for people to adopt the practice of sustainable consumption. In water supply schemes, water charges remain lower than operation and maintenance costs in many cases. The agriculture sector is often exempt from the charging scheme in most cases and pays less for water. The removal of subsidies for water development infrastructure would be an option to reduce water consumption in the sector. Water trading is also a promising option, but there are huge institutional reforms and capacity development that must be applied before a formal water trading scheme could be adopted. To promote the effective application of economic instruments for sustainable water consumption, the following points should be considered by policy makers in the region.

Economic instruments should be easily accepted if sufficient and reliable information on water use volume and usage of charges is available. For example, appropriate metering is a key factor that can be used to convince public water supply users how much they should pay in return for water actually consumed. Metering is also useful to filter out those who are along for a free ride, i.e., those who are connected but do not pay. Enough information to facilitate trust between water users and water suppliers and also amongst water users is very important.

The water tariffs of municipal water supply should look at the cost recovery of operation and maintenance costs to realise sustainable water supply. The proper tariff can be an incentive to conserve water in residential and industrial sectors.

The tax for the conservation of water resources is useful in convincing water users about the importance of water. The revenue collected from conservation tax should be used for research, financial support for water saving actions, and other necessary measures to promote conservation of water resources. Water users can easily accept such taxes/ charges.

Financial support for the introduction of water saving technologies should be accompanied by water charges to accelerate the behavioural changes of water users. However, the details of such supports should be time-bound or regularly reviewed to ensure their effectiveness.

Subsidies for lower income households are necessary to ensure safe water supply for all. To provide more opportunities to access to water supply to more households, it is useful to provide subsidies for connections to municipal water supply, rather than provision of subsidies for water use volume. The installation of water meters should be also supported to ensure proper charging.

The removal of subsidies related to agricultural water is effective to motivate farmers to reduce water consumption and/or to encourage them to grow higher value crops.

Formal and informal water markets can enhance the efficient use of water such as allocating water from lower value crops to higher value crops, and from crops requiring high volumes of water to crops that do not require as much water. In order to promote water trading, water access entitlements should be separated from other related rights, especially land titles. Various and precise arrangements are necessary to introduce and practice water trading, and therefore not all countries and regions can apply the scheme immediately.

An integrated approach to water resource management is a critical element to further promote the application of economic instruments. Current economic instruments target specific water resources and therefore are unable to reflect the total value of water in target areas.

Notes

1. Examples include large dam construction and large scale diversion of rivers.
2. Water stress can be defined in different ways. In this case, water stress is shown in the percentage of the amount of water consumed for households, industry and agricultural purposes to the total amount of renewable freshwater resources available in a country. The amount of water use does not include so-called “green water” which is “the volume of rainwater stored in the soil that evaporates from crop fields” (WWF 2008, 20).
3. BAU (business-as-usual) scenario assumes that current trends and existing plans in water and food policy, management and investment will continue. For example, management efficiency of river basins and irrigation will increase, but slowly. Public agencies manage water distribution to different sectors, although river basin organisations (RBO) would play a key role in promoting stakeholder involvement and information management. Technological innovation will take place in some water systems. For more details, to refer Rosegrant et al. 2002, 33-60).
4. Waterborne fees are charges to “offset the cost of treating used water” (Tortajada 2006, 233)
5. The water policy reform framework encouraged the State Government members of the Council to implement comprehensive systems for water allocations or entitlements backed by separation of water property rights from land title and clear specification of entitlements in terms of ownership, volume, reliability, transferability and, if appropriate, quality (COAG 1994).
6. COAG is “the peak intergovernmental forum” in Australia. Members of COAG include the Prime Minister, State Premiers, Territory Chief Minister, and the President of the Australian Local Government Association (COAG web site. http://www.coag.gov.au/).
7. Australia Capital Territories also joined the agreement in 1996 through a Memorandum of Understanding (MDBC website. http://www2.mdbc.gov.au/about/the_mdbc_agreement.html).
8. A water saving society is one in which people try to reduce water consumption such through the efficient use of water.

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