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Water Pricing Experiences

An International Perspective

Edited by
Ariel Dinar
Ashok Subramanian

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FOREWORD

With water availability declining in many countries, it is becoming increasingly important to allocate and use this important resource efficiently. Improved water allocation and conservation can be achieved by implementation of appropriate water pricing mechanisms. The World Bank Water Resources Management Policy Paper of 1993 emphasizes the role of water pricing as a policy tool.

This comparative report, a result of a two-year effort of the staff of the Agriculture and Natural Resources Department and country contributors, presents detailed and timely information on water pricing experiences from 22 countries around the world. We hope that the reader will benefit from comparing the past and present water pricing experiences of many countries.

Alexander F. McCalla

Director

Rural Development Department

ABSTRACT

Water pricing is an important way of improving water allocation and encouraging users to conserve scarce water resources. Prices which accurately reflects water's economic, or scarcity value give information to users, which they use to make choices regarding water consumption and use. Thus water pricing can affect water use efficiency, at both the individual and social levels. In practice water pricing schemes may be designed to meet many objectives: policymakers may wish to discriminate among different categories of users or use water charges to raise revenues for general purposes. Because different levels of decisionmakers may interpret such pricing policies differently, this can lead to undesirable outcomes and, sometimes, to disputes.

This work presents water pricing experiences across 22 countries in various sectors and over time. Country case studies are presented in a structured form allowing easy comparison of results. The information shows that countries have different reasons for charging for water, including cost recovery, redistribution of income, improvement of water allocation, and water conservation. Pricing schemes often comprise both fixed and variable components. Fixed prices vary greatly across countries, reflecting countries' various objectives in charging for water. However, volumetric charges for urban and agricultural water are relatively similar across countries. But per meter charges for industrial water vary more widely across countries, reflecting the different use of subsidies and the inclusion of pollution taxes that vary by industry.

For urban and agricultural water, all developing countries, and some developed countries, set charges on the basis of average rather than marginal cost of supply. Countries do not generally adjust charges by region even though the costs of supplying water may vary greatly across regions. Agricultural water users generally pay something for the operations and maintenance costs of irrigation systems, ranging between 20–75 percent of total costs. Few countries attempt to recover capital costs from users.

The willingness of countries to undertake water pricing reforms and successfully implement them cannot be solely explained by their water scarcity levels nor by the size of their budget deficits. However, high income countries are relatively more open to reforming water pricing policies.

Almost all country reports discuss the need for volumetric pricing, metering, moving away from uniform tariffs, and abolishing minimum prices. Many specify the need to significantly increase water charges to all users. Several country reports discuss the use or the need to use of measures, such as pollution taxes, to protect the environment. Several countries recognize the need to provide incentives to water suppliers and consumers.

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This report includes information that was reported between 1995 and 1996. With rapid development in the water sector in many of the participating countries, some new water-related initiatrives may not have been fully addressed in this publication.

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1 WATER PRICING EXPERIENCES: AN INTERNATIONAL PERSPECTIVE

Ariel Dinar and Ashok Subramanian

Introduction

In countries in all parts of the world people are demanding ever larger quantities of water. Yet developing new water supplies is becoming increasingly costly. To meet demand at reasonable costs policymakers are exploring approaches that better allocate existing water supplies and encourage users to conserve water. This is in contrast to the past when governments met new demand primarily by searching for affordable technologies that could augment water supplies.

Water pricing is a key way to improve water allocation and encourage conservation. Prices which accurately reflects water's economic, or scarcity, value gives information to users, which they use to make choices. Thus water pricing can affect water use efficiency, at both the individual and social levels. The literature provides many examples of the influence water charges can have on water use efficiency. However, if prices do not reflect the value of the resource, but are determined to meet other objectives they will not send the right signals to users. In practice water pricing schemes may be designed to meet many objectives besides better water allocation and water use efficiency. Policymakers may wish to discriminate among different categories of users or use water charges to raise revenues for general purposes. Because different levels of decisionmakers may interpret such pricing policies differently, this can lead to undesirable outcomes and, sometimes, to disputes.

Several studies exist which explore the role of water price policies in theory and in practice (Sampath 1992, Tsur and Dinar 1997). Some surveys concentrate on a particular sector (National Utility Service 1995) or a particular country (Duke and Montoya 1993, Ernst and Young 1994). The National Utility Service survey of urban water utility prices in 15 industrial countries shows that changes in prices between July 1994–July 1995 varied considerably, falling 18 percent in one country but rising 21 percent in another. In most places prices rose more than the rate of inflation (Table 1.1).

Both the Ernst and Young 1995 survey of 100 water utilities and the Duke and Montoya 1993 survey of 159 water utilities serving major cities in the United States find that residential water prices increased 9.7 percent above the rate of inflation between 1988 and 1994. Charges in all regions increased at similar rates. In 1994 the water charge in the west, south, midwest, and northwest water scarce regions of the United States was about US$13.5 per 1,000 cubic feet ($0.0038 per cubic meter). About 37 percent of the utilities charged uniform prices regardless of quantity consumed, 22 percent used rising block rates, and 38 percent used declining block rates. The remaining 3 percent used a mixture of schemes. Ernst and Young find that many utilities are charging higher prices than in the past to encourage consumers to use water more efficiently — thereby delaying the need to develop new water supplies. They find that, increasingly, utilities are becoming financially self-sufficient, funding their operations with customer charges. They also find that utilities are sending bills more often to their customers, commonly moving from quarterly to monthly billing as rates increase.

We are not aware of any studies which have tried to compare changes in water prices with changes in policies across countries. Such a study could provide an understanding of why various water pricing policies are adopted. This study aims to document water pricing experiences across countries in various sectors over time.

Table 1.1 Increases in water prices in 15 industrial countries, July 1994 – July 1995 (percent)

	Rate of change in prices per cubic meter	Rate of inflation
Australia	-18.04	4.5
Belgium	20.84	1.3
Canada	6.22	2.9
Finland	0.00	1.9
France	16.45	2.4
Germany	7.06	2.3
Ireland	5.97	2.8
Italy	8.04	5.8
Netherlands	4.40	1.8
Norway	1.98	2.7
South Africa	7.45	10.0
Spain	2.92	4.3
Sweden	0.00	2.9
United Kingdom	3.70	3.5
United States	-0.45	2.8

Source: National Utility Service 1995.

Country case studies

Here we present the findings from a review of 22 country case studies. Table 1.2 lists the countries and provides indicative water prices.

Methodology

Initially 40 countries were selected to participate in the survey. Countries were chosen to represent a wide range of natural, climatic, and economic conditions. The following were key criteria:

- The degree of water scarcity, either in the country as a whole, or in important agricultural regions or population centers; and
- Availability of information on past attempts to implement water pricing schemes in more than one sector.

A structured outline was prepared as the basis for the country reports, and was sent to key people in the water sector in 40 countries. The outline asked for multisectoral information on pricing and changes in pricing policies which have occurred over time (past and present practices, and future perspectives). Experts from 25 of the 40 countries responded: some produced the reports, others provided the names of another expert who could. For the most part authors structured their reports in accordance with the suggested outline. This will help the reader follow and compare the case studies. Only 22 country studies are included in this volume; three of the 25 reports were not returned after the final round of review. Since the countries represented here were not selected through any particular sampling procedure, the results should not be interpreted as reflecting the status of water pricing worldwide. However a comparative reading of the country reports reveals patterns and suggests several lessons and implications.

Findings

Figure 1.1 depicts the "water availability index," as defined by Falkenmark in 1989, for

the countries in the review. One common feature of the water situation is the decline of the "water availability index." The index is calculated by dividing available water resources in a country (assumed to be constant over time) by population. It should be noted that other methods for calculating water availability exist, which may result in different findings and grouping of countries. For example, such methods may take into account the level of water regulation in a country. Figure 1.1 presents the water availability index for 1955, 1990, 2025, and 2050 divided into four group levels of water availability per person, based on the 2025 water availability index results. Group A contains countries with water availability index values of less than 1,000; group B covers countries with index values of 1,000–2,000; group C contains countries with index values of 2,000–4,000; and group D covers countries with index values above 4,000.

Two interesting patterns emerge from the figures. First, the three countries in the Middle East and North Africa have much less water available per capita than other countries in the review, and the amount of water available per person is declining rapidly. These countries had between 2,750–1,000 cubic meters of water available per person in 1955, but by 2050 they will have only 100–500 cubic meter per person. Second, the other countries in the survey either had relatively abundant water supplies in 1955 and high rates of population growth (most of the countries in group B), or moderate water supplies and little or negative population growth (most of the countries in group C). Later we will explore the influence of water scarcity on policy decisions.

Countries have different reasons for charging for water. Some wish to recover costs, some want to transfer income between sectors through cross-subsidization, and others use charges to improve water allocation and water conservation. A recent example of water pricing is the water cess (tax) planned by the government of the state of Gujarat in India, for industries (Box 1.1).

As reported in various country chapters, in many countries users paid the full costs of water supply in the years prior to World War II. Although it sounds unbelievable, farmers in India and Pakistan paid fully for their water supply. However, during the 1950s many countries embarked on huge irrigation investment programs intended to bring down the costs of food production. The investments created a financial burden that farmers could not afford to meet. And because governments in pursuit of food security wanted to control their investments, they willingly subsidized the investments. However trends have now reversed, and users are again being asked to choose and pay for the services they desire.

Comparing water charges

Table 1.2 presents current water prices as reported in the country case studies. Water prices are reported for the agricultural, domestic, and industrial sectors in 1996 United States dollars. For most countries there is a range of prices presented, representing the high and low values reported in the case studies. Local prices were converted into constant United States dollars by using the exchange rate of the noted year, then applying United States dollar deflators using information from the International Monetary Fund (1997). It should be noted that the prices presented in Table 1.2 do not represent national average water prices, and are indicative only.

Values for each sector include fixed and variable prices. The fixed term for the various countries may have different denominators (crop, unit of area, year, season, month, water entitlement, water velocity), which makes them difficult to compare. The huge variation of the fixed element of pricing schemes between sectors and countries reflects the varying objectives of countries for their pricing schemes (cost recovery, income distribution, others).

The variable water prices are expressed in 1996 United States dollars per cubic meter and are easy to compare. Hereafter our discussion of water prices refers strictly to prices per cubic meter. Prices per cubic meter for the agricultural and domestic sectors are relatively similar across countries. Prices for industrial water vary

more widely across countries, probably because some countries view industry as an easy source of revenue, capable of subsidizing consumption in other sectors. In addition some countries include pollution taxes in industrial water prices. Although we did not conduct a statistical analysis, it appears that water prices across countries are not related to relative water availability.

Basis of charges

For urban water supply, the surveyed countries are for the most part replacing flat fees with tariff schemes consisting of two parts, a fixed charge and a variable charge. The fixed charge gives the service provider a reliable stream of revenue to cover overhead expenses, and the variable charge provides consumers with incentives to use water efficiently. The feasibility of charging for water by volume used depends on the practicality of using meters.

There is considerable variation among countries in the design of block rates. Eight countries use increasing block rates, while a couple use decreasing block rates. Taiwan uses increasing rates for the first four consumption blocks but decreasing rates for the last three. In some countries the quantity of water to which the lowest price applies is so large that few users face the higher charges associated with larger consumption levels. This diminishes the impact of this pricing structure on consumption patterns. Most industrial countries in the survey use increasing block rate schemes, although Canada uses flat rates.

For urban and agriculture water, all developing countries and some industrial countries in the survey set charges on the basis of average rather than marginal costs of supply. For agriculture, authorities generally calculate charges by dividing the average cost of service by area irrigated, often adjusting the results by season, type of crop, or type of technology used (for example, gravity versus pumping). Charges are not generally adjusted by region even though regional variations in water availability may be responsible for differential costs of supplying water and for technology used, as in Botswana and Israel.

Among industrial countries, France sets urban water prices on the basis of the long-term incremental costs of supplying water to account for future resource development costs.

Box 1.1 Gujarat plans water cess for industrial houses

"The Gujarat government has planned to levy special cess on the water to be supplied to the industrial houses to partly finance its project to supply drinking water to the villages and semiurban centers from the Narmada dam, the Water Resources Minister, Mr. Raghavji Patel, said here today.

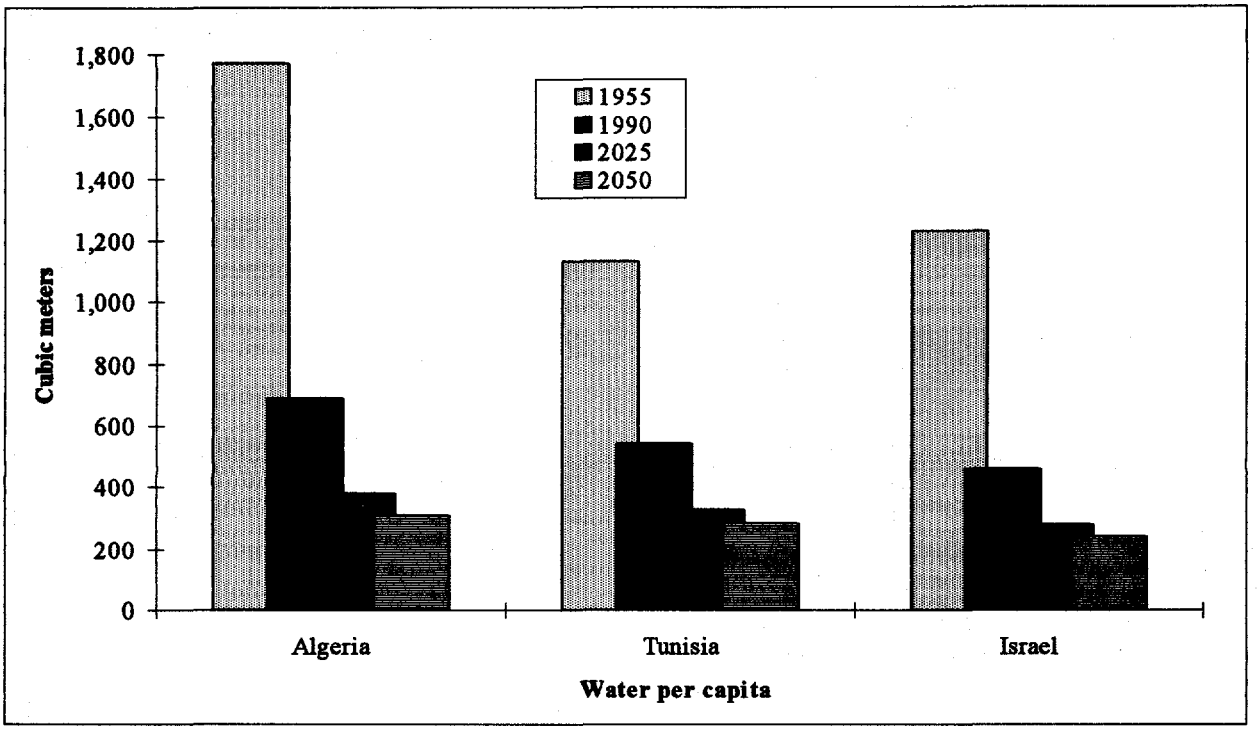
"Talking to newsmen, Mr. Patel said the State Government's plan to supply drinking water to over 8,200 villages and about 130 urban and semi-urban areas, mostly in the arid Kutch-Saurashtra region, was estimated to cost 4,700 crores [Rs. 470 billion.]

"He said the government would also raise funds from its internal resources, assistance from the Central Government and loan from the Asian Development Bank. He said the details of the proposed water cess had not yet been worked out...."

Source: The Hindu 1997.

Figure 1.1 Water availability, 1955-2050

1a



1b

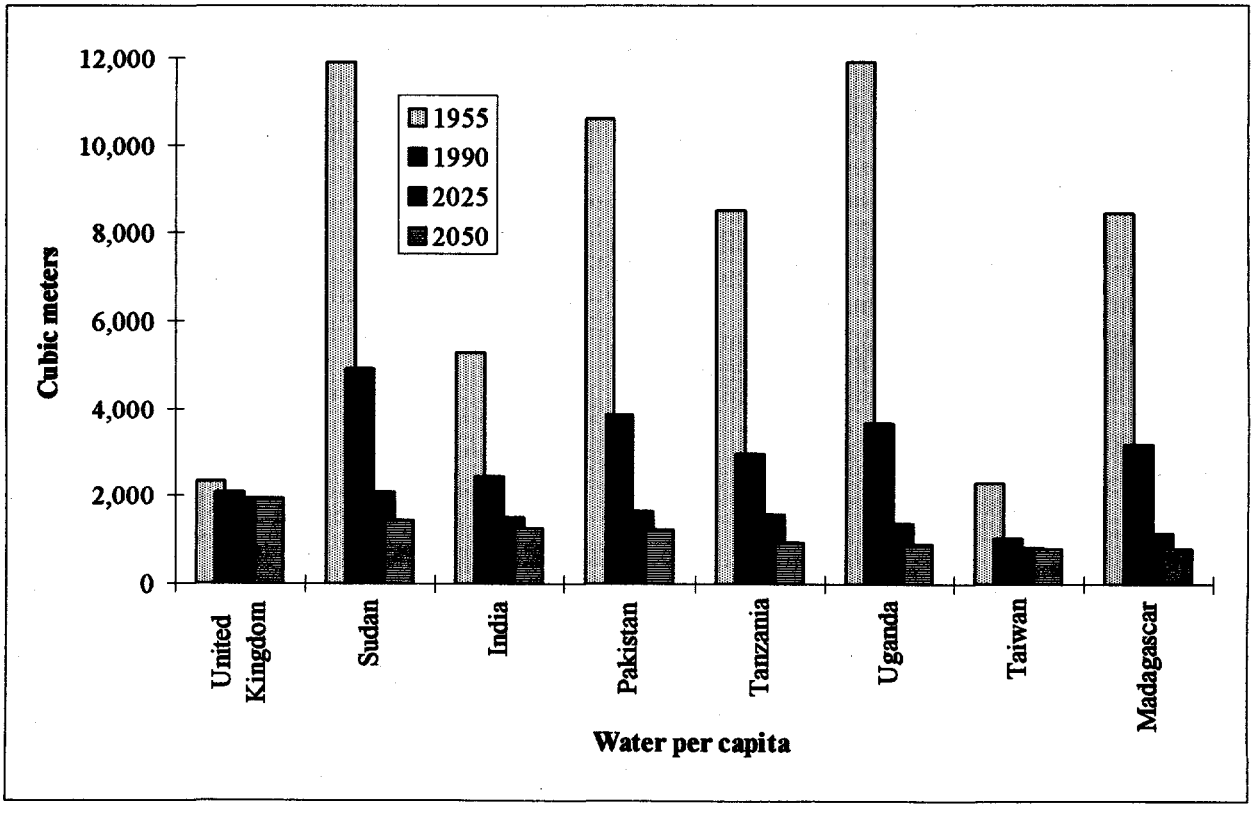
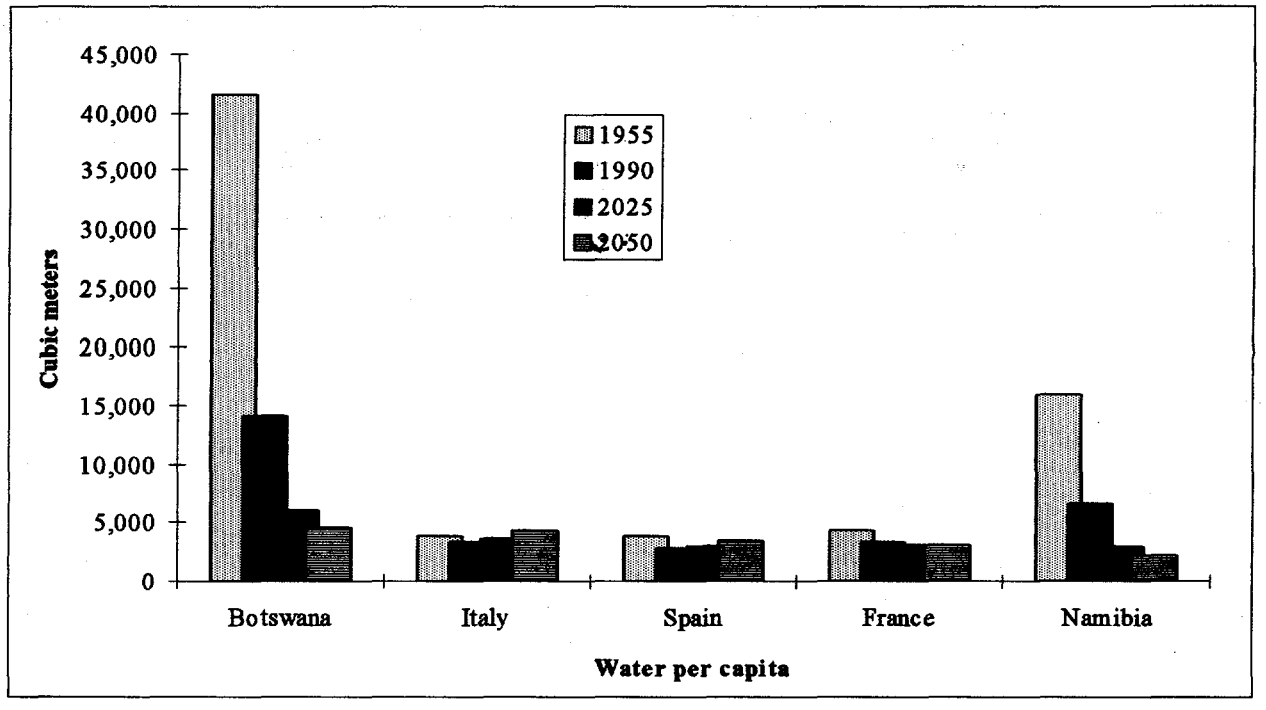
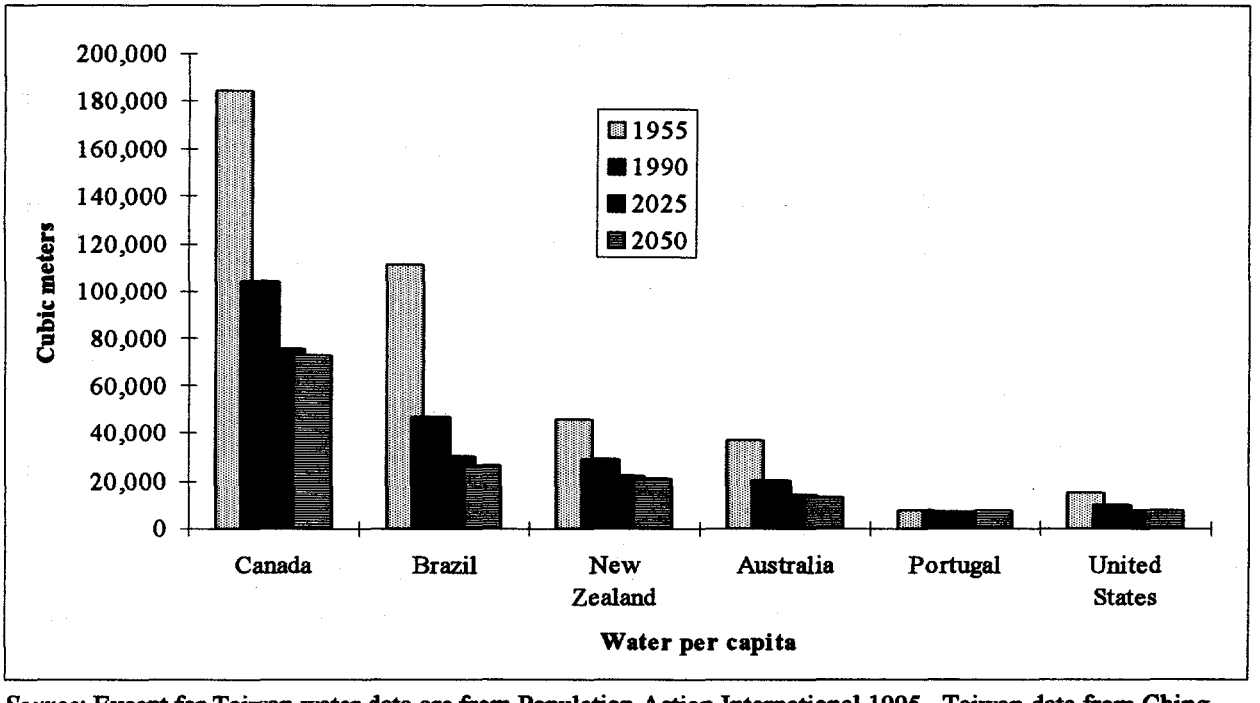


Figure 1.1 Water availability, 1955-2050 (cont.)

1c



1d



Source: Except for Taiwan water data are from Population Action International 1995. Taiwan data from Ching-kai Hsiao (personal communication, 1997.

Table 1.2 Price ranges for various sectors and countries in the analysis (in 1996 US$)

	Agriculture		Domestic		Industry	
	Fixed (per hectare per year or season)	*Variable* (per cubic meter)	*Fixed* (per household per year or month)	*Variable* (per cubic meter)	*Fixed* (per plant per year or month)	*Variable* (per cubic meter)
Algeria[a]	3.79–7.59[1]	0.019–0.22		0.057–0.27[2]		4.64
Australia[b]	0.75–2.27[3]	0.0195	9–162	0.23–0.54		7.82
Botswana[c]				0.28–1.48		
Brazil[d]	3.50	0.0042–0.032[4]		0.40		
Canada[e]	6.62–36.65	0.0017–0.0019		0.34–1.36		0.17–1.52
France[f]		0.11–0.39		0.36–2.58		0.36–2.16
India[g]	0.164–27.47[4]		0.824[5]	0.0095–0.082[2]	5.49[5]	0.136–0.290[2]
Israel[h]		0.16–0.26		0.36		0.26
Italy[i]	20.98–78.16			0.14–0.82[2]		
Madagascar[j]	6.25–11.25[14]		0.075–0.25	0.392[16] 0.325–1.25[17] 0.9–1.75[18]		
Namibia[k,6]	53.14	0.0038–0.028	1.54–4.28 n.a.	0.22–0.45 0.33–1.38		
New Zealand[l]	6.77–16.63		16–164	.31–.69		
Pakistan[m]	1.49–5.80[7]		0.25–1.63[8]	0.06–0.10[9]		0.38–0.97
Portugal[n]		0.0095–0.0193	4.46–1937	.1526–.5293	8.86–2,705	1.19
Spain[o]	.96–164.48	0.0001–0.028		0.0004–0.0046		0.0004–0.0046
Sudan[p]	4.72–11.22[10]		1.67–3.33[11]	0.08–0.10	1.67–3.33[11]	0.08–0.10
Taiwan[q]	23.30–213.64			0.25–0.42		
Tanzania[r]		0.260–0.398[12]		0.062–0.241[12]		0.261–0.398[13]
Tunisia[s]		0.020–0.078[12]		0.096–0.529[2]		0.583
Uganda[t,2]			[7]	0.38–0.59	[15]	0.72–1.35
United States[u]		0.0124–0.0438				
United Kingdom[v]			152–171	0.0095–0.0248		

Table 1.2 (cont.)

1 Per liter per second per hectare.
2 Depending on consumption tier.
3 Per unit of water entitlement.
4 Depending on state and crop.
5 Fixed minimum rate.
6 Domestic includes rural areas (first line) and urban areas (second line).
7 No fixed charges were reported.
8 Depending on crop and province.
9 Depending on monthly rental value per dwelling.
10 Depending on crop and irrigation scheme.
11 Depending on dwelling size.
12 Depending on location.
13 Depending on industry and location.
14 Depending on scale of irrigation perimeter.
15 There are many pricing schedules for unmetered standpipes and unmetered domestic pipes.
16 For house connections, > 10 cubic meters per month
17 For standpipes
18 For vendors

Exchange rates, one US$ equals:

a DA50 in 1995.
b 1.30 Australian $ in 1996.
c P2.82 in 1995.
d R$ 0.96 in 1995.
e 1.20 Canadian $ in 1991.
f 5.55 French francs in 1994.
g 34.54 India rupees in 1995.
h 3.22 Israeli shekels in fall 1995.
i 1,628.9 Italian lire in 1995.
j 4,000 FMG in first half of 1996.
k 3.62 Namibian $ in 1995.
l 1.54 NZ$ in 1995.
m 34.60 Pakistan rupees in 1995.
n 150 PTE in 1996.
o 120 Pts in 1993.
p R$ 0.96 in 1995.
q 27.5 NT$ in 1994.
r 606 Tanzania shillings in 1996.
s 1 Tunisian dinar in 1994.
t 1,050 Uganda shillings in June 1996.
u US$ 1994.
v 0.62£ in 1995.

Source: Exchange rate data from International Monetary Fund 1997.

Operation and maintenance costs versus capital costs

For social and political reasons water services have long been treated as public goods and financed by general public revenues. Policymakers are gradually recognizing however that charging users for water results in more sustainable operation and maintenance of urban and rural water systems. Yet governments often encounter resistance when they attempt to implement new charging schemes intended to recover costs from users.

Countries' experiences with recovering operation and maintenance costs has been mixed. In the developing countries irrigation operation and maintenance cost recovery ranges from a low of 20–30 per cent in India and Pakistan to a high of about 75 per cent in Madagascar. In India and Pakistan the state remains heavily involved in operating irrigation systems. By contrast Madagascar has developed an innovative approach to financing the operation and maintenance of irrigation systems. Among the industrial countries surveyed, Italy and Canada recover the smallest proportion of costs from consumers.

Few countries attempt to recover capital costs from users. Indeed countries rarely include asset replacement or depreciation costs in calculations of operations and maintenance costs (see Spencer and Subramanian in this volume). However governments of both industrial and developing countries are rethinking this policy, and some are starting to recover at least a portion of capital costs from users, as in Australia and Brazil.

Nonprice measures to encourage water use efficiency

In some countries implementing water pricing reforms is very difficult: rural or urban dwellers may resist paying for water and apply political pressure, or technical and managerial capacity may be inadequate to assess and enforce charges. Where this is true, governments may use non-price measures to encourage consumers to use water more efficiently, including transferring management responsibilities to user

groups or promoting the development of water rights and water markets.

Transferring management responsibilities for operations and maintenance to user groups

Madagascar provides a good illustration of the potential benefits that might arise by transferring management responsibility to users. Through a series of pilot projects with the involvement of nongovernmental organizations, the government has organized users of rural public standpipe and irrigation systems into user groups, and has transferred responsibility for operation and maintenance to them. The user groups collect water charges and maintain the physical facilities. Tunisia and Pakistan are now planning similar responsibility transfers. Indeed this approach has become the favored way of improving the financial sustainability of irrigation systems (Gorriz, Subramanian, and Simas 1995).

Promoting water rights and markets

Economists argue that active trading in water rights promotes water use efficiency as markets allocate water to its highest valued use. The potential for water markets to improve resource use is great, particularly in water-scarce regions. Allowing the transfer of water from agriculture to other users can help meet rising demand without the costly expansion of water supply networks. Interbasin transfers can also help improve water allocation. In the United States and Australia there is already some form of water trading taking place. Israel is developing a market to facilitate future trading in water rights. No other countries in the survey are planning water markets at this time.

Progress in reforming water prices: A high-medium-low classification

We have developed a "water pricing progress index" (WPPI) and classified the 20 countries with full data sets of the 22 in the survey into one of three categories of progress: high, medium, and low. Our assessments, which are somewhat subjective, were based on two criteria: current pricing practices, and current mode of funding. We placed a country in the "high" category if it employed some economic pricing methods or, at the very least, recovered full operation and maintenance costs and a portion of capital costs from users. We placed a country in the "low" category if it financed water systems primarily with government resources.

We also identified three characteristics that could influence policy reform: the level of development (gross national product per capita), available water per capita, and the size of the budget deficit relative to gross domestic product.[1] Table 1.3 presents the results of the classifications. The following inferences can be drawn.

Gross national product. High income countries are relatively open to reforming pricing policies. Australia and New Zealand, which introduced water charging systems only in the early 1990s, has adopted some quite radical and advanced policies. Canada is the one high income country that is moving only very slowly to reform water pricing schemes. Botswana and Namibia, two middle-income countries, are making good progress in reforming charging schemes. The city of Windhoek in Namibia, with its progressive pricing policies, may account for the country's relatively high national performance with regard to pricing. Madagascar, a low-income country, has also instituted important reforms in water pricing.

Water availability. We hypothesized that countries with relatively little available water would be more aggressive in reforming pricing schemes than those with relatively more water, since improving water allocation and water use efficiency is especially important to them. However this relationship does not always hold. For example most countries with low water availability have made changes only very

[1] Data on the three variables are from the following sources. Gross national product data are from the World Bank (1995), and refer to 1992 estimates. Except for Taiwan, water data are from Population Action International (1995), and refer to 1990 data. Taiwan water data have been provided by Ching-kai Hsiao. Budget data are from the International Monetary Fund (1997), and represent an average of 1989–95 estimates.

slowly. By contrast Canada, a water-abundant country, has made little progress on reform, but Botswana, also with abundant water supplies, has made significant reforms. Like Botswana, Australia and New Zealand have substantial water resources at the national level and have implemented pricing reforms. Both countries have serious regional shortages, such as in the Murray Darling basin of Australia, so perhaps pricing reforms began at a regional level and were later scaled up.

Budget deficits. We expected that countries with budget deficits would be more likely to implement pricing reforms. However our data do not provide strong evidence that this is the case. Australia, Spain, and the United States have introduced or strengthened water charge systems in response to budgetary pressures. However Canada, India, Pakistan, and Tanzania, all countries with high budget deficits, have not.

Table 1.3 Relationship between pricing reforms and selected country characteristics

		High	*Medium*	*Low*
			Gross National Product	
WPPI	*High*	Australia, France, New Zealand, Spain, United States	Botswana, Namibia	
	Medium	Israel, Italy, United Kingdom	Brazil, Portugal, Tunisia	Madagascar
	Low	Canada		India, Pakistan, Tanzania, Uganda
			Water Availability	
WPPI	*High*	Australia, Botswana, New Zealand	France, Namibia, Spain, United States	
	Medium	Brazil	Italy, Portugal, United Kingdom, Madagascar	Israel, Tunisia
	Low	Canada	India, Pakistan, Tanzania, Uganda	
			Budget Deficit	
WPPI	*High*	Australia, France, Namibia, Spain, United States	Brazil	Botswana, New Zealand
	Medium	Israel, Italy, Portugal, Tunisia, Madagascar	United Kingdom	
	Low	Canada, India, Pakistan Tanzania, Uganda		

Source: Authors estimates.

Summary: Pricing issues in the surveyed countries

The country case studies in this volume provide a perspective of present and future water pricing and water management issues. Most countries are now gradually turning over management responsibilities of water supplies to private enterprises and nongovernmental organizations. Some countries are developing legal frameworks to decentralize water management, and encouraging the private sector to become involved through incentives. Still their water supply authorities have the power to set and adjust water rates. A large majority of the countries are implementing prices schemes to recover operation and maintenance costs from users, and some are also recovering at least a portion of capital costs. Almost all country reports discuss the need for volumetric pricing, metering, moving away from uniform tariffs, and abolishing minimum prices. Many specify the need to significantly increase water charges to all users.

The country reports identify the development of formal transferable water rights and water markets as crucial issues to consider for managing water resources in the future. The reports also recognize the need to provide incentives to water suppliers and consumers. These include both performance related incentives for water suppliers to reduce the costs of water supply, and incentives to consumers to use water more efficiently. Some reports also discuss the use of measures to protect the environment, such as pollution taxes.

Several countries are exploring unique pricing-related issues, worthy of mention. Israel is considering charging different prices for irrigation water of different quality (saline water, wastewater, fresh water), adjusting prices to reflect water supply reliability, and implementing a resource depletion charge. Several countries are considering adjusting charges to reflect regional differences in water supply costs. A few countries have addressed the need to charge the end-user for safer drinking water by including treatment costs in the water tariff.

We have not evaluated the impact of water pricing schemes on the attainment of policy goals. Although the countries in our study reflect a wide range of physical, economic, and institutional conditions, the case studies show that countries are implementing water pricing schemes to achieve short-term and long-term policy goals to recover costs, encourage water conservation, and protect the environment. Although the implementation problems facing countries are different, it appears that efforts to implement water pricing mechanisms are underway with modest success.

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2 ALGERIA

Abderrahmane Salem

Introduction

Consumers use a total of about 950 millions cubic meters water in Algeria each year. Urban consumers use about 600 million cubic meters (63 percent), agriculture uses 280 million cubic meters (30 percent), and industry uses 70 million cubic meters (7 percent). Overall consumption of water in Algeria has fallen dramatically over the past few years, due to the severe drought in North Africa.

Drinking water

Huge investments have been made in urban water systems since 1962, and especially since 1970 when a government ministry responsible for water policy was created. However, frequent restructuring of water institutions has made it difficult to establish efficient organizations and pricing systems.

Before 1970, many different enterprises — some in operation since the colonial period — supplied drinking water without intervention from the state. Among these were local water utilities, local government monopolies, intermunicipal companies, and private foreign enterprises. However, many of the companies were not financially sound or capable of managing the water supply infrastructure. In 1970 the state established the National Water Distribution Company (Société Nationale de Distribution des Eaux), and gave it responsibility for producing and distributing water nationwide. The utility was expected to operate without state subsidies, recovering its costs from water users.

However, throughout its existence from 1970-1983, the National Water Distribution Company was unable to meet this objective. There were a number of reasons:

- Prices remained too low to give the utility financial autonomy Localities, through the Ministry of the Interior, challenged the monopoly position of the National Water Distribution Company, since they had traditionally managed water supply.

As a result, responsibility for providing drinking water was divided into two segments: the National Water Distribution Company retained responsibility for water production, but local water utilities and agencies took responsibility for distribution. The restructuring, which commenced in 1983 and was completed in 1987, also redistributed functions between the central government and local bodies. There is now a hierarchy of organizational bodies involved with water management and supply, comprising:

- 9 regional concerns (under the jurisdiction of the Ministère de l'Equipement);
- 26 departmental concerns (under the jurisdiction of the *wali*[2]); and
- 1,000 local utilities or local government monopolies (under municipal jurisdiction).

These three groups of institutions distribute 54 percent, 28 percent, and 18 percent of water supplies respectively.

Irrigation water

Until 1985, the central government managed irrigation districts through specialized subdivisions, and placed water revenues into special, supplemental irrigation budgets.[3] However in 1985, management of irrigation systems was taken over by four district irrigation agencies (office des périmètres irrigués) in large districts and eight local agencies in small districts. These agencies, responsible for operating and maintaining the irrigation and drainage systems, are financed through water sales and state subsidies.

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2 Equivalent to a prefect or governor.

3 A subdivision is a style of organization for the management of hydraulic systems.

Present water pricing practices

Drinking water

Until the mid-1980s water charges to users were well below costs of supply. For example, in 1974 the average price of water was DA0.25 per cubic meter (US$0.05 per cubic meter). However each locality had its own pricing scheme. Thus price varied by region, village, and type of user, ranging from DA0.10–DA0.60 cubic meter (US$0.02–US$0.12 per cubic meter). Prices did not reflect differences in the costs of supply. Furthermore, local accounting systems did not distinguish between the costs of water production and the costs of water distribution.

The 1985 Water Code law (Code des Eaux) was designed to increase the level of cost recovery for water systems.[4] The tariff system now discriminates among four types of users: domestic, institutions, service enterprises, and the tourism sector. Water tariffs for domestic users depend on consumption block, of which there are four. Water tariffs to other users are set in relation to a base rate, which equals the charge for the first consumption block for domestic users. Table 2.1 presents water prices for 1985–95.

Algeria depends on surface water sources for most of its supplies. Abstracting and treating surface water requires large investments in dams, water transport infrastructure, and water treatment facilities, and has resulted in relatively high operating costs. However, tariffs have not increased as quickly as costs, and water distributors have been operating at losses. The situation has worsened since 1990. This is for two reasons: the drought has resulted in much smaller water production and thus water sales than normal, and the local currency has been devalued, leading to higher investment and operating costs (most water treatment products, hydraulic materials, and other equipment and supplies are imported in foreign currency, so their prices have risen sharply).

[4] Décret 85-287, October 29, 1985.

Irrigation water

Pricing structures for irrigation water lag behind those for drinking water. Before 1985 charges for irrigation water were very low. For example, between 1979 and 1985 prices ranged between DA0.08 and DA0.10 per cubic meter, and revenues did not cover costs. At the same time subsidies from the supplemental irrigation budget were used mostly to construct new irrigation projects, rather than to maintain existing ones. When the irrigation district agencies took responsibility for the irrigation systems, the technical and financial problems became very apparent. This stimulated interest in revising the water pricing policy.

The irrigation water pricing structure now involves a two-part tariff, with one part a fixed charge based on amount of water used per hectare (expressed as DA per liter per second per hectare), and the other a volumetric charge. Irrigation water prices are expected to rise further to ensure the financial viability of irrigation water suppliers.[5] Table 2.2 presents irrigation water prices 1985–95. Table 2.3 shows the prevailing exchange rates of the period.

Irrigation water charges are meant to reflect full costs of service.[6] However, the government pays many of the costs, particularly for capital equipment. Furthermore tariffs are not adjusted in line with changes in costs. For example in 1992, among the nine regional enterprises responsible for nearly 60 percent of urban water supplies, it cost DA4.10 ($0.18) per cubic meter to supply water, but revenue amounted to only DA3.16 ($0.14) per cubic meter. Revenues thus covered only 77 percent of costs. The government gave the water enterprises DA300 million (about US$14 million) to cover the deficit.

[5] The marginal cost of irrigation water was estimated in 1996 around DA18-20 per cubic meter, and it is likely to be an underestimation.

[6] While the OPI are autonomous, the price of water they sell is set by the government without any measure to compensare them. The new water code is expected to rectify some of these problems.

Table 2.1 Drinking water prices (US$ per cubic meter)

	Domestic *Consumption band (cubic meters per year)*				Institutions	Service Enterprises	Tourism
	11-100	101-220	221-330	> 330			
1985	0.20	0.20	0.35	0.50	0.40	0.50	0.60
1986	0.20	0.20	0.35	0.50	0.40	0.50	0.60
1987	0.17	0.17	0.29	0.83	0.33	0.83	0.50
1988	0.14	0.14	0.25	0.36	0.28	0.36	0.43
1989	0.12	0.12	0.22	0.31	0.25	0.31	0.37
1990	0.11	0.11	0.19	0.27	0.21	0.27	0.32
1991	0.06	0.06	0.17	0.24	0.23	0.24	0.29
1992	0.07	0.07	0.12	0.17	0.16	0.17	0.21
1993	0.07	0.17	0.29	0.34	0.24	0.29	0.34
1994	0.06	0.14	0.24	0.29	0.20	0.24	0.29
1995	0.06	0.15	0.25	0.29	0.20	0.25	0.29

Note: Between 1985 and 1992, there were three consumption bands. The first band was from 1–220 cubic meters per year.

Table 2.2 Irrigation water prices, 1985–1995

	Fixed charge (per liter per second per hectare)		Volumetric charge (per cubic meter)	
	DA	*US$*	*DA*	*US$*
1985	150–200	30–40	0.12–0.17	0.02–0.03
1988	150–200	21–29	0.12–0.17	0.02–0.03
1989	150–300	19–38	0.35	0.04
1994	150–300	4–8	0.35	0.04
1995	200–400	4–8	1.00–1.25	0.02–0.03

Note: Both fixed charges and volumetric charges vary by water district.

Table 2.3 Exchange rates 1985–95 (DA/US$)

Year	1985–86	1987	1988	1989	1990	1991	1992	1993	1994	1995
Exchange rate	5	6	7	8	9.3	16	22	24	38	50

Current debates and future prospects

In 1990 Algeria embarked on large scale economic reform, moving from a centrally-planned economy to a market-based one. Institutional reforms are underway to increase management efficiency and improve service. Of particular importance for water institutions are the following:

- The Water Code law is currently being revised to allow private enterprises and non-governmental organizations to manage water supply systems through leasing contracts and concessions.[7]
- The administration, is currently considering implementing tariffs which vary by region, reflecting regional cost differences.
- To raise revenues for the maintenance and expansion of facilities, distribution entities will be permitted to include management fees in water prices starting in 1996.
- In 1995 the National Drinking Water Fund (Fonds National de l'Eau Potable) was established to manage funds to expand and renovate drinking water systems and provide subsidies to disadvantaged regions.

[7] The new Water Code has been published in the official Gazette (June 15, 1996).

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3 AUSTRALIA

Warren F. Musgrave

Introduction

Although Australia is a relatively dry country, its institutional arrangements for supplying water are more appropriate to a water-abundant country.[8] Prices for irrigation water have been low and entitlements to it poorly specified. Most urban consumers have not paid for water in accordance with use, and cross-subsidies have been common. Regulation, rather than price, has played the major role in allocating water among competing uses. Tariff systems have been designed more to raise revenue than to promote the efficient allocation of a scarce resource.

There is now widespread agreement that such arrangements are not appropriate today. Indeed, reform of the Australian water industry has been under way for about a decade. A number of government inquiries have been held, public water utilities have been commercialized, corporatized or privatized, and the attenuation of property rights reduced. And prices have been rationalized, subsidies reduced, and water markets developed.

Australia has six states and two territories. All have been reforming their water policies to some degree. A detailed discussion of the situation in each state and territory is not possible here. Much of the discussion which follows will be general, and apply to the country as a whole. Specific examples will be taken mainly from New South Wales — one of Australia's most important states. The focus of the discussion is on water supply. Other aspects of water management, such as drainage, are largely ignored.

[8] Opinions expressed in this paper are those of the author and are not necessarily of the New South Wales Government nor of the New South Wales Independent Pricing and Regulatory Tribunal.

Past experiences

Irrigation

In the past, irrigation water pricing has been determined mainly by social and developmental considerations rather than by commercial principles. Users have rarely paid the full costs of supplying water, particularly capital costs. Rates of return on irrigation assets have been negative. For example, in 1988–89 real rates of return on irrigation and drainage assets varied between -0.9 and -5.2 percent (Australian Water Resources Council 1991).

In 1992 the Industry Commission a federal government body charged with assessing industry performance, reported that charges to users would have to increase significantly if returns on irrigation assets were to become positive (Industry Commission 1992). In New South Wales a policy requiring a non-negative return on capital would require a 50 percent increase in charges to users (Industry Commission 1992). In the southern Murray-Darling Basin the average charge for irrigation water delivered to the farm would need to rise by 80 percent over 1991–92 levels in order to meet full operations, maintenance, administration and depreciation costs (Collins 1996). The Industry Commission estimated that charges would have to rise by about 250 percent if irrigators were to pay the full cost of the system (including capital replacement costs) and provide a 5 percent return on assets. Similar situations prevailed in other states.

Institutional issues. In Australia the state owns the water. Abstractions are made under license, and state authorities allocate instream flows for environmental and riparian purposes.

Typically, the state agency responsible for allocating water provides both wholesale services by supplying water to distributors, and retail services by supplying water to irrigators. Until the 1980s licenses to abstract water for irrigation were attached to specific parcels of land. During the 1980s this arrangement was modified in most jurisdictions and transferable entitlements were introduced. However, a variety of restrictions were put into place that limited the ability of markets to rationalize the use of water. Initially only temporary transfers were permitted. Transfers were allowed only among irrigators and could take place only within defined geographical boundaries. Bureaucrats supervised transfers closely, prohibiting those potentially harmful to third parties. Experience with the new system has led to a relaxation of some of these constraints. In particular permanent transfers and transfers across spatial boundaries (and thus interbasin transfers) are gradually being allowed.

In New South Wales individuals or entities must have a license to use water from regulated streams. License holders are entitled to a specified quantity of water, depending on needs.[9] Some large water users, such as towns and certain horticulturists, receive secure entitlements, allowing them full specified allocations except during the most severe droughts. Other users, such as ranchers and farmers of annual crops, receive their full allocations only when stream flows and water in storage are sufficiently high. Fees for licenses for secure allocations are higher than fees for other types of licenses. One type of license can be converted into the other by means of valley-specific conversion factors. Holders of licenses to streams with variable flows or which are highly committed may rarely receive their full allocations. Over and above their entitlements, abstractors may be granted access to surplus or off-allocation flows at times of high flows.

While licensing has proved to be a robust institution for the allocation of water in environments with highly variable flows, rights of abstractors are attenuated in a number of ways. Irrigators, in particular, are dissatisfied and seek better specification of rights, including improved security of tenure and specification of more reliable access to water.

License holders on regulated streams in New South Wales pay a combination of license fees (covering less than the costs of administration), metering charges where meters are installed (costs of metering are fully recovered), and volumetric charges where the quantity of water extracted is regulated and can be measured (New South Wales Government Pricing Tribunal 1995).[10] On the principle that others benefit, extractive users pay for only about 70 percent of the costs of supplying water from the rivers. Users pay for only a portion of operating costs and no capital costs for dams and weirs. Depreciation costs of the government-owned irrigation infrastructure is, however, included in the cost calculations. Holders of secure licenses pay an additional charge. All users pay a minimum charge for access to water which is independent of the license and metering charges. A new "water management charge" has been introduced recently to cover the costs of resource management, as distinct from irrigation operating and supply costs. The volumetric pricing structure for bulk or wholesale water in the Barwon Region of New South Wales is shown in Table 3.1.

[9] Discussion here is restricted to allocation policies on regulated streams (streams whose flows are controlled by people using storage facilities). This covers most water used in the state, particularly for irrigation.

[10] Volumetric charges were introduced gradually starting in the late 1960s. Their introduction was an important step, without which subsequent reforms to promote more efficient water use would not have been possible.

Table 3.1 Bulk water tariff structure in the Barwon region of New South Wales

	Volumetric charge (Aus$ per megaliter)
Delivery service charge	2.02
Metering charge	0.50
Total	**2.52**
	Minimum annual charge (Aus$ per year)
Low security	(2.95 x entitlement ML) x 0.33
High security, irrigation	(3.50 x entitlement ML) x 0.33
High security, other	(3.50 x entitlement ML)

Note: In March 1996 1US$ = Aus$1.30.
Source: New South Wales, Government Pricing Tribunal 1995.

Holders of licenses for use of water from unregulated streams pay license fees and, where in use, charges for meters. They do not pay volumetric charges. Groundwater users pay license fees. Unregulated stream and groundwater users pay management fees intended to cover the costs of resource management services (New South Wales Government Pricing Tribunal 1995).

Urban sector

In Australia the supply of water for urban use has nearly always been a public responsibility. Consumers have paid operating, maintenance and administration costs, interest expense and, to varying degrees, depreciation or the costs of asset refurbishment (Industry Commission 1992). The Industry Commission reports that during 1988–89 all major metropolitan water supply authorities had sufficient revenues to service debt and pay a return on capital. Water utilities are increasingly relying on assets they receive from developers, who are required to provide water and sewerage services to their developments and to transfer the assets to the relevant water authority without charge at the time of sale (Industry Commission 1992).

Water authorities are often required to provide services at low or no cost to households as part of government programs of welfare. For example, they may be required to charge uniform rates for service, although the costs of providing the service vary. Or they may be required to provide low or no cost service to low-income households. Utilities rarely receive direct government contributions for these services, and finance them by charging higher prices to their other customers.

Urban consumers typically pay a flat fee for water, based on property value or meter size, and receive a base or free allowance of water. For consumption above this allowance they pay by volume used. The volumetric charge may be constant or may rise with rising consumption (rising block pricing). In 45 percent of jurisdictions in New South Wales, households receive between 350 and 500 kiloliters of water as part of their base allowance (1 kiloliter = 1 cubic meter). In 60 percent of jurisdictions consumers pay between US$0.23 and US$0.54 per kiloliter for water used above this level. In about 9 percent of jurisdictions households pay two-part tariffs with no free water allowance (New South Wales Government Pricing Tribunal 1993).

Where water fees are based on property values, owners of relatively expensive properties, such commercial establishments, pay a relatively high average price for their water. According to the Industry Commission (1992),

in 1990–91 the average household paid US$0.51 per kiloliter of water, but the average commercial establishment paid US$7.82 per kiloliter, 15 times more. Demand management was achieved mainly through exhortation and education rather than through price changes. Table 3.2 shows typical household water and sewerage bills in the major urban areas in Australia in 1993–94.

Table 3.2 Typical household water use and charges for major Australian urban areas, 1993–94 (Aus $)

Major urban authorities	Average annual water use *(kiloliter)*	Access charges		Usage charge	Environmental levy	**Total water and sewerage bill**
		water	*sewerage*			
Adelaide	300	120	216	144	24	**504**
Brisbane[a]	n.a.	311	167	n.a.	24	**502**
Brisbane[b]	430	150	167	161	24	**502**
Darwin	700	n.a.	257	287	n.a.	**544**
Hobart	unmetered	175	189	n.a.	n.a.	**364**
Melbourne	270	11	311	136	n.a.	**458**
Newcastle	220	81	126	293	74	**574**
Perth	330	118	345	111	n.a.	**574**
Sydney	250	89	252	109	40	**490**
Other						
Gosford	245	210	448	29	n.a.	**687**
Wyong	230	176	445	18	n.a.	**639**

a Brisbane charges for property tax based tariff.
b Brisbane charges for properties electing to pay metered charges.
Note: n.a. means not applicable.
Water use is assumed constant throughout the financial year.
Source: New South Wales Government Pricing Tribunal 1993.

Present water pricing practices

Concern over traditional pricing practices has arisen because of their failure to encourage efficient allocation of water, and because of the inequities generated by providing subsidies to some users at the expense of others. More recently, people have become concerned about the financial condition of water utilities and their ability to maintain, renew, and extend their systems and pay dividends to government. Furthermore, charging systems which are not related to demand make it difficult for water supply authorities to determine levels of investment and service provision which the people truly demand. Finally, such charging systems distort the production and consumption decisions of water users (Industry Commission 1992, New South Wales Government Pricing Tribunal 1993).

There have been significant reforms of both urban and irrigation water charging practices. In the case of urban water systems, charges based on property values are being replaced with two-part tariffs, comprising connection fees and charges per unit consumed. Free allowances are being abolished. Although charges under the new tariff system are often insufficient to fully

cover costs, they improve water allocation by providing consumers with incentives to conserve and by eliminating the cross-subsidy which was part of the traditional system. The Hunter District Water Board pioneered these reforms in 1982. It reports, "Substantial expenditures on water storage and distribution infrastructure have been postponed. In addition reductions in out-of-doors use and peak summer consumption postponed the supplementation of the existing distribution infrastructure." (New South Wales Government Pricing Tribunal 1993).

For irrigation, the reforms have entailed mainly higher prices — thus higher levels of cost recovery and improved incentives to conserve water — and the introduction of transferability of water entitlements. The price increases have been implemented despite the objections of irrigators.

In Victoria revenues are sufficient to cover nearly all operation and maintenance costs. In New South Wales charges for water are still well below those of its neighbors. In 1995 the New South Wales Minister for Land and Water Conservation reported "the current charge in New South Wales on the Victorian border is US$1.20 per megaliter compared to US$4.36 across the border in Victoria. The current charge in New South Wales on the Queensland border is US$1.94 compared to US$7.39 (across the border) in Queensland" (New South Wales Government Pricing Tribunal 1995).

The weighted average charge for irrigation water delivered to the farm in the southern Murray-Darling Basin during 1991–92 was US$10.16 per megaliter. It is estimated that charges would have to increase by about 80 percent to cover all costs and by more to provide a return on assets. Since 1992 real charges have risen by 11 percent. Simultaneously, water suppliers have reduced their costs, narrowing the gap further between revenues and expenditures (Collins 1996).

Transferable entitlements and the establishment of water markets were introduced to improve the allocation of water while protecting farmers who had benefited under the old system. Water would flow from lower to higher valued uses through the market mechanism. Promoters of transferable entitlements believed they would lead to overall reform of the industry. However, because of restrictions, trading in entitlements has not been as active as expected, and reform of the industry has been slow. There is increasing acceptance of the usefulness of tradeable permits to improve the allocation of water, particularly in areas where the reliability of water supply is low (Pigram, *et al.* 1992). In the future while central control may remain high, transfers are likely to occur across greater distances, between catchments, jurisdictions and sectors and for greater periods of time. The success of tradeable permits has encouraged policymakers to consider developing markets for a variety of scarce water resources, such as storage space, groundwater, and the pollution dilution capacity of streams (Agricultural and Resource Management Council of Australia and New Zealand 1994).

Current debates and future prospects

Reform of the Australian water industry is proceeding on a broad front. Changes in tariff structures and the development of water markets are two aspects of the process. In New South Wales the Government Pricing Tribunal (now the Independent Pricing and Regulatory Tribunal) is increasingly contributing to the debate on both urban and irrigation pricing issues. Other states are planning to establish similar bodies. The Tribunal has already concluded a major review of pricing practices in major urban areas (New South Wales Government Pricing Tribunal 1993). Local authorities (mainly rural urban entities) and the Ministerial Corporation which regulates streams and provides irrigation water services have both been referred to it for review.

A central government body, the Council of Australian Governments has promulgated a Water Policy Agreement which provides a strategic framework for the industry. The framework targets the following:

- Pricing reform, including full cost recovery and the removal of cross-subsidies
- Asset refurbishment
- Clarification of property rights to water

- Allocation of water to the environment
- Adoption of trading arrangements in water rights
- Institutional and organizational reform
- Community consultation and education programs.

The implications of this agreement are substantial. The Council has agreed to an implementation timetable. However not all states embrace the Agreement and there may be scope for interpretation of its provisions. The history of cooperative federalism in Australia and the power of the federal government (compliance with Council of Australian Governments principles is a condition for states to receive payments from the federal government resulting from a wider program of competition reform) suggest that the prospects for the implementation of the Agreement are good (Pigram *et al.* 1994).

Council of Australian Governments has formed an expert group to establish methodologies for asset valuation and determination of costs to be recovered. Ultimately, these methodologies may be used by water utilities to set charges and report on performance. However, defining and measuring costs is not straightforward. Two central questions are: To what extent should charges be set to cover the typically large capital costs involved in water storage and reticulation? And, how should the charging systems be devised? Some people argue that equity requires charges to cover at least a portion of the capital costs. Others argue that, for efficiency, prices should reflect only non-zero opportunity costs. If the latter view prevails, then charges per unit of water would be very low — the existing capital assets effectively have zero opportunity costs, particularly if they are not to be expanded or replaced.

The expert group also considered a number of alternatives for valuing assets, including historical cost, net present value of earnings, deprival values and variants of renewals accounting.[11] The group recommended the use of deprival values, but some have expressed dissatisfaction with the approach, mainly on the basis of the circularity involved in its determination (Wells 1995). The issue has not yet been settled.

For irrigation water pricing issues, the upcoming work of the Ministerial Corporation to the New South Wales Independent Pricing and Regulatory Tribunal is particularly important. The Tribunal will make recommendations on the following issues:

- Costs that should be recovered and who should pay
- The definition of relevant capital costs
- The appropriate degree of attenuation of property rights, particularly with regard to the security of supply
- The extent to which transferability of entitlements should be liberalized
- The appropriate way of adjudicating the tradeoffs between consumptive use and the environment
- The rate of return the government should receive on its rural water assets
- The impact of alternative price regimes on financial and environmental sustainability
- The recovery of costs of managing common property catchments
- The appropriate nexus between price and regulation in determining water quality standards
- Whether or not compensation should be paid to losers under the reforms
- The regulation and pricing of groundwater use
- The optimal way of allocating water resources, which are stochastic in supply and demand
- The treatment of joint costs
- The appropriate relationships of government agencies responsible for management, operation and regulation of the water resource system
- The replacement of assets and their funding
- The appropriate structure of fixed and variable charges
- The use of differential prices and cross-subsidies

[11] The deprival value is the value to the entity of the future economic benefits that the entity wold forego if deprived of the asset (Steering Committee on National Performance Monitoring of Government Trading Enterprises 1994).

- The valuation and pricing of non-extractive water.

Clearly the task facing the Tribunal is complex and will involve a comprehensive review of water resource economics. Its report is anticipated with great interest.

Conclusion

In Australia water charge systems have not been devised either to provide incentives for the efficient allocation of water resources or to recover costs. Reforms are now underway, but much remains to be done. The development of socially-optimal water charging systems is not easy because of conceptual and measurement problems that remain to be resolved. Australia's progress in attacking these problems should be of interest to more than a local audience.

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4 BOTSWANA

Jane M. Thema

Introduction

In Botswana the Ministry of Mineral Resources and Water Affairs is responsible for national water policy. There are two water supply authorities under the ministry, the Department of Water Affairs and the Water Utilities Corporation, which are responsible for managing the country's water supply systems. The district councils, under the Ministry of Local Government Lands and Housing, are also water supply authorities. The water supply authorities provide water to residences, industries, commercial enterprises, and institutions.

The Department of Water Affairs is responsible for supplying water to the 17 major villages in Botswana, defined as villages with district administrative headquarters or more than 5,000 people in 1975. The Water Utilities Corporation is responsible for supplying water to all urban and mining centers except Orapa, which receives water from the mining company. The district councils are responsible for supplying water to rural villages, defined as settlements with more than 500 people (250 people if it is a remote area settlement).

The Ministry of Agriculture is responsible for supplying water to farmers and herders. The ministry constructs small dams in farming areas used for livestock and assists syndicates (user groups). Until 1993 the ministry supplied water to farmers at no charge. Farmers had responsibility for operating and maintaining the dams, which mainly involved building and maintaining fencing around the dams and keeping the spillways in good repair. In 1993 the ministry changed its policy and asked farmers to contribute 15 percent of dam construction costs.

The ministry also gives grants to syndicates to finance a portion of the costs of sinking boreholes for livestock watering. Syndicates operate and maintain the boreholes, but pay nothing for the water. They are required to obtain water rights from the Water Apportionment Board, which are free of charge. Table 4.1 shows the water demands by sector in 1990. Newer figures are being computed to use for national development plan 8.

Past experiences

Urban water

The Water Utilities Corporation was established by an act of Parliament in 1971 to supply water to the urban areas. From its inception, the Corporation set water charges to cover its costs and generate a reasonable return on its assets so that it could finance new capital investments.

Rural water

In the early 1970s the government initiated a rural water supply program, with assistance from the Swedish International Development Authority. By 1982 most major rural villages had replaced their traditional sources of supply — boreholes, rainwater catchment, hand dug wells, and rivers and streams — with piped water systems. Village households were charged a flat tariff of P2[12] per year for water from standpipe supplies. The tariff was intended to instill a sense of ownership among villagers. However, few villagers actually paid the tariff; indeed the administrative costs of collection exceeded the revenue collected. The tariff was abolished in 1979. Still policymakers hoped, because standpipes were relatively rare and allowed users

[12] "P" stands for PULA, the local currency, introduced in 1976. When the rural water tariff was introduced, Botswana was still using the South African RAND for currency: 1 PULA = 1 RAND.

to save time while providing better quality water, villagers would value and maintain them.

Table 4.1 Water consumption by sector, 1990

	Consumption (million cubic meters)	Percent
Settlements	**33.8**	**28.9**
Urban	19.6	16.8
Major villages	7.4	6.3
Rural villages	6.8	5.8
Agriculture	**54.2**	**46.4**
Livestock	35.3	30.2
Irrigation	18.8	16.1
Forests	0.1	0.1
Mining	**20.7**	**17.7**
Wildlife	**6.0**	**5.1**
Energy	**2.2**	**1.9**
Total	**116.9**	**100.0**

Note: Industrial and commercial other than mining account for 3.5 percent of total demand.
Source: Ministry of Finance and Development Planning 1991.

In 1975 households were allowed to obtain private connections, for which they paid a flat rate of P0.30 per month. The tariff was intended to limit the burden on the government budget and, by increasing it periodically, encourage water conservation. The tariff was to be reviewed annually and adjusted to reflect changes in costs and inflation. However the government never actually carried out the review, and tariffs were not adjusted for the next fifteen years. Once the rural water supply cost and tariff study was completed in 1988, policymakers realized that government could no longer afford the massive subsidies being given to construct and maintain rural water supplies. In 1990 tariffs were raised (Table 4.2), generating sufficient revenue to cover 40 percent of operation and maintenance costs. This was double the rate of recovery in 1989, when revenues covered just 20 percent of costs.

Present water pricing practices

Rural water

The current pricing policy is based on the principles of equity, efficiency, and cost recovery. Equity requires that no one be denied access to safe water because of inability to pay. Financial sustainability requires that revenues equal the costs of supplying water. Efficiency requires that prices reflect the marginal costs of supplying water.

In accordance with these principles, an incremental or rising block tariff system was introduced in 1990. While tariffs are still too low to fully cover costs, they are gradually rising. For equity, water from standpipes is supplied free of charge, and households with private connections pay a concessionary rate for the first five cubic meters of water consumed.

The seventh national development plan of 1991–92 specified a target: by the end of 1996–97 revenue from villagers should cover all recurrent costs for water supply. The tariffs introduced in 1990 were to be reviewed each year and adjusted to reflect changes in costs and inflation. However the tariffs were not actually adjusted until 1993 after they had fallen in real terms by 35 percent. In 1993 the cabinet approved a tariff increase of 50 percent for 1993–94, and increases of no more than an average of 45 percent for the next three, 1994–95, 1995–96 and 1996–97. Table 4.3 presents the 1993 tariff schedule.

Table 4.2 Tariff schedule, 1990

Band	Monthly consumption (cubic meters)	Tariff (P per cubic meter)
1	0-5	0.30
2	6-20	0.60
3	>20	1.20

Table 4.3 Tariff schedule, 1993

Band	Monthly consumption (cubic meters)	Tariff (P per cubic meter)
1	0-5	0.45
2	6-20	0.90
3	21-40	1.80
4[a]	>40	3.50

a Band 4 is applicable to periurban areas only and is equivalent to the bulk rate for urban areas.

Table 4.4 Revenue compared with costs

Year	Operation and maintenance (billion P)	Revenue (billion P)	Percent recovered
1988–89	5,800	1,920	33
1989–90	7,790	2,870	37
1990–91	11,220	5,400	48
1991–92	14,760	6,220	42
1992–93	17,050	6,590	39
1993–94	23,960	8,730	36
1994–95	24,860	10,990	44

Source: Ministry of Finance and Development Planning, various years.

Clearly tariffs will not be sufficient to cover recurrent costs as stipulated in the national development plan by 1996–97. Even if tariffs are raised as scheduled, they will cover only about 60 percent of recurrent costs. Table 4.4 provides data on revenues compared with costs from 1988–89 to 1994–95.

Government pays the full costs of standpipes. However, the budget burden of standpipes is declining in major villages as more households choose private connections. Already in major villages 70 percent of water consumed is through private connections, for which consumers pay. As a result revenue collection from major villages is improving. It should be noted however, that 41 percent of water from private connections carries the concessionary tariff applicable to the first band of water consumed. Annex Table 4.A1 shows the proportion of water consumed through standpipes compared with private connections for typical major villages.

By contrast, in rural villages 85 percent of the water consumed is from standpipes. Villagers pay only about 15 percent of the costs of these services. Although the cost per capita is higher in the rural villages than in the major villages, the district councils use the same tariff schedule as the major villages, set by the Department of Water Affairs. The central government provides grants to the rural villages to finance the deficit. The national development plan proposes that users pay 30 percent of costs by the end of the next plan period, March 2003.

Urban water

The Water Utilities Corporation sets water charges to fully recover costs, as stipulated by the act. Its tariff structure involves rising block rates: rates are low for a specified initial consumption level, and are higher for consumption above this level. This makes water affordable to low income consumers, while en-couraging conservation among higher income users. Block tariffs were restructured in 1992 to more closely reflect water scarcity: the quantity of water eligible for the lowest tariff was reduced from the first 15 cubic meters to the first 10 cubic meters, while the quantity subject to the highest tariff was reduced to 25 cubic meters and above from 40 cubic meters and above. Table 4.5 pre-sents the 1992 changes in the tariff structure.

Table 4.5 Tariff schedule 1991 contrasted with tariff schedule 1993

Band	Monthly consumption (cubic meters)	Tariff			
		Gaborene/ Lobatse	*Jwaneng*	*Francistown*	*Selebi Phikwe*
Old (March 1991)					
1	0-15	0.65	0.55	0.55	0.55
2	16-40	2.60	2.10	2.20	1.28
3	>40	3.50	2.40	2.50	1.65
4	Raw water	0.82	n.a.	0.55	Special tariff
New (October 1993[a])					
1	0-10	0.85	0.85	0.85	0.85
2	11-15	2.50	1.75	2.20	1.28
3	16-25	3.20	2.30	2.50	1.65
4	>25	4.40	2.65	3.20	2.20
5	Raw Water	3.85	n.a.	2.50	Special tariff

a The revisions to the bands were implemented in October 1992.

Source: Ministry of Mineral Resources and Water Affairs 1994.

Urban water tariffs are set by supply region: tariffs in the Gaborone-Lobatse area are higher than tariffs in the Jwaneng area. This reflects the differential costs of supply, which are higher in the water-scarce Gaborone-Lobatse area than in the Jwaneng area. Tariffs send signals to water users on the costs of supplying water in each region. Water intensive industries will factor these costs into their location decisions, and choose to situate in regions with relatively abundant and cheap water, all other factors being equal.

Successes

Rural. There has been a slight improvement in revenue collections relative to costs in rural areas. Rural water users paid 44 percent of total costs in 1994/95, compared with 37 percent in 1989–90 (Table 4.4).

Urban. By 1995–96, 95 percent of urban households received water through private connections which are metered, and pay for water according to quantity consumed. As a result, people treat water as a scarce commodity and waste very little, according to the national water master plan and water use and affordability studies. These studies, while failing to identify a specific measure of elasticity of demand, found a sharp drop in water use following the real increase in the average price of water which occurred in the mid-1980s. The Water Utilities Corporation has succeeded in operating on a commercial basis. It is not however able to meet the rates of return specified in its charter, earning only a small profit on sales.

Difficulties

Rural. Tariffs do not reflect the recurrent costs of rural water supply, and as a result revenues do not come close to covering costs. For example, the cost figures shown in Table 4.4 do not include costs of producing water or of fuel; these costs are combined with the department's other fuel and transportation costs.

Uniform tariffs are set for all supply areas. While administratively simple, this policy masks differential costs of supply, meaning that water users in some areas subsidize those in others. For example, users in both Kasane and Mahalapye pay the same tariff for water, yet Mahalapye is 45 kilometers from its reservoir (annual fuel costs: P368,900) while Kasane is only 0.5 kilometer from its water source (annual fuel costs: P4,553).[13]

The tariff remains too low to achieve the cost recovery objective. The low tariff also inflates demand, thus leading to the need to develop new resources faster than would otherwise be the case. Users with private connections can easily afford to pay double the current charges for water.

Institutional. The Department of Water Affairs still processes its records manually, making it difficult to rapidly identify and follow up probems or identify users who have not paid their bills. In addition, many of the users in default are other government departments. Since the water institution cannot disconnect government departments, it cannot enforce its water charges or raise the revenues its needs to function.

Another problem is that there is no clear policy regarding debt collection. Currently water suppliers do not have legal authority or in-house capacity to collect debts. The department can disconnect consumers who have not their bills, but has no legal means of recovering the debt. Consumers know this, and sometimes request connections for which they have no intention of paying. Currently the costs of operating and maintaining the water systems are paid with government allocations, so the water utility does not have strong incentives to collect debts or review tariffs.

Urban. Manufacturers regard charges for utilities — water, power, and telecommunications — as too high. So policymakers are reluctant to revise them in line with costs or commercial practices (tariffs were last revised in October 1993). This has serious implications for the via-bility of the Water Utilities Corporation, which is now embarking on two major investment pro-grams: the Gaborone-Lobatse's water system upgrade project and the North South Carrier Water Project.

[13] The costs are expressed in 1995/96 prices. US$1 = P2.82 (P1 = US$0.35) in December 1995 (Bank of Botswana 1995).

Table 4.6 Utility prices as percentage of total cost, 1995

	Utility		
Industry	*Water*	*Power*	*Telecommunications*
Hotel	1.11	3.43	0.81
Concrete	0.53	0.72	0.62
Bakery	0.39	1.81	0.62
Packaging	0.33	2.08	0.77
Brewery	1.80	1.20	0.60
Abattoir	1.80	1.99	0.21
Textile	0.74	4.33	0.36
Other	0.74	5.85	1.08

Source: Water Utilities Corporation 1995.

Financing the latter project will require tariff increases of about 7 percent per year until the date the system becomes operational. A recent survey by an interministerial advisory committee on water tariffs shows that water tariffs constitute 0.5–2 percent of total production costs for industrial and commercial consumers, as shown in Table 4.6 (Advisory Committee on Water Tariffs 1995).

Current debates and future prospects

Debates

Issues being debated include:

- *Charges for standpipe water supplies.* Subsidies for standpipe supplies constitute a significant government burden. The national water master plan and the water use and affordability study recommended that standpipe consumers pay a flat rate tariff. Many standpipe consumers are accustomed to paying tariffs, especially in the urban areas.
- *Responsibility for water accounts.* Currently the Ministry of Finance and Development Planning settles government accounts. Therefore government departments have no incentive to pa their water bills.
- *Urban–rural differences in the basic needs water band.* Currently the size of the bands differs, but the rationale for this is unclear.
- *Targeting of concessionary tariffs.* The current tariff structure provides a concessionary rate for the first consumption band — for businesses and households, and for high income and low-income consumers. Yet there is no clear justification for giving businesses or high income consumers the concessionary rate.

Future perspectives

Urban. Policymakers are currently considering introducing a tariff for commercial and industrial users. Compared with the current tariff, the business tariff will involve a higher tariff for the first consumption band but lower tariffs for higher consumption bands. Because this is likely to benefit large consumers while penalizing small ones, decisionmakers will likely allow small business owners to elect whether or not to participate.

The eighth national development plan, now being prepared, is likely to make the water supply authority responsible for wastewater management and reuse. Although sensible, this change may make tariff adjustments even more difficult to achieve, especially in urban areas. Currently

sewerage charges are included in the rates levied by urban councils, but the Water Utilities Corporation operates on a commercial basis, so will almost certainly have to raise the rates.

Rural. It is expected that rural consumers will pay an increasing proportion of the costs of supply. The eighth national development plan is likely to include increases in tariffs to generate sufficient revenue not only to cover operating and maintenance costs but also a portion of capital costs.

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Annex Table 4.A1 Proportion of water consumed through standpipes versus private connections, selected locations

Year	Production (1,000 cubic meters)	Standpipes (1,000 cubic meters)	Private connection (1,000 cubic meters)	Percent private connections	Percent standpipes
Tlokweng					
1989	367	17	282	76.97	4.68
1990	443	1	360	81.35	3.88
1991	481	18	390	81.04	3.80
1992	706	54	546	77.41	7.68
1993	671	27	503	74.93	4.01
1994	730	14	586	80.26	1.93
Mahalapye					
1989	517	77	307	59.34	14.85
1990	654	122	428	65.47	18.72
1991	588	91	363	61.72	15.54
1992	758	77	522	68.94	10.18
1993	896	74	544	60.75	8.20
1994	1,094	110	776	70.91	10.05
Kasane					
1989	212	53	97	45.65	25.02
1990	292	30	117	40.13	10.41
1991	258	34	123	47.76	13.26
1992	409	34	205	50.20	8.25
1993	432	26	266	61.58	6.10
1994	455	29	263	57.71	6.28
Kanye					
1989	704	142	362	51.40	20.18
1990	740	145	407	54.95	19.54
1991	766	182	386	50.36	23.72
1992	864	187	481	55.64	21.64
1993	986	205	560	56.76	20.76
1994	1,074	167	677	63.03	15.58

Source: Derived from Department of Water Affairs, operation and maintenance statistics.

5 BRAZIL

Luiz Gabriel Todt de Azevedo

Introduction

Until recently most Brazilians viewed water as a free good — a gift of god. Over the past few years however, as conflicts over water-use have intensified and public resources to develop water supplies have become scarcer, interest in charging users for has grown. It is believed that introducing water charges will achieve a more efficient allocation of water resources and generate funds for sustainable operation and maintenance of existing infrastructure.

The Brazilian legal framework for water resources management is based on the constitutional distinction between federal and state waters. Federal waters are those that flow across state boundaries or along the boundaries between two or more states or a foreign country. State waters are situated entirely within the territory of a single state. The granting of formal water use rights has been limited to hydroelectric and public irrigation projects. The tradition of treating water as a public good, free to all, rather than an economic good has stymied the development of a manageable water use rights system.

Congress approved a new federal water law (law 9433) in January 1997. The law permits the establishment of bulk water tariffs for federal waters. However, implementing the policy still requires the passage of regulations of the law, expected no sooner than the end of 1997. In the meantime, the establishment of tariffs for federal waters is supported by the country's Civil Code, which states that "common use of public goods can be free or provided for a fee according to specific legislation at the federal or state level," and the Water Act, which states that "charges can be imposed for the common use of waters in accordance with laws and rules of the administrative region where they belong." The states of São Paulo, Ceará, Bahia, and Santa Catarina have already enacted water laws for state waters which include provisions for the establishment of water tariffs for bulk water supply. Water and environmental laws in some states also include provisions for the establishment of pollution charges, to be estimated in accordance with the amount of waste contained in effluent discharges.

There is currently a strong movement in Brazil to develop water tariff systems at the federal and state levels. Studies to support the establishment of bulk water tariffs are being carried out for the Curú river in Ceará, Piracicaba and Capivari rivers in São Paulo, Fêmeas river in Bahia, and the Vacacaí river in Rio Grande do Sul, among others.

Present water pricing practices

Currently there are no bulk water fees for the use of water for irrigation or urban water supply. Hydropower producers do pay tariffs. Farmers using public irrigation projects pay a tariff for operation and maintenance of the systems. Urban water users pay a fee covering the costs of water treatment and distribution and sewage collection. Thus the current practice is to charge users for the operation and maintenance costs of water resources projects, but not for investment or resource costs.

Charges for irrigation water

The current water charging system for public irrigation projects is inconsistent. Tariffs are allocated to the sponsoring agency and distributed to the irrigation districts. In 1995 tariffs for irrigation water supply ranged from US$3 to US$40 for 1,000 cubic meters depending on whether the project was public or private, and whether the water was supplied through gravity or pumping (Table 5.1). By contrast the net economic benefits of 1,000 cubic meters of water averaged about US$20 for low-value crops

and between US$50–US$400 for high value crops.[14] Thus the economic viability of irrigated agriculture for the production of grains and other low-value crops is linked to efficient operation and maintenance of projects.

The irrigation law (law 89.496, 1984) requires that water tariffs for public irrigation projects be set as the sum of two coefficients, K1 and K2. K1 reflects capital costs of the project, and is calculated based on the assumptions of a 50 year repayment period and a subsidized interest rate. Per hectare values are computed by dividing the total value by the number of hectares under irrigation: in 1995 the K1 value for public irrigation projects was R$3.58 (US$3.69) per hectare per month. K2 is supposed to cover the operation and maintenance costs of the project, and is estimated as a function of the volume of water used (R$ per 1,000 cubic meters). Irrigation water is metered in most public irrigation projects. The K1 tariff is paid to the sponsoring federal agency, while the K2 component is normally paid directly to the water users district.

While the two-part tariff may make sense, the way the federal government calculates the K1 tariff leads to many problems, including a lack of clarity as to what methodology to use to estimate its annual value. Furthermore charging farmers for the water on the basis of use alone sometimes leads to a failure to cover the fixed operation and maintenance costs of projects, since revenues from this source are somewhat unpredictable. The law does allow irrigation districts to charge a fixed minimum value of 30 percent of the forecasted volumetric bill to cover fixed operation and maintenance costs. However this is not always sufficient, particularly since farmers choosing not to grow crops in a season rarely have to pay K2 charges at all.

A revised tariff system is under consideration for some projects, for example Jaíba. The approach would involve dividing the K2 coefficient into two factors, one representing the fixed operation and maintenance costs, and the other the variable costs. Farmers choosing not to grow crops one season would still be responsible for the fixed operation and maintenance costs.

The Jaíba irrigation project, under implementation in the state of Minas Gerais, is one of Brazil's best managed public irrigation projects. Water charges and receipts for the irrigation district are illustrative of Brazil's irrigation tariff system. Since the project started operation, nearly 29,700 water bills have been issued, of which 19,600 have been paid (66 percent). The value of these bills totaled R$1.42 million, of which R$742,000 (52 percent) has been paid. The value attributed to the K1 coefficient was about R$370,000 (26 percent), while the value attributed to the K2 coefficient was about R$1.05 million (74 percent). The district is undertaking an effort to collect unpaid water bills. In addition it is implementing a public awareness campaign to encourage users to pay voluntarily. Unless it is successful the project will not have the funds it needs to operate sustainably.

Charges for water supply and sanitation

State-run companies provide drinking water and sewage collection and treatment services in most urban areas. Water users pay a monthly fee for water, which averaged US$0.42 per cubic meter in 1989–90. In the past revenues rarely covered costs. In response most state companies have tried to reduce their expenses by shrinking their staffs and modernizing their systems. Until recently state companies did not pay bulk water fees. However in November 1996 the state of Ceará began charging water utilities US$10 for 1,000 cubic meters of bulk water.

The ongoing federal Water Sector Modernization Project is supporting the modernization of water supply and sanitation agencies in Santa Catarina, Bahia, and Mato Grosso. The main objectives of the project are to help the state companies operate on a commercial basis, and become financially self-sufficient, autonomous, and accountable for their actions. Similar efforts are being initiated in other states, and include privatization of urban water supply and sewage services and the establishment of tariffs which can provide for the long-term sustainabil-

[14] Brazil's currency unit is the real (R$). US$1.0 = R$0.96

ity of water supply and sewage systems and delivery of high quality services.

Charges for hydropower

Brazilian hydropower producers pay fees for the use of water, while foreign firms pay royalties. The fees and royalties are divided among the states and municipalities where the projects are located, the National Department of Water and Electrical Energy for its monitoring networks and safety programs, the Secretariat of Science and Technology for research, and the Brazilian Institute of Environment for studies and water quality improvements.

Table 5.1 Irrigation water tariffs in public irrigation projects, 1995

Project	State	K2 (US$ per 1,000 cubic meters)
Pirapora	Minas Gerais	33.84
Gorutuba	Minas Gerais	4.40
Jaíba	Minas Gerais	10.11
Estreito	Bahia	10.62,[a] 19.95[b]
São Desidério	Bahia	8.24
Formoso A	Bahia	9.36,[a] 15.28[b]
Nilo Coelho	Pernambuco	3.08,[a] 19.36[b]
Bebedouro	Pernambuco	16.00
Mandacaru	Bahia	6.20
Tourão	Bahia	14.98
Maniçoba	Bahia	13.35
Curaça	Bahia	23.80
Propriá	Pernambuco	9.84
Itiuba	Alagoas	9.70
Cotinguiba	Sergipe	8.50
Boacica	Alagoas	8.86

a Gravity Systems
b Pumping Systems
Note: The K1 coefficient is standard; in 1995 its value was US$3.69 per hectare month.

Current debates and future prospects

Bulk water supply tariffs

The chief water resource management issue in Brazil is the establishment of bulk water tariffs. Bulk water tariffs are already being implemented in many states, and studies are underway in others. Some major studies are presented here.

Ceará. A bulk water tariff study is underway in Ceará to establish an initial tariff level, appropriate tariff structure, and timetable for increasing tariffs. The water tariff will help pay for new water storage and conveyance infrastructure. The key constraint in setting the bulk water tariff is that it not exceed the user's ability to pay. Analysts studying the impact of charges on the water company's financial health chose US$18 per 1,000 cubic meters as a realistic tariff: a tariff at this level would require poor urban

families to pay about 1 percent more of its income for water, neglecting the effect of subsidies. In addition it was assumed that the water company would pay US$1 per 1,000 cubic meters of water released from federal reservoirs (currently there is no charge); water losses would be 30 percent of the water yield from reservoirs; the percent of users paying would grow from about 30 percent the first year to 70 percent the fifth year, and stabilize at this level; the unit price of water would increase from 60 percent of the final tariff (US$18 per 1,000 cubic meters) to 100 percent in the fifth year.

Under these assumptions, the water company's revenues would grow from zero in the first year to US$17.7 million in the tenth year, while operation and maintenance costs would increase from US$1.8 million in the first year to US$6.5 million in the tenth year. After the tenth year costs and revenues would be stable. The present value of the stream of income (which generates a rate of return of 8 percent) is very close to the present value of the US$110 million water resources program launched in 1994, assuming that investments are uniformly spread over a ten-year period. This attractive result is also predicated on the assumption that the water company does not pay for the past investments of the federal government.

Bahia. Garrido (1994) conducted the initial, pioneering work for the Fêmeas River, as part of a detailed bulk water tariff study for Bahia. His innovative approach used the willingness-to-pay methodology to set ranges for bulk water tariffs rather than the more commonly used marginal cost method. The study found that users willingness to pay for drinking water was relatively high (US$31 per 1,000 cubic meters) while their willingness to pay for water for irrigation or hydropower in this particular basin was relatively low (US$0.51 and US$0.33 per 1,000 cubic meters respectively).

São Paulo. Investigators are considering implementing bulk water tariffs in the Piracicaba watershed in the state of São Paulo. Here analysts are calculating tariffs as the sum of the marginal cost of developing new supplies and the marginal cost of increasing treatment capacity to treat effluents. Estimates of the second factor are based on the pollution load (tons of biological oxygen demand (BOD) per day). Makibara (1995) has studied the use of variable or seasonal tariffs to reflect differences in water availability regionally or seasonally and differences in the potential of water use to damage the environment. He estimated the cost of urban water supply and wastewater treatment to be between US$10–US$62 per 1,000 cubic meters.

Rio Grande do Sul. Lanna (1995) conducted a study to determine bulk tariffs for flood irrigation of rice in the state of Rio Grande do Sul. He estimated that the marginal capital cost of building two new dams to supply additional water varied from US$22.5 per 1,000 cubic meters (assuming an interest rate of 11 percent and a 20-year repayment period) to US$14.5 (assuming an interest rate of 8 percent and a 50-year repayment period). Local rice farmers found these values very attractive. Lanna has also carried out tariff studies for the states of Santa Catarina in the south and Mato Grosso in center west Brazil.

The use of markets to allocate water

Policymakers are considering developing water markets to allocate water. Water markets are uncommon in Brazil, but both state and federal governments are studying experiences in the United States West, Chile, Australia, and Mexico. Kemper, Gonçalves, and Brito (1995) studied water markets of the Cariri region in the state of Ceará, which have existed for more than a century. This is the only documented example of tradable water rights in existence in Brazil. While the Cariri market is a small isolated system, it provides indications of the value of water, the possibilities of allocating and enforcing water rights in rural areas, and the willingness of water users to pay and cooperate to assure a secure water supply.

The authors compare the prices Cariri users paid in 1993 for water rights to the prices that users in the United States West and Australia paid for water user rights in 1988 and 1989. In 1992 users paid US$1.18 per cubic meter for permanent water rights in Colorado, and about US$0.11 per cubic meter in Australia. The price

users paid in the Cariri region in 1993 corresponds to about US$0.14 per cubic meter per year, which is somewhat higher than in Australia, but considerably less than in the United States. Hearne and William Easters (1995) show that users paid between US$0.06–S$0.51 per cubic meter for water rights in the Elqui and Limay watersheds in Chile. Thus users in the poor and undeveloped Cariri region value water about as highly as users in industrial economies.

Privatization

Brazil is also experimenting with privatizing water suppliers. These companies would operate on a commercial basis, so tariffs would have to cover all costs of supplying water and collecting and treating wastewater — both capital costs and operation and maintenance costs. Some irrigation and hydropower projects have already been privatized. Currently the state of Ceará is offering a ten year concession to build and operate a water plant for the city of Fortaleza (500,000 people) and collect water tariffs in exchange for an investment of US$37 million to build the plant.

Conclusions

Brazil now recognizes the potential of water charges to allocate water efficiently and provide water suppliers with funds to operate and maintain water systems sustainably. The country is quickly moving towards establishing water tariffs for all major users categories in the country. In November 1996 the state of Ceará initiated its program to collect bulk water supply tariffs. Tariff systems are likely to be implemented in the Piracicaba watershed in São Paulo and in selected basins in Bahia within the next two to three years. In addition, the Brazilian government is interested in developing a legal framework which would decentralize the management of water resources and would provide incentives for private sector participation in the development, operation and maintenance of water resources projects.

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6 CANADA

Theodore M. Horbulyk

Introduction

History of water pricing practices

Water pricing policies and management in Canada have focused on managing water supply, not demand.[15] Except for water used in hydroelectric generation, charging for water on the basis of use has not played an important role in allocating water, even where water resources are scarce or there is conflict over access to resources. Many provinces did not introduce volumetric-charges until the 1980s (Tate and Scharf 1996).

Water charges do not, in general, cover the social marginal costs, including environmental costs, of supplying water or of treating wastewater. In the past water utilities received operating support and capital grants from the federal and provincial governments. However, in recent years, government has reduced its support. As a result, many regional and municipal water agencies and utilities have failed to maintain or to reinvest in the physical infrastructure necessary to continue providing water service at historical levels. This has generated interest in charging consumers for water and wastewater treatment on the basis of use (Renzetti and Tate 1994).

In the mid-1980s the federal government initiated a study of water policy. In 1987 a new water policy was adopted. Further refinements in the policy were made in 1990 (Environment Canada 1987, 1990a). One of the five key recommendations of the water policy is to improve water pricing practices (Karvinen and McAllister 1994). However, many homes and apartment buildings lack water meters, and this is a barrier to introducing volumetric-charges.

Present water pricing practices

Institutional context for water pricing

In Canada federal and provincial governments delegate most of their authority for setting charges for the use of surface water to other agencies. Three issues are important: the constitutional authority to set water prices; the distinction between wholesale level and retail level water prices; and the distinction between pricing policies as applied to surface water versus groundwater.

The historical constitutional authority for setting and collecting water charges rests largely with the ten provinces. These provinces, in turn, delegate responsibility for municipal (residential and commercial) water tariffs to regional and municipal water agencies in their jurisdictions. Provinces retain the authority to establish prices for water which users acquire directly from a surface or groundwater source rather than from one of the regional agencies. Federal laws govern water use in the Yukon and Northwest Territories. Federal laws also establish guidelines or set minimum standards for water quality and transborder flows, and regulate activities which affect water use or water quality such as navigation and fishing. The authority to regulate and to charge for wateruse by aboriginal peoples on aboriginal lands appears to be unresolved constitutionally, and may constrain government control in some instances.

The specific regulations governing access to water (including water use licensing and water charges) vary considerably from province to province. Still, there are many similarities in the system of water charges. Foremost, at the provincial government level, water charges have historically been relatively insignificant for allocating access to water or as a source of revenue.

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[15] This chapter was prepared while the author was Visiting Associate Professor in the Department of Agricultural and Resource Economics at the University of New England, Armidale, Australia. Research support from the university is gratefully acknowledged.

Other means of allocating access continue to be important.

Surface water

Four of Canada's ten provinces (British Columbia, Saskatchewan, Ontario and Nova Scotia) have two separate water pricing structures for the use of surface water — wholesale and retail. Wholesale rates apply to transactions between the provincial governments and their direct licensees (such as municipal agencies or irrigation districts). Retail rates apply to transactions between the licensees and individual end-users such as households and farmers. Ontario charges fees per unit of time rather than of volume. The other three provinces charge according to volume (Renzetti and Tate 1994).

Groundwater

Neither the provinces nor the federal government currently charge fees for the direct abstraction of groundwater. However, municipal agencies charge retail prices for water obtained from groundwater sources on the same basis as for surface water sources.

Two provinces, British Columbia and Quebec, have not until recently regulated access to or use of groundwater (Karvinen and McAllister 1994). Two provinces, British Columbia and Manitoba, and the federal government are exploring the possibility of developing groundwater pricing policies (see Canada 1987, 1990a, British Columbia 1993, and Manitoba Provincial Government 1993). If prices for surface water rise, municipalities and agencies may increasingly tap groundwater supplies as a substitute.

Thus, Canada's system of water pricing is principally one in which each province delegates its authority for setting retail prices for surface water supplies to municipal agencies and irrigation districts. The features of this system will be elaborated by considering, in turn, the pricing practices that apply for water in municipal, agricultural, industrial and electric power uses.

Irrigation water

Only a small fraction (2.7 percent, or about 950,000 hectares) of cultivated lands in Canada were irrigated in 1988, although irrigated area has been growing.[16] Most of the irrigated area is in the western provinces. Here irrigation districts, improvement districts, and other agencies that fall under the provinces' jurisdiction are responsible for supplying irrigation water. In contrast, individuals are responsible for irrigation in central and eastern provinces.

Based on data from 1988 farmers pay for irrigation water in three of Canada's ten provinces (Environment Canada 1989).[17] These are British Columbia, Alberta and Saskatchewan, the three western and relatively arid provinces. Even here, farmers do not pay the full costs of supplying the water. Charges are most often defined as service charges. These are retail charges to consumers and are based on the costs of providing water-related services, such as storing and conveying the water, and administering the system. In other cases, water charges to farmers are defined as resource royalties, levied on the use of the water resource itself.

In 1988 farmers paid something for about 80 percent the total volume of water used for irrigation in Canada (this water was applied to 72 percent of the irrigated land area). Specifically, farmers paid service charges for about 61 percent of Canada's irrigation water, and resource royalties for another 19 percent of the irrigation water. Farmers pay both charges for about 4 percent of irrigation water (Environment Canada 1989).

The rate structures employed vary considerably even within a single province. The most common system involves charging a flat rate per hectare per year. Other systems involve charging by volume used and charging a flat rate per

[16] This review of irrigation water pricing is based on Canada (1989). All prices are reported in US$ (1988) with US$0.81/Canadian$. Values for British Columbia come from pp. 4-6; Alberta, pp. 2-3; and Saskatchewan, pp. 10–13.

[17] There was also a charge for the agricultural use of water in the Yukon and Northwest Territories of US$0.033 per day per cubic meter in 1988, but less than 150 hectares were irrigated (Canada 1989).

year, regardless of area irrigated. Generally, volumetric charges are imposed only when a pre-determined minimum level of use is exceeded. In many areas, the existing pricing scheme plays no allocative role: at the prices being charged, there is excess demand in some or all years for irrigation water. Rather water is apportioned according to established water rights, licenses or other sharing rules.

In British Columbia the wholesale (marginal) price of irrigation water in 1988 was US$0.165 per cubic decameter (equivalent to 1,000 cubic meters or 1 million liters or 0.811 acre feet) for individual users and US$0.198 per cubic decameter for users served by a local authority. A typical (retail) flat rate charge would be US$90 per hectare per year which is equivalent to about US$11.20 per cubic decameter.

In Alberta most irrigation water is provided at retail rates by irrigation districts. Some of these districts maintain two rate schedules whereby users with permanent water rights pay a lower charge than those with terminable water rights. Retail prices charged by irrigation districts in 1988 ranged from US$6.50 to US$27.00 per hectare per year under permanent rights, and from US$7.50 to US$36.00 per hectare per year under terminable rights. This water is typically conveyed to individual irrigators in lined canals. Some schemes use pumps and pipes to convey water. In Alberta there is no wholesale charge for water nor is there a charge to individual irrigators.

In Saskatchewan there is no wholesale or retail charge for irrigators drawing water directly from natural water courses. Irrigators receiving water from irrigation districts or drawing water from reservoirs or conveyed in canals or the like, pay according one of a dozen regional rate schedules. A typical retail price in 1988 was US$12.20 flat rate per hectare per year. Another quoted rate is US$3.90 per cubic decameter.

Across Canada there appears to be increased interest in reexamining charging systems used for irrigation and other agricultural uses of water. Some governments and water agencies are following decades old pricing and allocation practices that are no longer entirely satisfactory to the agencies. As in the case of municipal water supplies, some jurisdictions are facing growing conflicts over access to water and budget shortfalls, and this may renew interest in reforming water pricing practices. The recent experience of Alberta, where there are growing conflicts over water use, may be instructive. In this province water policy has been under review since 1991. Recent legislation eliminates a provision in the government's earlier policy proposals allowing the use of diverse economic instruments, including water pricing, to allocate water. The public also opposed the use of resource royalty charges. However, the public supported the introduction of tradable water entitlements, which protect the interests of established water users. Under the new Water Act, the government will be able to impose fees only for water used for electricity generation (Alberta Legislative Assembly 1996).

Urban water

In Canada households consume about 25 cubic meters of water per month. Commercial users, such as light manufacturers or shopping and office complexes consume about 100 cubic meters water per month.[18] In most cases municipal agencies charge users for both the supply of water and the provision of sewage or wastewater services, with charges for the latter often blended with the former. Accordingly, the following will review the prices charged for this bundle of water supply and collection and treatment services, except as otherwise noted in Table 6.2.

[18] This review of municipal water pricing practices draws almost entirely on Tate and Lacelle (1995). In 1991, Tate and Lacelle sent mail surveys to all Canadian municipalities with populations above 1,000. They received replies from 1,325 of 1,523 municipalities (87 percent response rate) and obtained2,762 residential or commercial water rate schedules. These municipalities cover 87 percent of Canada's urban population and pump about 83 percent of all municipal water supplied in Canada. Of the responding municipalities, 93 percent have municipal water supply systems; 89 percent have sewage collection systems, and 88 percent of these provide some level of sewage treatment (Tate and Lacelle, 1995).

Tables 6.1, 6.2 and 6.3 present results from a 1991 municipal pricing survey reported by Tate and Lacelle (1995). Table 6.1 shows that more than one-half of municipal agencies charge flat rates which do not depend on the volume of water used. Indeed, nearly one-half of the households covered by the 1991 survey lacked water meters capable of measuring the volumes of water consumed. Moreover, even where rate schedules are not flat rate by design, they often are in effect. This is because tariff structures often contain a flat fee for a pre-determined level of consumption, which is often set higher than the average household consumption level.

More than 25 percent of the rate schedules apply constant unit charges per cubic meter of water supplied (Table 6.1). In some cases these rate schedules also contain a fixed charge, forming a two-part tariff. About 19 percent of the rate schedules applied decreasing block rate charges, while only 3 percent used increasing block rates (3 percent). Less than 1 percent of the rate schedules sampled are hybrids ("other") that combine, for example, multiple sets of declining or increasing block charges.[19] As noted by Renzetti and Tate (1994), the rate schedules that are in use reflect the adoption by many municipalities of the pricing methods endorsed by the American Water Works Association (1991), or more recently, those of the Canadian Water and Wastewater Association (1993).

Table 6.2 shows the average price per cubic meter of water consumed based on representative levels of monthly use for a typical residence and a typical commercial establishment served by the surveyed municipalities. This price measure also includes charges that are not based on volume used (price per cubic meter is estimated by divided the average monthly bill by the average monthly volume used). Column (a) shows the amount of the charge that is made for the water supply alone, and column (b) shows the integrated payment for water and wastewater service together (sewage charges account for about 40 percent of the integrated charges.) The spatial pattern of charges reflects, in part, the range of climatic and geophysical differences of the country.[20] Permafrost is a feature in some parts of the Yukon and Northwest Territories, which significantly raises the cost of providing water and sewerage services.

Price increases averaged about 33 percent nationwide over the five year period, 1986 through 1991, or slightly more than the overall rate of inflation (during the same period, Canada's consumer price index rose about 27 percent). It is likely that new and increasing sewage charges are responsible for a large part of the price increase (Tate and Lacelle 1995). In a number of provinces commercial water rates are lower than residential rates.

Table 6.3 shows the mean *per unit* price paid for integrated water and sewage service under constant unit charge rates as well as for the first and last available blocks of the block rate schedules sampled in the survey. The favored decreasing block rate structure dominates the block rates sampled and thus the national averages. The constant unit charges have increased by an average of 63 percent over the period 1986 through 1991. These constant unit charges generally lie between the first and last published block rates in a given province.

Table 6.3 also shows the marginal price of integrated water and sewage service for residential water users — the price charged when households increase their monthly consumption of water by one cubic meter above the monthly allowance. Note that these values are defined only for the sub-sample of households in each province that pay for water by volume used, and use larger quantities than the base allowance. In many provinces (and nationally) the majority of users do not pay marginal charges.

[19] The number of users affected by the various rate schedules employed and the charges that they face are not evident in Tables 1, 2 and 3, since these estimates are not population-weighted. Tate and Lacelle acknowledge this potential limitation of their published data. They show that for the "average monthly dollar charge per household," the effect of including such a population-weighting makes less than 1 percent difference in the national total. They show a considerable change for some provinces, however (Tate and Lacelle 1995).

[20] Provinces are listed geographically from west to east, and the two Arctic territories are listed last.

Table 6.1 Frequency of municipal water rate structures by province and rate type, 1991

	Type of municipal water rate structure *(percent of rate schedules offered in each jurisdiction)*				
	Flat rate	*Constant unit charge*	*Decreasing block rate*	*Increasing block rate*	*Other*
	(a)	(b)	(c)	(d)	(e)
British Columbia	57	17	20	4	2
Alberta	20	47	25	7	2
Saskatchewan	12	52	23	11	1
Manitoba	19	16	64	0	0
Ontario	37	33	25	4	1
Quebec	71	24	3	1	0
New Brunswick	68	10	19	2	0
Nova Scotia	28	3	70	0	0
Prince Edward Island	64	36	0	0	0
Newfoundland	90	7	4	0	0
Yukon and Northwest	39	61	0	0	0
Canada (mean)	**50**	**27**	**19**	**3**	**1**

Source: Adapted from Tate and Lacelle 1995.

Important issues to be resolved in setting tariffs for municipal water use in Canada include a chronic and perhaps worsening (capital) funding shortfall by the water utilities. Many municipalities claim not to have the financial resources needed to maintain or to expand the water supply and associated wastewater treatment facilities that they are responsible for providing. Some agencies will want to raise revenues by charging users by quantities consumed. Those municipalities that undertake reforms in municipal water pricing will have to take responsibility (regulatory and financial) for assuring that all establishments are equipped with water meters. Currently, few people pay for water on the basis of time-of-use or place-of-use. However metering technology is now capable of measuring both. Introducing charges based on these characteristics would lead to more efficient allocation of water.

Industrial water pricing

In five of Canada's provinces industries were not charged for water used on a self-supply basis in 1988.[21] Industries typically use this water for activities such as manufacturing and processing, for example hydraulic mining, and for cooling. (The use of water for hydroelectric generation is discussed below.) In Canada's five other provinces and two territories industries paid something for water. In many cases the charges for water was identified as being for the use of services or water infrastructure and were not considered a resource royalty.

[21] This review of industrial water pricing is based on Canada (1990b).

Table 6.2 Average price for municipal water service, by province and class of service, 1991

	Residential water supply only	Residential water supply plus sewage	Change in (b) 1986 to 1991	Commercial water supply plus sewage
	(US$ per cubic meter, assuming consumption of 25 cubic meters per month)		*(Percent)*	*(US$ per cubic meter, assuming consumption of 100 cubic meters per month)*
	(a)	(b)	(c)	(d)
British Columbia	0.34	0.48	+35.6	0.28
Alberta	0.72	1.09	+25.8	0.83
Saskatchewan	0.61	0.89	+23.4	0.74
Manitoba	0.67	0.94	+14.9	0.85
Ontario	0.50	0.80	+38.1	0.59
Quebec	0.38	0.45	+34.0	0.22
New Brunswick	0.42	0.71	+22.3	0.36
Nova Scotia	0.59	0.69	+41.8	0.43
Prince Edward	0.35	0.65	+31.0	0.32
Newfoundland	0.37	0.50	+46.4	0.17
Yukon and Northwest	1.34	1.53	+40.2	1.49
Canada (mean)	**0.48**	**0.69**	**+33.5**	**0.44**

Note: Dollar values are 1991 US$ converted at US$0.83/Canadian$.
Source: Adapted from Tate and Lacelle 1995.

Four jurisdictions used a constant unit charge rate structure in 1988, two used decreasing block rates, and one used increasing block rates. Some jurisdictions also offered a partial credit for clean return flows such as occur when water is used for cooling. The rates in effect in 1988 varied widely across the country and bore no obvious relationship to the rates charged for municipal or agricultural uses in each jurisdiction. Consider an industry that uses about 1,500 cubic meters per month on a self-supply basis (about 1.5 cubic decameters per month). In 1988 Nova Scotia and Manitoba reported the lowest incremental rates, at US$0.00036 per cubic meter and US$0.0008 per cubic meter, respectively. The Territories, Saskatchewan and Alberta had higher rates of US$0.018, US$0.02 and US$0.066 per cubic meter respectively. British Columbia had the highest rates US$0.143 per cubic meter. (See Environment Canada 1990b, with US$0.81/Canadian$ 1988.)

It appears that water charges for industries have not received the same degree of public scrutiny as for municipalities. Policy makers are likely to focus on this issue in the future, either in seeking solutions to conflicts over water access or when various governments find it necessary to find new sources of revenue either to develop water resources or for other purposes.

Table 6.3 Unit prices and marginal prices for municipal water service by province 1991 (all prices expressed in Canadian dollars per cubic meter)

	Constant unit charge	Average price first block	Average price last block	Marginal price[a] for residential use of 25 cubic meters/month	Percentage change in (a) 1986–91
	(a)	(b)	(c)	(d)	(e)
British Columbia	0.23	0.29	0.22	0.28	+47.4
Alberta	0.72	0.84	0.68	0.74	+53.6
Saskatchewan	0.63	0.71	0.58	0.67	+35.7
Manitoba	0.98	0.92	0.63	0.94	+51.9
Ontario	0.62	0.70	0.48	0.64	+85.0
Quebec	0.28	0.27	0.23	0.30	+37.5
New Brunswick	0.49	0.58	0.26	0.55	-53.5
Nova Scotia	b	0.30	0.17	0.30	n.a.[c]
Prince Edward Island	0.25	n.a.[b]	n.a.[b]	n.a.[b]	n.a.[c]
Newfoundland	0.15	0.17	0.08	n.a.[c]	-71.9
Yukon and Northwest Territories	1.64	n.a.[b]	n.a.[b]	1.51	+71.3
Canada (mean)	**0.52**	**0.60**	**0.43**	**0.60**	**+63.2**

a Thirty-six observations were excluded since minimum-use levels were not met, making marginal price effectively zero.
b Not available, no relevant rates.
c Not available, too few observations.

Note: Dollar values are 1991 US$ converted at US$0.83/Canadian$.
Source: Adapted from Tate and Lacelle 1995.

Pricing of water for electric power generation

There also exists in Canada a series of rate structures that apply to the use of water for the generation of electricity by hydroelectric and thermal steam technologies.[22] Since almost all of the water used for generation is returned to water courses for the benefit of other users, few specific details will be reported here. In many cases power generators pay flat rates or multi-part tariffs based on some combination of installed or utilized levels of water storage or electric generation capacity. Many jurisdictions that charge for hydroelectric uses do not charge for thermal uses. It does not appear that any of the rates charged depends on the storage season and few depend on the specific location of the water source (Environment Canada 1990c).

In some cases water is added to hydroelectric storage reservoirs at times of the year, such as late spring, when it can be used in agriculture, and released at times of the year, such as mid-winter, when it is not useful to other users. If

[22] This review of water pricing for power generation is based on Canada (1990c).

there is growing competition for use of the same water at the same time, there may be increasing pressure to rationalize these uses and thus to use water prices as a means to allocate water. It is also well-documented that water storage regimes may harm fisheries and other instream uses, again raising interest in using water pricing to allocate resources.

Current debates and future prospects

There is little evidence so far that Canadians are ready to widely implement relatively sophisticated forms of water charges, such as differential charges for time-of-use, or location-of-use. Instead, it is likely that recent trends will continue, including the introduction and reform of wastewater charges, and the increase in the use of water metering, especially as some jurisdictions seek to move away from flat rates. At the same time water agencies will be seeking new ways to finance capital investments and operating expenses as subsidies from the federal and provincial governments decline. This will force them to raise a larger proportion of their revenues from users.

The proposed move to create transferable water entitlements, such as for irrigation users in Alberta, will for the first time allow market forces to play a direct role in allocating water rights in times of scarcity. Moving to market-based instruments to allocate water from surface water sources, will put pressure on other aspects of water supply. For example, regulators and users alike will likely draw more heavily on groundwater sources, attempt to reduce conveyance losses, and work to improve utilization of return flows if these become the least-cost sources of supply under a new market-based allocation policy. Water pricing reforms are likely to also be used to encourage industrial users to reuse their wastewater (Renzetti and Tate 1994, Tate and Scharf 1996). Further pricing policy reforms may be inevitable.

These piece-meal or sector-by-sector reforms are almost certain to draw attention to the potential to rationalize water pricing and management across sectors and users. Pricing policy reforms for irrigation users may raise questions about rates being paid by those who would draw water from the same source, including municipal and industrial users, and those who store or draw water for electric generation. Indeed, historical pricing practices that charge for hydroelectric generation but exempt thermal electric generation may face increased scrutiny, especially from irrigators and industries whose own access has become determined by markets.

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7 FRANCE

Marielle Montginoul

Introduction

In France water rights are public and non-tradable. Table 7.1 presents estimates of water abstraction and net consumption for different water uses. Cities and farms are the largest net consumers of water; hydroelectric power stations use more than half of all abstracted water, but return nearly all of it to the water courses.

Table 7.1 Water resources, withdrawals, and consumption by sector, 1990

	Withdrawals		Net consumption	
	Billions cubic meters	*Percent of total*	*Billions cubic meters*	*Percent of total*
Urban water	6.1	16	2.5	44
Irrigation	4.9	13	2.4	42
Industries not connected to a distribution system	4.4	12	0.4	7
Hydroelectric power stations	22.3	59	0.4	7
Total	**37.7**	**100**	**5.7**	**100**

Source: Ministère de l'Environnement.

In France, river basin organizations are responsible for managing water resources and supplying water to users. River basin organizations all employ the same water charging structure, which contains four main components:

- A levy that theoretically reflects the economic value of water, determined at the level of the river basin.
- A fee for the cost of purifying water and conveying it to the end user, determined at the local level.
- A pollution tax that theoretically reflects the cost of environmental externalities. The charge is based on the polluter-payer principle, and is determined at the river basin level.
- For drinking water, a value added tax was levied by the National Fund for the Development of Water Conveyance with various adjustment and compensation objectives. The value added tax is included in the price for water, as with other goods and services.

Past experiences

Historically, charges for water have been differentiated by use. Charges for the three main users of water are described below.

Urban water

For urban water, service charges originally reflected the cost of conveying the water, and nothing more. The concept of setting charges to reflect the economic value of water started at the end of the nineteenth century with the establishment of distribution companies, which metered water use and charged for water according to consumption. As demand for urban water steadily grew (by 1-2 percent per year over the

past 100 years), and new sources of clean water became increasingly scarce, water treatment was introduced. Charges were raised to reflect the increased scarcity value of the resource and the costs of purifying water for drinking. Since 1964 water agencies have also included pollution charges in water bills. In 1992 a new water bill was adopted, which increased water charges to users. The National Fund for the Development of Water Conveyance, specific to drinking water, has been in existence since 1954.

Industry

Industries connected to the water distribution network pay the same charges as other users. The steady increases in water charges have stimulated industries to reduce their water consumption significantly. Indeed during the 1980s industrial water use fell by about 20 percent. The drop in demand is also due to the decline of water-intensive industries in France.

Irrigation

Farmers have paid for irrigation water ever since large-scale transfer and storage works were first constructed. An early example is the case of the Saint Julien Canal, built in 1171 and extended for irrigation in 1235. Large-scale irrigation works were first constructed in the relatively dry regions in the south. However, during the 1970s, irrigation works were built throughout the entire country. As a result, water abstraction for irrigation grew by 43 percent during 1975–88. Resource taxes were introduced at the same time as the creation of water agencies. Farmers pay pollution taxes for water used for cattle, but not for water used for crop irrigation. Historically, water charges were based on area irrigated. Currently, farmers pay a two-part tariff, comprising a fixed charge per hectare and a volumetric charge.

Present water pricing practices

Water charges in France take different forms, depending on local political decisions, regulations, management of the resource, and taxes and charges collected by the state or other organizations involved in managing and supplying water.

Regulations

Regulations have been passed to meet three objectives:

- *To comply with norms of the European Union.* Since the beginning of the 1970s regulations for water management have been increasingly restrictive at the European level. European Union Directives set standards for drinking water quality, river water quality used for the abstraction of drinking water, and water quality of sensitive ecosystems.
- *To price water closer to its true economic value.* An accounting instruction of November 1992, part of a national law, required towns to balance the water service budget and not just the town's global budget by January 1993. The water law of January 3, 1992 forbids the use of a two-part tariff for drinking water.
- *To include costs of environmental externalities in prices.* The 1964 water law created basin committees and water agencies, which manage water in six French hydrographic basins. They are responsible for applying the user-pays and polluter-pays principles by means of taxes, levies, subsidies, and the granting of concessions.

Two types of taxes are used, the pollution tax and the resource tax. The pollution tax is set to reflect the concentration and nature of pollutants in industrial and household discharges. In theory, the tax should cover the costs of treating the contaminated water. In practice, the tax is set to assure budget balance. The resource tax (Table 7.2) is set to manage water demand and to cover the costs of modifying waterways to cover the costs of infrastructure and to compensate people who are harmed as a result of the change. It is comprised of:

- A catchment component, which is related to the volume abstracted.
- A consumption (or net withdrawal) component — the difference between the abstracted volume and the return flows.

- A water diversion component. This is calculated on the basis of the length of the watercourse made dry as a result of the diversion, and its importance for drainage.
- A materials extraction component, which is based on the tonnage of extracted alluvial materials.

Table 7.2 The resource tax from Rhône–Méditerranée–Corse Water Agency (covering Rhone Valley, Mediterranean and Corsican water basins) (1994 US$)

	Urban[a]	Urban[b]	Industry[c]	Irrigation[d]	Irrigation[e]
Catchment	908	908	908	227	908
Consumption	280	190	13	401	401
Drinking water[f]	4,180	4,180	n.a.	n.a.	n.a.
Total	5,296 (0.027 per cubic meter)	5,278 (0.0252per cubic meter)	922 (0.0047 per cubic meter)	628 (0.0031 per cubic meter)	1,309 (0.0065 per cubic meter)

a Southwestern town withdrawing 200,000 cubic meters from groundwater sources.
b City in water-abundant zone 1 withdrawing 200,000 cubic meters from groundwater sources.
c Industrial establishment of Franche-Comté (zone 1) pumping 200,000 cubic meters from groundwater water sources.
d Irrigators withdrawing 200,000 cubic meters in Provence to spray irrigate 50 hectares.
e Irrigators diverting 200,000 cubic meters from groundwater in Provence to spray irrigate 50 hectares.
f Water agencies levy a separate tax on drinking water in addition to taxes for catchment and consumption.
n.a. is not applicable.

Current water charges

Water charges vary for individual users, so it difficult to calculate average prices. Water charges vary according to use, location, mode of management, or tariff type (fixed-rated, proportional, two-part, and others). An example of charges set by a regional development company, which sells untreated bulk water, is discussed below.

Sale of untreated water: The case of the Canal de Provence Company

Regional development companies (société d'aménagement régional) were created in France between 1955 and 1960 under the auspices of the Ministry of Agriculture to promote agricultural development. These companies currently sell bulk water to irrigators and others. Although they benefit from advantages generally reserved for state-owned enterprises (such as the access to public funds), they are private companies required to balance their budgets. Thus, the Canal de Provence Company, in southeast France, sets water charges to fully cover long-term incremental costs.

Canal de Provence Company differentiates its rates according to category of user, distance from water source and pumping costs, nature of the demand (year-round or seasonal only, peak period or security only), and season of use. Charges for water for normal use have three components. The first consists of either an annual tax proportional to the rate of outflow diverted by the consumer or an inclusive fixed rate consumption tax. The fixed rate consumption tax includes a water allowance of 100 cubic meters for each cubic meter per hour subscribed for irrigation water. The second component is a

volumetric charge, which is based on volume used and time of year (charges are higher for water used between May 15 and September 14 than during other times of the year). The third component is a supplementary pumping tax, covering the cost of fuel when the company is required to pump water to supply its customers.

The board of directors of the Canal de Provence Company reduced water rates by 50 percent in 75, and have maintained the lower prices. However, they may raise rates at any time. In 1993 consumers paid an average US$0.31 per cubic meter for bulk water. This was comprised of different charges for different uses:

- Agricultural irrigation: US$0.11 per cubic meter.
- Nonagricultural irrigation (gardens, lawns): US$0.39 per cubic meter.
- Urban: US$0.36 per cubic meter.
- Industry: US$0.36 per cubic meter.

Water tariffs for different uses

Urban water. Charges for drinking water in France is comprised of different elements, described in Table 7.3. Average water prices have increased rapidly since the beginning of the 1990s due to the promulgation of new national and European regulations. In constant dollars, average charges (including taxes) have increased by 65 percent from 1990 to 1995, from US$1.55 per cubic meter in 1990 to US$2.56 in 1995. The rate of increase slowed in 1995. Average charges however mask considerable variation in charges to different users.

Geographical disparity. Charges vary with river basin. For example, in Rhône-Méditerranée-Corse in 1992, the charges ranged from zero to US$4.05 per cubic meter, and averaged US$ 0.93. Water charges in the countryside are 8 percent less than in towns (the standard deviation in charges is also higher in the countryside). In Ile-de-France in 1992 prices ranged from US$1.62 per cubic meter in Paris to US$2.34 in the Department of Essonne. Seine-et-Marne had the largest variations charges of any department, with charges ranging from US$0.21 to US$4.41 per cubic meter.

Type and size of town. Water charges are generally higher in small rural towns than in medium- and large-size cites. Nevertheless, data collected in 1994 by a consumer association show inconsistencies. The Conso 2000 (1995) survey of over 1,200 towns found that water charges averaged US$1.57 per cubic meter in towns with less than 500 residents, and US$3.00 per cubic meter in towns with more than 200,000 inhabitants. The national average was US$2.22 per cubic meters. Water charges increased more in large cities than other settlements between 1990 and 1994. However, charges grew faster in small towns between 1992–1994.

Type of service management. Local administrative bodies (the mayor or the president of union towns) are responsible for drinking water purification. The local body may manage this responsibility directly or may delegate it to private enterprises. According to the French national consumer council, in 1995 charges were 30 percent higher when water was managed by private companies rather than local authorities. This is partly because private water companies deliver higher quality service. The Ministry of Agriculture, Food and Fisheries estimated that in 1994 in rural towns (with fewer than 2,000 inhabitants), the average charge with direct management was US$1.75 per cubic meter (with a standard deviation of US$0.71), and US$2.51 (with a standard deviation of US$0.84) with delegated management. The results by river basin are presented in Table 7.4.

Charges for purifying drinking water and treating wastewater are still low. This can be explained by the low level of investment in these activities. According to Boistard (1993), the lack of information on total costs makes it difficult to separate out this item from total costs.

Table 7.3 Urban water prices (1995 US$)

Elements	US$ per cubic meter	Percent	Contribution to overall price increases, 1992–94 (percent)
Water agency and National Fund for the Development of Water Conveyance taxes	0.40	15.5	35
Drinking water distribution service	1.17	46.0	17
Wastewater treatment	0.85	33.0	41
Taxes	0.14	5.5	7
Total	2.56	100	100

Source: Syndicat Professionnel des Entreprises de Services d'Eau et d'Assainissement, cited in Retowsky 1995.

Table 7.4 Drinking water price according to the management, 1994 (US$ per cubic meter)

River basin	Direct management	Delegated management
Adour Garonne	1.91	2.65
Artois Picardie	1.45	2.01
Loire Bretagne	2.14	2.86
Rhin Meuse	1.29	1.88
Rhône Méditerranée Corse	1.45	2.40
Seine Normandie	1.89	2.70

Source: Ministère de l'Agriculture, de la Pêche et de l'Alimentation, personal communication.

Industrial water. Industries connected to the urban water distribution network pay the same for water as domestic consumers. But, as industry consumes more water than households and water pricing is regressive (decreasing block pricing), industry benefits from important discounts. Industries pay less for untreated water delivered by a bulk water distributor, such as a regional development company. They may also supply water to themselves by pumping directly from an aquifer or river. In either case, industries are required to pay water agency taxes depending on the quantity of water abstracted and consumed, and the quantity and type of pollutants discharged. Thus, companies pay highly variable water taxes.

Irrigation water. Information on irrigation water charges in France is not readily available. For this discussion charges are estimated using information on charges for other uses and data on irrigation such as the technology in use (sprinkler, drip, others). Irrigation water charges depend on the water management mode. Charges are higher for water conveyed to the field by a wholesaler like a regional development company or a farmer's group cultivating irrigated lands (association syndicale autorisée), than for water delivered by water agencies. Moreover, charges are higher when collective networks are used to convey water to the fields than when regional development companies convey water from rivers. Figure 7.1 presents water management modes. Estimates of irrigation water charges are presented in Table 7.5.

Figure 7.1 Irrigation water handling in France

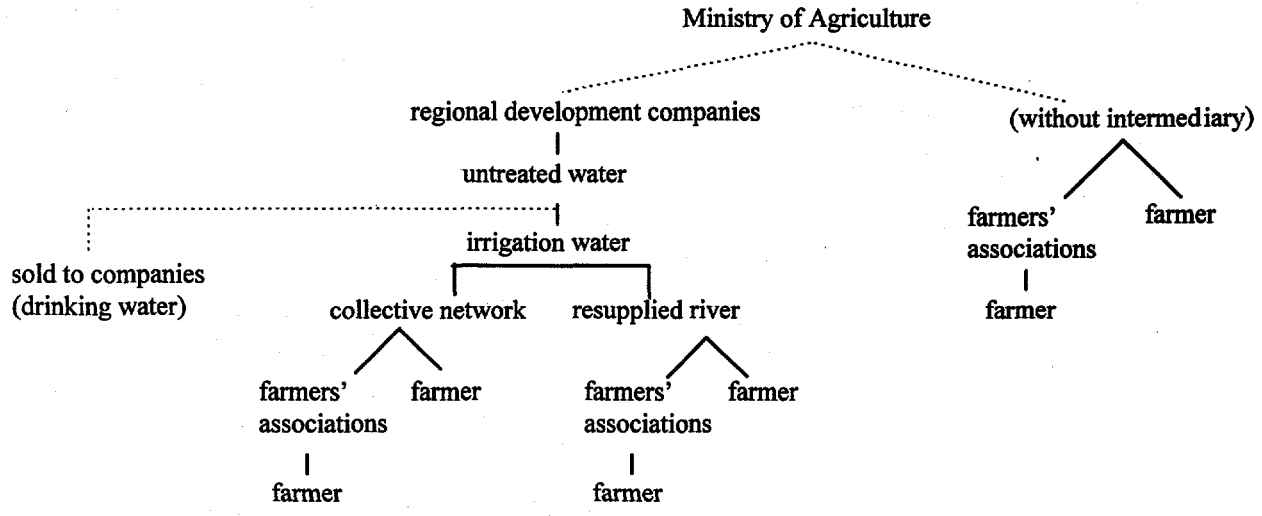

Table 7.5 Irrigation water charges by type of water management

Regional development companies		Farmers groups		Individual irrigation		
Collective network	*Resupplied rivers*	*With regional development companies*	*Alone*	*Wells*	*Non-resupplied rivers*	*Resupplied rivers*
SCP (1993) US$0.049–US$0.150 per cubic meter **BRL** (1993): US$0.171 per cubic meter	**CACG** (1990) US$0.022 per cubic meter	**CACG** (1989) US$0.081 per cubic meter	**Tarn** (1994) US$0.058–US$0.18 per cubic meter (US$0.118 per cubic meter on average)	Water agency charge	Water agency charge	Water agency charge **Charente** (1997) US$0.002 per cubic meter

SCP: Canal de Provance Company
BRL: Bas-Rhône Languedoc Company
CACG: Aménagement des Coteaux de Gascogne Company

Water charges shown here do not include pumping costs. If these were included, the per meter cost of water from individual systems would likely exceed that of water from collective systems.

The water agency sets resource charges on the basis of river basin and the location of user. Farmers also have a choice between fixed rate withdrawal charges or volume-based water charges: volume-based charges are generally

less per cubic meter to encourage farmers to install meters. Charges collected by water agencies in different regions of the country are presented in Table 7.6.

Current debates and future prospects

In France charges for drinking water have increased significantly over the last five years. Yet, prices still vary considerably among users. In general, charges are set on the basis of the principles that users should pay for their services and polluters should pay for the costs of wastewater treatment or environmental damage. But charges for irrigation water still do not fully incorporate these principles: farmers still pay less than industrial or domestic water users. It is also uncertain that charges are high enough to truly encourage consumers to conserve.

Drinking water prices are likely to increase slowly between 1995 and 1998. While prices increased by 7.8 percent between 1992 and 1995, it is anticipated that they will increase by only 4.7 percent between 1995 and 1998. Water charges could thus reach US$2.92 per cubic meter by 1998. These increases are required to pay for the increasingly stringent European drinking water standards, increased costs of water purification, and the need for water agencies to fully cover their costs. Industrial water prices are likely to follow the same path. It is expected that industries will respond by adopting measures and technologies to save and reuse water. Irrigation water charges are also likely to rise. Farmers are likely to gradually install meters and pay for water on the basis of consumption.

Table 7.6 Water charges collected by water agencies, 1995 (US$ per cubic meter)

	Adour-Garonne	Artois-Picardie	Loire-Bretagne	Rhin-Meuse	Rhône-Méditerranée-Corse	Seine-Normandie
Groundwater	0.0045	0.011–0.041	0.006–0.012	none	0.006–0.017	0.011 (fixed rate)
Non-resupplied rivers	0.0045	0.001–0.04	0.004–0.012	none	0.002–0.003	not known
Resupplied rivers	0.0045	not known	0.006–0.012	none	not known	not known

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8 INDIA

R. Maria Saleth

Introduction

In India, water resource management is emerging as one of the major issues facing the country. Water consumption has been rising rapidly: consumption was 540 cubic kilometers in 1985, and will likely to exceed 750 cubic kilometers in 2000, and 1,050 cubic kilometers in 2025. However, the amount of water available from storage and groundwater is not likely to exceed 600 cubic kilometers by 2000 (Central Water Commission 1995). In the long-run the gap between supply and demand must be closed by increasing water-use efficiency, rather than by developing new supplies. This will require radical changes in the institutions —water policy, water law, and water administration— governing water supply development, distribution, and use. Water pricing policy implemented within a carefully designed institutional framework would be an effective way to achieve water use efficiency.

Past experience

Water charges in the form of land revenue were common before British rule in the kingdoms of Andhra Pradesh, Karnataka, and Tamil Nadu. However India's current water charge system originated with the British colonial administration (Vani 1991; Maloney and Raju 1994). The British treated irrigation projects as commercial ventures, and set water rates on the basis of an internal rate of return commensurate with the rate prevailing in the London money market. The charges were set to cover all costs and generate a return on capital. The authorities periodically revised the internal rate of return (and water rates), from the 4 percent prevailing before 1919, to 5 percent during 1919–1921, and to 6 percent after 1921 (Sangal 1991). Although policymakers tried twice to use a volume-based charging system (1854 and 1917 for the Ganga Canal), doing so proved impractical with the technology available at the time. Instead the British decided to charge for water on the basis of irrigated area. They differentiated the area-based rates by crop and season to account for variations in water demand.

After independence attitudes towards water charges changed. Authorities viewed irrigation projects as routes to development rather than purely commercial ventures, important to augment income, generate employment, and increase food security. Policymakers lowered the internal rate of return to 3.9 percent in 1949, then substituted the benefit-cost ratio criterion for project selection in 1958. Because the minimum benefit-cost ratio for project acceptability was low — 1.0 for projects in drought-prone areas and 1.5 for projects elsewhere — water rates were also low. However authorities continued using the area/crop/season based method of determining water charges. Among the criteria for setting rates were farmers' capacity to pay (as determined by yield), quantity of water used (determined indirectly by area, crop, and season), the continuity and dependability of irrigation services, and irrigation system costs (Government of India 1972). Today's water charge system is based very closely on this post-colonial model.

Present water pricing practices

Irrigation water charges

According to the Indian constitution, states and provinces have jurisdiction over water management and have the responsibility of fixing water rates. Water rates vary widely both across and within states. Table 8.1 shows the overall and crop-specific canal water rates, the benefits of water in terms of incremental yield, and working expenses. All states except the seven northeastern states impose charges for canal water either directly or indirectly.

In West Bengal water rates vary only by season and in Kerala rates are based only on irrigated area. In all other states the area-based water rates are highly differentiated not only by crop and season but also by category of project, irrigation type (flow or lift), category of user (private parties, cooperatives, government lift schemes), and other factors (Sangal 1991; Government of India 1992). Water charges for projects built prior to British administration in Andhra Pradesh, Karnataka, and Tamil Nadu are based on assessments of land revenue, which are higher for irrigated than rainfed lands. For example in Tamil Nadu assessments for wet lands range between Rs. 7.41–54.36 per hectare compared with Rs. 1.24–19.77 for dry lands (Government of India 1992).[23]

The variations in water rates across project categories reflect the dependability and continuity of irrigation services. Andhra Pradesh has divided its canals into two water rate categories, Haryana into three, and Tamil Nadu five. Bihar, Orissa, and Madhya Pradesh have separate rate structures for perennial and nonperennial canals. Bihar charges different rates for long leases (Rs. 74.11 per hectare), seasonal leases (Rs. 89.45 per hectare), and a single watering (Rs. 51.15 per hectare). The rates for water from nonperennial systems are about one-half those for perennial canals. Maharashtra charges range between Rs. 35–90 per hectare for a single watering, depending on crop and season. Notably, Maharashtra and Madhya Pradesh also distinguish between "demand-rates" and "agreement-rates." Demand-rates apply to out-of-turn single waterings and agreement-rates apply to regular irrigation service. Demand-rates are double agreement-rates (Government of India 1992).

Water rates also differ depending on whether irrigation is flow or lift. Area-based rates apply to private lift irrigation systems, but volumetric rates are used for cooperative and state-owned lift systems. Charges for lift irrigation are further refined depending on whether the owner is private, a cooperative, or the state. In Gujarat, Haryana, Punjab, and Uttar Pradesh private lift rates are one-half to two-thirds cheaper than state lift rates, but in Goa, Himachal Pradesh, and Maharashtra they are substantially higher (Sangal 1991). Volumetric rates apply primarily to sugar and rice cooperatives and state-owned lift irrigation schemes in Gujarat and Maharashtra (Government of India 1992). Generally, rates per cubic meter of water are higher for state-owned lifts than for cooperative lifts. This is because rates for state systems include the costs of operation and maintenance. In Gujarat water from state-owned lifts costs Rs. 0.80 for 10 cubic meters but water from cooperative lifts costs only Rs. 0.25. In Maharashtra, rates vary between Rs. 0.10–Rs. 0.30 depending on the season (Maloney and Raju 1994).

Other charges

Most states impose other levies on canal water in addition to water charges (Central Water Commission 1988, 1991; Government of India 1992). Two states impose betterment levies on irrigated land: Tamil Nadu (45 percent of land revenue) and West Bengal (Rs. 400 per hectare). Four states, Gujarat, and Maharashtra, Kerala and Tamil Nadu, add fees for irrigation cess. In Gujarat, and Maharashtra irrigation cess equals 20 percent of the water rates, but in Tamil Nadu fees amount to 37-75 percent of water rates. Interestingly Maharashtra uses the revenue it collects to finance primary education (Rs. 40-380 per hectare depending upon crops) and an employment guarantee scheme (Rs. 25 per hectare) (Rath and Mitra 1989). Only Madhya Pradesh has a crop cess (Rs. 20 per hectare for a flow irrigation system and Rs. 10 for a lift irrigation system).

[23] US$ = Rs. 16.65 (1989-90). This exchange rate applies to all water rates reported in the text unless otherwise specified.

Table 8.1 Canal water rates for irrigation in major states of India, 1989-90

State	Range	Crop-specific rates			Water benefits[a]	Gross receipts per hectare			Year rates last revised
	(Rs. per hectare)	*Paddy*	*Wheat*	*Sugar-cane*	(Rs. per hectare)	*Rs.*	*As percent of benefits*	*As percent of working expenses*	
Andra Pradesh	99-222	222	n.a.	370	4,407	27	0.6	1.1	1986
Bihar	30-158	89	n.a.	158	714	33	4.6	12.1	1983
Gujarat	40-830	110	110	830	3,639	139	3.8	5.7	1981
Haryana	17-99	74	61	99	3,169	70	2.2	16.6	1975
Karnataka	37-556	99	n.a.	556	4,528	58	1.3	10.3	1985
Maharashtra	65-1,000	n.a.	n.a.	750	1,735	90	5.2	35.1	1989
Madya Pradesh	15-297	59	76	n.a.	5,812	140	2.4	3.2	1990
Orissa	6-185	40	n.a.	n.a.	1,770	66	3.7	46.2	1981
Punjab	14-81	49	29	n.a.	3,370	53	1.6	25.3	1974
Rajasthan	20-143	n.a.	74	n.a.	2,405	93	3.9	9.7	1982
Tamil Nadu	6-65	49	n.a.	62	4,364	9	0.2	2.0	1962
Utter Pradesh	7-327	143	143	237	1,555	111	7.1	10.0	1983
West Bengal	74-593	125	n.a.	n.a.	2,457	7	0.3	3.6	1977

a Water benefits are computed as the incremental yield from irrigated lands compared with unirrigated lands.
Source: Government of India (1992) and Central Water Commission 1990, 1991, and 1995.

Charges for nonirrigation purposes

Canal projects also earn income by selling water to domestic and industrial users, leasing fishing rights, selling timber, and other activities. Nonirrigation related revenue accounted for nearly one-third of total canal project revenue during 1989–90 (Government of India 1992). Income from nonirrigation sources tripled between 1976 and 1988, rising from Rs. 30 million (US$ = Rs. 5.45) to Rs. 99 million (US$ = Rs. 12.97). This reflects the growing demand for irrigation water from other sectors. The increase in nonirrigation receipts is most pronounced in Maharashtra (nonirrigation income rose 11 times) and Madhya Pradesh (6 times). Together these two states accounted for over 70 percent of total nonirrigation income (Central Water Commission 1990). During 1989–90 income from nonirrigation-related water sales averaged Rs. 5 per hectare, and income from miscellaneous sources averaged Rs. 15 per hectare (US$ = Rs. 16.65).

Charges for groundwater for irrigation

Charges for groundwater for irrigation from state or public tubewells are set according to the same principles as charges for canal water: charges must cover operation and maintenance costs. By contrast charges for water from private wells are set through negotiations between buyers and sellers, and generally reflect factors such as water availability, crop patterns, well capacity, and type of pumpset (diesel or electric). Of course the agreements may also reflect personal relationships and local customs. Charges for groundwater are usually by the hour, although some contracts are by season. Groundwater charges are lowest in Andhra Pradesh, Tamil Nadu, and Uttar Pradesh, ranging between Rs. 3–6 per hour. They are highest in Gujarat, which

has better organized and competitive groundwater markets, ranging between Rs. 25–45 per hour (US$ = Rs. 12.97) (Shah 1993). Seasonal payments are in the form of water rent, and are equivalent to 33 percent of the irrigator's crop output in Tamil Nadu, and 50-66 percent of output in Gujarat (Janakarajan 1993; Asopa and Dholakia 1983). The price of electricity strongly influences the attractiveness of extracting and selling groundwater. Where electricity rates are low and charges are flat rate, people are eager to sell water. However, low power rates also encourages aquifer depletion, and water table decline. Eventually they lead to higher pumping costs.

Table 8.2 Domestic and industrial water rates in Delhi, Madras, and Hyderabad

	Delhi (1995)		Madras (1990)		Hyderabad (1992)	
	Cubic meters per month	*Rs. per cubic meter*[a]	*Cubic meters per month*	*Rs. per cubic meter*[a]	*Cubic meters per month*	*Rs. per cubic meter*
Domestic	0-20	0.35	0-50	1.00	0-15	30.00[b]
	> 20	0.70	> 50	2.00	15- 25	2.50
					> 50	3.00
Nondomestic[c]	0-50	3.00	0-50	3.00	0- 20	100.0[b]
	> 50	5.00	50-100	4.00	20- 50	5.00
			> 100	5.00	> 50	7.00
Industrial	0-50	5.00	Per cubic meter	7.00	0- 200	200.00[b]
	50-100	6.50			200- 500	7.50
	> 100	8.00			> 500	10.00

a There is a surcharge at 30 percent for Delhi and 20 percent for Madras.
b Fixed minimum rates.
c Includes shops, hotels, offices, household industries, hospitals, and others.
Note: US$ = Rs. 16.65 (1990); Rs. 24.47 (1992); and Rs. 34.54 (1995).

Domestic and industrial water charges

Charges for domestic and industrial water are either subsidized or set to recover costs. The gov-ernment supplies drinking water as part of its basic needs program, and water to industry to support industrial development. Broadly, water charges for nonirrigation purposes are differentiated according to purpose (domestic, commercial, and industrial), income group, and region (urban and rural). Most urban water is metered, so users pay for what they use. However meters often do not work properly, either because they are defective or have been vandalized (50–80 percent of the meters in some towns do not work), and volumetric pricing seems to be more in theory than in reality. Households without meters, as in urban slums and rural areas, pay a fixed charge for private connections. Water theft, illegal tapping, and corruption contribute to poor revenue collection experience. Urban water supply enterprises (in all major cities) or local bodies like municipalities and panchayats (in other cities and rural areas) set water charges, which are subject to approval by state governments.

In Bombay, water charges are set on a bulk rate basis, and vary from Rs. 3 per cubic meter per month for domestic users to Rs. 20–60 for

commercial and industrial users (US$ = Rs. 26.19). In addition households pay a water benefit tax that comprises from 6-9 percent of the ratable value of residential properties. All water charges are also subject to a surcharge. Charges for industrial water are higher than for domestic water and include fees for wastewater discharge as required under the Water Cess Act (Prevention and Control of Pollution) of 1977. For example, in Delhi, this fee equals 2 percent of water rates. Madras and Hyderabad, which have had considerable external assistance to develop urban water supply projects, have higher water charges than other cities, and their water suppliers perform relatively well financially. These two cities periodically review and revise their water rates to assure that rates cover all cash-based costs. Table 8.2 presents water rates in Delhi, Madras, and Hyderabad.

In Madras — a coastal city with serious water scarcity problems (the groundwater is salty and unusable for drinking) — private groups are active in supplying water especially for hotels, cinemas, commercial establishments, and upper income households. The private suppliers transport water by tanker truck. They charge between Rs. 300 and Rs. 800 (US$ = Rs. 34.54) per tank load (which comprises about 5–8 cubic meters) depending on the season. Although they still supply a relatively small proportion of total water supply, private water companies have been providing an increasingly large proportion of the city's water in recent years.

Present water pricing policy: difficulties and problems

The area-based water charge method for irrigation is quite complicated to administer in India, since in most states the area-based rates are differentiated by many factors. The complexity of the system provides vast scope for discretion in assessing water charges. Furthermore, administration is inefficient: either different departments carry out the functions of assessment and collection, or a department not directly linked to irrigation performs both tasks. In Haryana, Punjab, Uttar Pradesh, and West Bengal the irrigation department carries out the assessments but the revenue department collects the fees. In Andhra Pradesh, Karnataka, Kerala, Orissa and Tamil Nadu the revenue department performs both functions. Farmers do not participate in setting rates, so resist revisions either politically, as in Gujarat and Karnataka, or through legal channels as in Andhra Pradesh. The farmer's lobby is politically strong. Involving farmers in the rate-setting process, and linking rate increases to improvements in irrigation services would help to win farmers' support for rate changes.

The most serious problems with India's irrigation charge system are: charges are too low, and it lacks incentives to encourage efficient water use in the face of escalating water scarcity. In no Indian state does the water rate structure bear any relationship to the costs of producing bulk water nor its scarcity value. No wonder then that irrigation projects sometimes turn out to be nonviable. While land productivity and crop prices have almost doubled since the 1960s, and the cost per hectare of constructing new irrigation systems has risen almost 20 times, water rates continue to remain low and outdated (Central Water Commission 1989; Government of India 1992).

In nearly all states, actual receipts fall short of full operation and maintenance costs. In Bihar and Rajasthan receipts do not cover even the administrative cost of collection. And the recovery rate is fast declining: it has fallen from 64 percent in 1974–75 to 8 percent in 1988–89 (Central Water Commission 1995). Thus by 1989–90 operating losses had accumulated to about Rs. 20 billion (US$ = Rs. 16.65) (Government of India 1992). Inadequate cost recovery also adversely affects irrigation system performance, since funds are not available to undertake even routine maintenance of canal and drainage works. Collections would need to be at least Rs. 200–250 per hectare to cover operation and maintenance expenses, yet in 1989–90 collections amounted to just Rs. 20–70 per hectare (Government of India 1989).

The water charge system also contains no incentives which would lead to the efficient allocation of water — a serious problem. Farmers, who pay according to area irrigated, have absolutely no reason to conserve water.

Indeed the rate structure provides incentives to maximize water per unit of output instead of maximizing output per unit of water. In some places misuse and waste of canal water is raising the groundwater table, and waterlogging and soil salinity problems have become serious threats in many irrigated areas in India.

Groundwater is used much more efficiently than canal water, due in part to private sector participation in developing the resources and in part to costs of development. Charges for groundwater are far higher and more market-oriented than canal water rates, and are generally sufficient to fully cover operating costs. This is especially likely to be true where electricity tariffs are low and flat-rate. However groundwater charges are rarely high enough to cover capital costs or resource costs. Therefore groundwater charges do not serve as a signal of the real value of the resource. Groundwater development and sales are very profitable in Gujarat and Tamil Nadu, but this is not true everywhere in India. For example, in Uttar Pradesh the average income from water sales covers less than 60 percent of pumpset operation and maintenance costs (Shankar 1992).

Current debates and future prospects

Policymakers in India have long debated water charge issues. Over the past twenty years expert groups, including the Irrigation Commission (1972), the National Commission on Agriculture (1976), and successive Finance Commissions have discussed changing both the level of irrigation water charges and the method of assessing them. Authorities agree that water rates must be revised periodically to generate the revenue needed to cover the full operation and maintenance costs and a portion of the capital costs. Recently, the debate has become more focused due to the release of the New Economic Policy of 1991, which advocates adopting a market-based approach to national economic management. The Vaidyanathan Committee report, which deals with irrigation water pricing, also contributed to the debate (Government of India, 1992). This report not only emphasized the need to recover more of the costs of water supply (operation and maintenance costs plus one percent each of capital cost and depreciation allowance), but also recommends eventually moving to a volume-based rate structure and a group-based distribution system for canal water. The report recommends implementing a two-part tariff comprising a flat annual fee of Rs. 50 per hectare and a volumetric charge. To reform the irrigation sector, the report recommends a three phase program: simplification of existing rates to involve just area and season; moving to volumetric pricing and group-based distribution; and irrigation system modification for better water control and distribution. Under the new scheme, user groups would have a central roles in both fee collection and system maintenance.

Policymakers are also considering privatizing canal irrigation. The Union Ministry of Water Resources has recently appointed a committee to study the legal, economic, and technical questions of privatizing public irrigation projects and to identify projects that could be given to the private sector to manage. The state of Maharashtra has already invited private bids to manage 52 irrigation projects valued at Rs. 150 billion (US$ = Rs. 34.54). The state will allot the projects — with investments between Rs. 10 million–Rs. 35.40 billion — to private investors to build/own/manage, or to build/own/transfer to the irrigation department. In the latter case, the irrigation department will buy water at an agreed price for distribution to farmers. In addition, private funding is being mobilized to finance new irrigation projects, as for the Narmada project in Gujarat and the Upper Krishna project in Karnataka. Both forms of private sector participation are likely to lead to greater financial discipline in constructing and operating irrigation projects.

The focus of the debate on water charges remains on recovering costs rather than promoting water use efficiency. The changes in water charges currently being considered will not even equalize the prices of canal water and groundwater, let alone reflect the resource value of canal water. The higher water rates proposed by the Vaidyanathan Committee would still comprise only about 6 percent of the gross value of output. As long as rates are lower than the marginal benefits of applying water, and there are no insti-

tutional mechanisms to limit water withdrawals such as quotas, neither volumetric charges nor group-based distribution would improve incentives enough to encourage true water use efficiency (Saleth 1994). If a water pricing system is to be used to encourage efficiency and still meet equity concerns, it must be a part of an institutional framework centered on a system of water quotas (Tsur and Dinar 1995). Irrigation sector reform, increased private farmer and corporate involvement, and the formation of more locally managed water rights systems would be the major elements of the new water institution. Future water resource management in India depends on how quickly and imaginatively institutional reforms are implemented to move India towards a more market-based approach to water management.

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9 ISRAEL

Dan Yaron

Introduction

There are three categories of water in Israel: fresh water from natural sources, brackish water from natural sources, and reclaimed sewage (which has been developed in recent years). This chapter focuses mainly on fresh and brackish water, for which the allocation and pricing rules are clearly defined.

Past experiences

According to Israeli water law of 1959 the nation owns all water from natural sources and the Water Commissioner controls its use. In the early 1960s a system of water allocations was developed. Cooperative agricultural settlements (kibbutz and moshav) — responsible for about 80 percent of Israel's agricultural output — received water quotas according to number of agricultural units on the settlement and the quotas per unit, which varied according to type of farm and the region. Noncooperative private farms received water quotas according to area irrigated and the prevailing irrigation norms. However, farms which had quotas before the new system was established, were able to keep them. Cities and towns had priority in water allocations over farms.

The Water Commissioner sets water charges for water delivered by the national water company, Mekorot. Water charges depend on use: farmers pay the lowest charges, industries pay higher charges, and households pay the most. Charges do not depend on location: users in all parts of the country face the same charges, regardless of the cost of supplying water.

Private and cooperative water suppliers set prices without government interference. The government does however impose a tax on water from low-cost sources, which it uses to subsidize water from high-cost sources.

This system has not changed since its establishment. Yet, there have been large changes in farming over the past thirty years, including the spread of greenhouse vegetable and flower production. The restriction on transferring water quotas from farms to other sectors has led to large inefficiencies. (The water law is based on the philosophy that water be allocated to users for their own use only.) Still, despite the law, farmers have been transferring water quotas since the mid-1980s.

Present water pricing practices

Agricultural water pricing

By the beginning of the 1970s pressure to modify the traditional system of allocating water was growing. Tier pricing was introduced between 1974–76, but abandoned in 1977 due to farmers' political pressures. According to Dlayahu and Avivi (1976), tier pricing reduced water consumption by 11 percent. Tier pricing was again implemented in 1989 and continues in use today.

For water from Mekorot farmers pay US$0.16 per cubic meter for the first 50 percent of their water quota, US$0.19 per cubic meter for the second 30 percent, and US$0.26 per cubic meter for the final 20 percent (all prices as of autumn 1995). Farmers using more water than the quota provides pay much more for the excess (Water Commission various years a). To avoid the punitive charges, farmers generally obtain additional water through interfarm water transfers (usually indirectly through water supply companies).

Thus water is allocated through a mixture of political and institutional means, and markets, with markets operating at the margin. It is a system that has evolved to meet egalitarian and efficiency objectives. Allocating some water through quotas, it is believed, prevents socially undesirable outcomes that might occur if water

were allocated purely through markets. And using a tiered pricing structure transfers some rent from water suppliers to farmers.[24]

Whatever its advantages, it is time to revise the current system of allocating water. The current quota system has not been adjusted to account for the rising urban population or the changes in the agricultural production technologies that have taken place over the past 30 years. The gap between the demand for water and what is available through the quotas is growing ever larger. For example, between 1988–1990 cities and towns required 17–25 percent more water than quotas provided, while kibbutz and moshav farms needed 11–24 percent less (Water Commission various years b). Of course, quotas to farms cannot simply be canceled, since farmers would resist such action.

Urban and industrial water pricing

For water from Mekorot, industries pay US$0.26 per cubic meter, and cities and towns pay US$0.35 per cubic meter. Neither industries nor municipalities face tiered charges. However, final consumers do face tiered charges, paying US$0.68 per cubic meter for the first block (typically eight cubic meters per household per month), US$1.00 per cubic meter for the second block (seven cubic meters per household per month), and US$1.47 per cubic meter for consumption above this level. Consumers also pay a municipal tax for wastewater collection, treatment, and disposal which varies by location. For example, consumers pay US$0.48 per cubic meter in Haifa, US$0.40 in Tel Aviv, US$0.20 in Rehovot, and US$0.18 in Kfar-Sava (Water Commission various years a).

The Finance Committee of the Israeli parliament (Kneset), with the approval of the Minister of Finance and Minister of Agriculture, periodically adjusts prices of water for industrial and domestic use. The Ministry of Interior sets the prices that municipalities may charge households; this price is generally set high enough to cover the municipality's cost of operations in addition to its wholesale water costs. However, municipalities often profit from their water supply services. In 1989–1990 cities and towns earned on average profits 26 percent above their costs. Some cities had even higher profit margins: Tel Aviv's profit margin was 44 percent, Raanana's was 80 percent, Herzliyah was 135 percent, and Bat-Yam's was 169 percent. In general, the wealthier the community the higher the profit margin (Eckstein and Rozovitz 1993).

Pricing of low-quality water

Farmers and farmer organizations have developed low-quality, brackish water sources. Water from these sources is not included in the quotas, a result of the Water Commission's desire to encourage private investment in the development of low-quality water sources. However, with the growing demand for high-quality water by towns and cities and its growing scarcity, it is now important to include the low-quality water in the quotas as a substitute for high-quality water wherever possible.

A committee appointed by the Water Commissioner recommended that brackish water be made part of the quotas depending on its salt content (and therefore the degree to which it could substitute for fresh water). It also recommended that its price be linked to that of high quality water, deflated by the rate of substitution; and that charges be tiered. These recommendations are now being implemented.

The Water Committee is now working on establishing rules for incorporating reclaimed sewage for irrigation into quotas, and on setting prices for reclaimed sewage water. One rule is widely accepted: the generator of the wastewater (generally municipalities) should pay the costs of treating the sewage to acceptable standards.

[24] The less-expensive sources of water are developed first, so the long-run incremental cost of supplying water is rising. For efficiency, the marginal price water should equal its marginal cost. But if all water were priced at marginal cost, water supply companies would appropriate huge rents. Tier pricing gives some of the rent to farmers, without incurring additional transactions costs.

Table 9.1 Salt content and rate of substitution between brackish and high-quality water

Salt content, parts per million chlorine[a]	400	500	600	700	800	1,000	1,200	1,400
Rate of substitution: brackish water/high quality water	1.02	1.04	1.07	1.10	1.13	1.19	1.26	1.34

a Roughly equivalent to 0.40 total dissolved solids.

Current debates and future prospects

A major weakness of the current water charging pricing system is that charges do not vary by region, although costs of supplying water do. In addition, prices do not necessarily reflect the real marginal cost of supply on a regional basis.

New ideas for the pricing of high-quality water are now being debated, including the need to rationalize water prices among different users. Domestic and agricultural users have different requirements for water in terms of quality, short- and long-term reliability of supply, and the ratio between peak and average demand. Yet, most water plants supply both domestic users and irrigators. This means that irrigators receive much higher quality water than they actually need, at much greater cost than is necessary.

Also being discussed is the use of water pricing as a means to better match supply and demand. Policymakers recognize that prices which fluctuate in response to changes in the water table in aquifers can encourage consumers to conserve when levels are low. Prices should also reflect water quality in the aquifer and aquifer's location (water is more costly in the south than in the north).

Finally, the allocation and pricing of high-quality water supplied to agriculture is a key issue (Table 9.1). Ideas for reform fall along a spectrum, with some arguing for modifying the current system (adjusting quotas to reflect actual use, or providing a rebate for unused quotas), and others maintaining that the current system should be scrapped completely, leaving the market to allocate water to its highest and best use.

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10 ITALY

Stefano Destro

Introduction

Italy receives about 300 billion cubic meters (1,000 millimeters) of rainfall each year. However, rainfall is unevenly distributed in both time and space. River flow regimes are very irregular, especially in southern Italy, which makes rivers unsuitable as direct sources of water supply. It is estimated that some 140 billion cubic meters of water a year are lost to evaporation. Italy's available water resources total about 110 billion cubic meters per year of which 35–40 billion cubic meters are available for irrigation (Institito Nazionale di Statistica (ISTAT) 1993). Overall water consumption is 46-50 billion cubic meters per year (Table 10.1).

Table 10.1 Water consumption by sector, 1971 and 1989

	1971		1989	
	Billion cubic meters	*percent*	*Billion cubic meters*	*percent*
Domestic	7	16.7	12	26
Industry	9.3	22.3	6	13
Agriculture	25.6	61	28	61
Total	**41.9**	**100**	**46**	**100**

Source: Nebbia 1993.

Past experiences

The Land Reclamation Act, enacted in 1933, was a milestone for water management in Italy, and has, until recently, been the fundamental law on fresh water and land reclamation. This act declared all major water sources to be public water, and placed restrictions on its use. People or entities wishing to use the water were required to obtain special state concessions and pay annual rents.

The Consortia for Integrated Land Reclamation, self-governing private institutions, were responsible for implementing initiatives under the law. The initiatives were intended to be private but very often they have been established through law. The consortia played critical roles in fostering rural development in Italy. During the 1950s and 1960s the consortia organized and financed the drainage of large marshes scattered throughout Italy, which at the time were breeding grounds for the insects carrying marshy-fever. In the early 1960s the consortia supported new agricultural development by developing irrigation systems.

The government has extensively subsidized land reclamation and irrigation projects, paying nearly 100 percent of the capital costs of waterworks, while the consortia have paid operating costs. As a result, farmers and other end-users have paid only maintenance and repair costs for waterworks and the cost of energy used to distribute the water. Water tariffs were calculated on the basis of average consortia costs; farmers paid an area-based rate.

Per capita water consumption in Italy is 220 liters per year, but there is considerable variation among cities. People in larger cities, mainly in

the north, consume about 400 liters per year, while people in most southern cities consume less than 200 liters per year. Thus per capita consumption is 40 percent higher in northern Italy than in southern Italy.

Nearly all households and enterprises in Italy have piped water supplies. However water quality is not always high because pipes are sometimes of poor quality. About 35 percent of water users do not receive sufficient quantities of drinking water. Drinking water shortages are especially prevalent in southern Italy. Perhaps for this reason Italians spend US$2.5 million for bottled mineral water, as compared with US$2.9 million for public water supplies.

Table 10.2 Average water tariffs to farmers

	Average annual water consumption (cubic meters per hectare)	1973 (US$ per hectare)	1978 (US$ per hectare)
Rice, northern Italy	46,000	85	138
Meadows, northern Italy	10,000	39	47
Horticulture crops, southern Italy	9,700	20	33
Orange trees, southern Italy	6,000	27	149

Source: Medici 1974 and 1980.

Drinking water

Many different public and private enterprises provide drinking water. Until 1974 the Interdepartmental Committee on Price set water tariffs, and did so without concern for the actual costs incurred. Since 1974 provincial or local Committees on Price have calculated water imposed by the Interdepartmental Committee on Price. The tariff structure involves step-rates, with a low rate for the first consumption step (Figure 10.1). The tariff structure also requires that water prices equal the average costs of supplying water. In the first half of the 1980s, water prices were controlled to prevent them from rising faster than the rate of inflation. But in 1985, communities were permitted to raise water prices.

The water pricing policy in Italy has been guided by a range of social and developmental considerations, rather than commercial principles. The result is a general failure to recover even the operating costs of supplying water, let alone the full costs of services. Government has financed all major waterworks (dams, canals) and owns these structures. Tariffs did not include the costs of depreciation. Charges for irrigation water were so low that irrigation systems tended to be very inefficient. In some parts of Italy, excessive water use has started to threaten natural systems. Increasingly the watershed authority is refusing to grant farmers permission to drain wetlands unless they can show that doing so will not threaten the natural systems, and that irrigation will improve the net income of people living in the region.

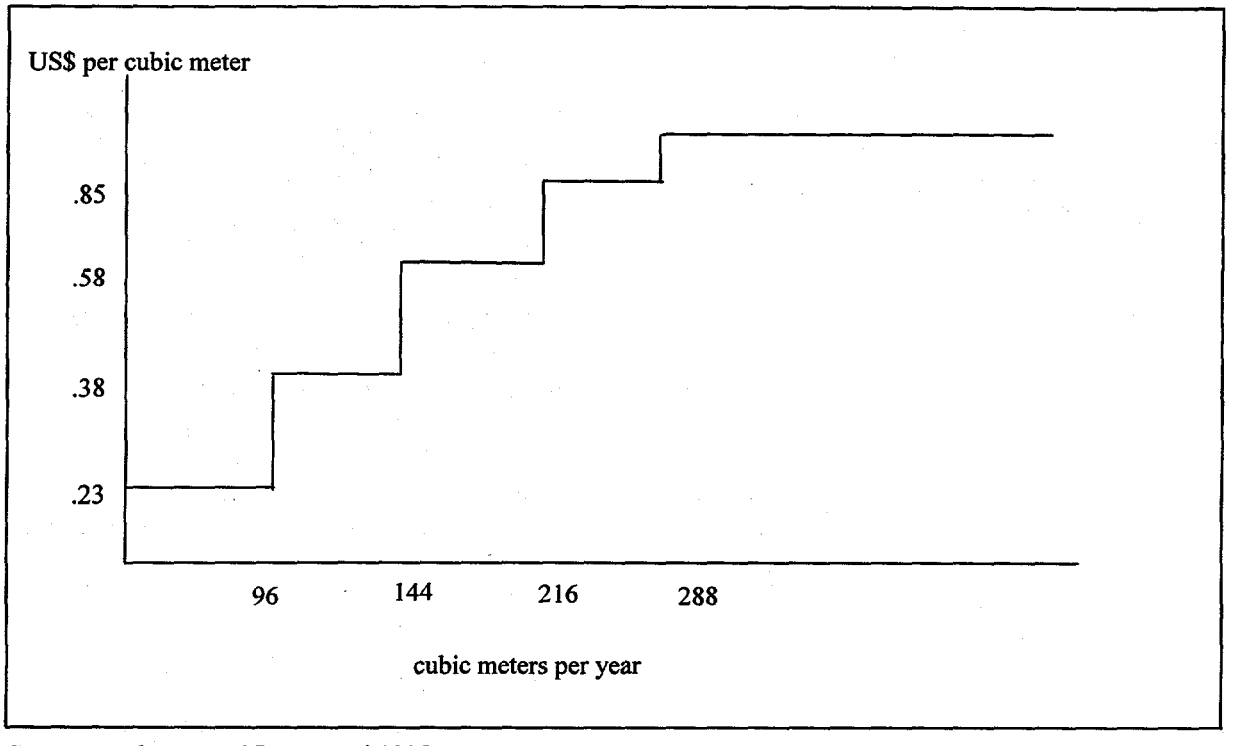
Present water pricing practices

Irrigation Water

Recently the government has reduced many of its subsidies for water systems. However, the Consortia for Land Reclamation and Irrigation still receive subsidies of different types, and farmers pay much less than any other users (Tables 10.2, 10.3). Currently there are 199 consortia entitled to abstract water for irrigation, covering 2.7 million hectares of which 2 million are in northern Italy. Maintenance, distribution

(pumping), and overhead costs make up the majority of the consortias' costs. Concession fees amount to only 0.25 percent of total costs. Persons or entities given a formal concession by the government have to pay an annual fee. The fee varies depending on the sector concerned.

Figure 10.1 Average water prices for various consumption bands, 1992 (1992 US$)



Source: Malaman and Prosperetti 1995.

Since the state owns all waterworks, consortia do not have provisions in their balance sheets for depreciation. Consortia set water prices in accordance with the principle of average cost pricing. All consortia use area-based charges regardless of the amount of water supplied, but vary charges according to soil quality and crop. According to a study carried out in 1990, few consortia collect enough revenue to cover their costs: indeed most make losses. A recent update of the study, completed in 1994, found that the situation has not improved over the last decade (Table 10.4). Total payments from farmers cover only 60 percent of the total fixed plus variable costs (Vacca, Atzori, and Linoli 1994).

Table 10.3 Concession fees, 1994

	Unit of measurement	Concession fees (1994 US$)
Domestic	module	1,820
Industry	module	13,330
Agriculture	module	43
Hydropower	nominal kilowatt	12

Note: A module is equivalent to 100 liters per second.

Source: Malaman and Prosperetti 1995.

Table 10.4 Economic performance of irrigation consortia (US$ per hectare)

	Irrigated area (hectares)	Average cost	Average receipts	Average deficit
Northwest	279,000	35.15	32.67	2.48
Northeast	355,190	22.11	18.56	3.55
Center-south	134,110	82.36	53.11	29.25
Total	**768,400**	**37.38**	**29.75**	**7.63**

Source: Vacca, Atzori, and Linoli 1994.

Drinking water

Thousands of public and private enterprises supply drinking water. Because there are so many different suppliers it is difficult to analyze current conditions in this sector. Each supplier serves an average of about 8,000 users, resulting in very low distribution efficiencies. Tables 10.5 and 10.6 present water prices for two municipalities, illustrating the variation in tariffs characteristic of drinking water supply in Italy. This example shows how confusing the situation in Italy is due to the absence of a framework law for drinking water. After years of debate, Parliament finally issued a new framework law on water resource management at the beginning of 1995.

Table 10.5 Water tariffs in municipality A

Cubic meters per year	Unit price (US$ per cubic meter)
< 80	.15
81–200	.30
201–500	.40
> 500	.50

Source: Bollettino Ufficiale della Regione del Veneto 1995.

Table 10.6 Water tariffs in municipality B

Cubic meters per year	Unit price (US$ per cubic meter)
< 108	.20
108–144	.28
144–216	.43
216–288	.57
> 288	.86

Source: Bollettino Ufficiale della Regione del Veneto 1995.

Current debates and future prospects

The Framework Law on Waters 36 dated January 5, 1995 provides guidelines on water management. The law emphasizes the importance of demand management to minimize the environmental impacts of water consumption. The key points of the law are:

I. All waters are public and must be managed according to the principle of sustainability, especially with reference to future generations;

II. Drinking water is top priority. Other uses are allowed provided they do not affect the quality or quantity of water used for drinking;

III. Water supply services are to be integrated with sewage services; private and public enterprises should be reorganized to encourage efficiency in operations.

IV. Local governments shall determine water prices according to a normalized method that will be defined by the Ministry of Public Works. Water charges must generate sufficient revenue to cover all investment and operating costs and should reflect the quality of water supplied. In effect, the law aims to integrate water supply and sewage services to define a life cycle price of water.

It is expected that, when implemented, the law will provide an appropriate framework for efficient water allocation and use by all water users.

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11 MADAGASCAR

Felix Rabemanambola

Introduction

The importance of water in the *Malagasy's* (resident of Madagascar) life is apparent in the proverbs and sayings that, because of the philosophy and traditions they express, have acquired a near sacred character. One common saying is *"Vary sy rano: an-tsaha tsy mifanary, an-trano tsy mifandao"* (As rice and water keep company in the rice fields, so do they in the home). In other words, water is needed to grow rice and to cook it as well. This proverb aptly captures the two principal uses of water — drinking and economic production.

Rainfall in Madagascar is unevenly distributed, with annual averages ranging from about 380 millimeters per year at Faux Cap, Madagascar's southernmost point, to nearly 3,800 millimeters at Maroantsetra the country's northeastern coast, where rainfall can reach as high as 5,000 millimeters per year. The southern part of Madagascar's is dry: it is necessary to drill progressively deeper to find groundwater. In the east, resources are abundant, but increasingly polluted. The tropical northwest receives about 1,500 millimeters rainfall per year. The southeast receives about 2,500 millimeters rainfall per year, but rainfall is irregular. The south southwest, the country's most arid zone, receives less than 600 millimeters of rain each year.

Less than 5 percent of people in Madagascar have running water in their homes (Table 11.1). Overall 33.4 percent of Malagasy households get their water from public fountains, pumps, wells or cistern trucks (Institut National de Statistique 1993). Nearly 60 percent of households get their drinking water from either springs, streams and rivers. More than 75 percent of urban households have access to water services of some kind. Rural households are much less well served: only 4.2 percent of rural households have access to treated water (0.6 percent with running water in the home, and 3.6 percent with access to public fountains). By contrast more than 71 percent of rural households draw water from springs, or rivers and streams.

Table 11.1 Water supply in Madagascar, 1993

	Percent of population with access to various water sources								
	Running water	*Public pump*	*Suction pump*	*Well*	*Cistern truck*	*Springs*	*Rivers and streams*	*Other*	*Total*
Urban	17.8	36.1	3.8	17.1	0.5	13.3	9.4	2.0	100.0
Rural	0.6	3.6	0.4	21.6	0.5	42.2	28.9	2.2	100.0
Total	**4.6**	**11.2**	**1.2**	**20.5**	**0.5**	**35.5**	**24.3**	**2.2**	**100.0**

Source: Institut National de la Statistique 1993.

Past experiences

Water prices in Madagascar vary according to the context or the area (urban or rural) to which they apply. Water prices reflect the various ways of managing water systems and the operating structures established in different periods. The following describes the development of institutions managing water and water pricing in the country.

Urban

There have been three distinct periods of Madagascar's recent past which have influenced the development of water institutions and water pricing practices. The first is the late colonial period (1950–1959), when the colonial company, Société Eau et Electricité de Madagascar, managed water supply. The Gérance Nationale de l'Eau was also important during this period. The second is the post-colonial period, during which the Société Malagache de l'Eau et de l'Electricité held the monopoly for water production and management. The third is from 1974–75 until the present, when Jiro Sy Rano Malagasy (JIRAMA) — a state-owned and operated company formed through the merger of the two water companies following their nationalization in 1975 — has managed the production and distribution of water for most urban centers. Communities continue to manage water supply in a few secondary centers — although with technical and financial difficulties.

Ordinance 74–002, issued February 4, 1974, stipulates that the state has responsibility for managing water supply and electricity.[25] This ordinance gives the state exclusive rights to manage all operations to produce and distribute drinking and industrial water. Within this general framework, ordinance 74-003 (February 4, 1974), established the Société Malagache de l'Eau et de l'Electricité, and defined its functions and prerogatives as well as the provisions of commercial legislation (requiring it to adhere to the principles of commercial accounting) to which it is subject.[26] Starting in January 1974, all operations and assets and liabilities of the colonial company were transferred to Société Malagache de l'Eau et de l'Electricité. As part of the reorganization, Société d'Energie de Madagascar was empowered to carry out its assigned operations and was put in charge of the Gérance Nationale de l'Eau. As part of the reorganization, the Société d'Intéret National de l'Eau et de l'Electricité was created, and gradually took charge of the electricity and water production, transport, and distribution facilities which had been operated as local government monopolies or private concessions.

Since 1974 Jiro Sy Rano Malagasy has been responsible for operating and maintaining drinking water facilities in urban areas. this institution is also responsible for undertaking studies, new projects, and extensions of existing services. Finally it is responsible for carrying out national objectives in the water and electricity sectors.[27]

Water rates for Jiro Sy Rano Malagasy are set at the government council level. Along with Jiro Sy Rano Malagasy, the Opération Alimentation en Eau dans le Sud, a public industrial and commercial concern created in 1986, operates in southern Madagascar around Ambovombe.[28] New statutes pertaining to this institution issued in 1995 make it possible for the new company to extend its operations throughout the country.

Rural water supply

Pricing practices for rural water supply are much less clear than for urban areas, because there is no single institution managing rural water supply. Three major nongovernmental organizations with religious affiliations have been operating in rural areas for quite some time. Fifanampiana Kristiana ho an'ny Fanmpandrosoana eto Madagascar (FIKRIFAMA), a non-

[25] Subsequently modified by ordinance 90–007.

[26] Modified by ordinance 75–032.

[27] Ordinance 75–032 of October 17, 1975.

[28] Decree 86–412.

profit organization, is one of the most active nongovernmental organizations in the country (Direction Générale du Plan 1980; Leroy and Gatin 1994). This group operates primarily in the in the high plateaus where the country's poorest and most isolated villages are situated. In these villages diseases from drinking contaminated water are very common. FIKRIFAMA requires villages receiving its assistance to build gravity-fed water supply facilities. Village water committees manage the public fountains, and pay a small fee each year to cover the costs of minor repairs such as faucet replacements.

Two other nongovernmental organizations with religious affiliations operate almost exclusively in areas where they have built churches. These groups nearly always supply water services either for free or for a small symbolic charge. Since 1986 Opération Alimentation en Eau dans le Sud has been managing water supply for a few small centers. Opération Microrealisations, an organization financed by the European Development Fund, was created by decree 87–360 (September 29, 1987) as a presidential project. It manages federally-financed small-scale pump or gravity-fed systems throughout the country.

Irrigation

The Rural Engineering Office has always been responsible for managing irrigation water. The agency has also built water conveyance systems in rural areas. Water pricing practices for irrigation water will be presented below.

Present water pricing practices

Urban water supply

Jiro Sy Rano Malagasy tariffs are uniform throughout the country. Households pay a low tariff for their first 10 cubic meters of water, regarded as an essential minimum quantity. Users pay higher tariffs for quantities above this basic level of consumption.

Cost recovery. During 1987–90 Jiro Sy Rano Malagasy recovered 65–97 percent of its average water costs through user charges. Ordinance no. 74–002 (February 4, 1974) requires user charges to cover operating costs of the water company, including interest charges and depreciation, and raise a sufficient surplus to finance new investments. In 1990–91 it was expected that water charges would be set to achieve these goals. However collections from water users fell short of fully recovering costs. For example, in 1990 the average cost of supplying water was FMG 289 per cubic meter, but charges (for consumption above 10 cubic meters per month) were only FMG 263, or 91 percent of average costs.[29]

In 1992, after a period in which the FMG depreciated rapidly, it was decided to adjust water rates every six months to allow water rates to reflect more closely the costs of supplying water. This is a significant improvement for the water company, which can now adjust rates in line with changes in key parameters, such as the exchange rate and the price of crude oil. The adjustments have led to sharp increases in water prices, to the great resentment of water users. Households currently pay FMG 1,570 per cubic meter for running water (for quantities above 10 cubic meters per month). In 1996 the price of one cubic meter of water was six times higher than in 1990. The AES sells water from cistern trucks at a price of FMG 40,000 for a cistern of 6 cubic meters: users collect the water in 12–15 liter buckets.

Public standpipes. The cost of private connections is much higher than most households can afford, so most urban dwellers receive water through public standpipes or from water vendors. Lines at public standpipes are becoming increasingly long, and informal water selling has been growing in some neighborhoods of Antananarivo, the nation's capital, and in other major cities.

In populated neighborhoods of Antananarivo water supply points are few. Around these points, middlemen collect water in 220 liter barrels or in 20 liter cans and deliver to customers. In return, they collect a fee for each can of water

[29] US$1 = FMG (Malagasy franc) 3,999.93 during the first half of 1996; and US$1 = FMG 330 in 1990.

distributed. Most customers are families without private connections or small businesses such as inexpensive restaurants. In some populated neighborhoods in the capital, households with private connections sell water: prices range from FMG 10–50 per 10–15 liter bucket or FMG 1,300–3,300 per cubic meter. In some cases, prices have reached FMG 5,000 per cubic meter (BURGEAP 1996). It is very difficult to estimate what proportion of the city's population purchases water from vendors, but it is likely to be significant.

A study of small water vendors found that vendors charge FMG 40–50 for a 10–15 liter bucket of water. In certain neighborhoods, they may charge as much as FMG 100–150 for a 20 liter can of water. Thus water vendors are charging FMG 3,600–7,500 per cubic meter of water (US$1–US$2 per cubic meter). In the five other major provincial towns, the situation is similar to that in Antananarivo. Prices vary from city to city depending on how acute the city's water problem is.

In the past two years the government has been encouraging public fountain users to participate in water management. Water committees or water supply point committees at the public fountain level have been formed in many places. Monthly or quarterly dues are collected from water users for the upkeep and repair of public fountains. The money collected is not sufficient to cover the costs of supplying water, but they have encouraged users to take more responsibility for the management of their water supply, and have led to reduced water wastage and water losses. Indeed, water committees are imposing discipline on water users. They impose sanctions on users who do not pay their dues, do not participate in site cleanups, or damage or steal faucets. In Antsiranana households pay quarterly dues of FMG 1,000, fines of FMG 5,000 for failing to participate in site cleanups and fines of FMG 500 for stealing faucets. Furthermore, to prevent Jiro Sy Rano Malagasy from cutting off water supplies, they are taking measures to stop users from leaving taps open for long periods of time.

Rural water supply

Rural water consumers do not generally pay for water on the basis of quantity consumed. However, this is not necessarily the case in southern Madagascar, where users buy water, often at very high prices. The cases discussed below provide some a representative sample of water pricing issues in rural areas. Since more than 71 percent of households get their water from springs or streams and rivers, the practices pertain to only about 27 percent of rural households.

The FIKRIFAMA experience. The FIKRIFAMA is an nongovernmental organization which provides almost exclusively gravity-fed water systems principally to communities in the high plateaus. To receive its services, communities must request them and agree to participate in all stages of the project — from the system's conception to its management and maintenance. Thus work cannot begin until the community establishes a village water committee.

Village water committees are responsible for maintaining the water systems and ensuring that they function properly. They are also responsible for making sure that members of the users' associations abide by the agreed clauses, or the *dina*.[30] Users who do not pay their share lose their right to be part of the users' association and forfeit their right to draw water from public fountains or water supply points. This discipline is a strong point of FIKRIFAMA's program.

Each family pays the water committee a flat fee of FMG 1,000 per month. The sums collected by the water committees thus vary according to the number of families served. Some water committees collect as much as FMG 1 million (Leroy and Gatin 1994). From these funds, water committees keep on hand a small sum (currently around FMG 50,000) to pay for upkeep and minor repairs. Water committees must deposit sums above FMG 300,000 in a

[30] The *dina* are specific conventions customary at the community level which apply uniformly to all members of the community. To transgress the *dina* is to risk incurring severe sanctions not only on oneself but also on one's entire family.

bank account bearing the name the water committee. According to FIKRIFAMA, users pay enough to cover about 90 percent of total costs. Water committees agree with users on mode of payment, which is generally in cash or in kind (usually rice).

The AES experience. The AES, financed by FAD, manages and operates water supply systems, including public fountains, in five small centers in the south of the country (Isoanala, Tsivory, Andalatanosy, Beraketa, and Antanimora) as part of the Southern Water Supply Project. Households pay FMG 800 per month for water. While this contribution is small relative to the actual cost of supplying water, it is high compared with average incomes in the region. The local people resist paying because they think it is unfair that they should have to pay while urban consumers do not, and because they believe that the services of AES — a public institution — should be free.

In 1995 following an intense information, education, and communication effort, the AES instituted a new policy. The policy makes AES responsible for managing water supply in the five centers, and the communities they serve responsible for collecting funds from water users at their public fountains (which are metered) on the basis of volume drawn. The community pays AES FMG 2,000 per cubic meter. The community sets water charges at a level to meet this payment and any additional expenses, such as wages for the person hired to collect water charges at the pump.

In the extreme south of Madagascar, along the Amboasary-Ambovombe-Beloha-Tsihombe route, AES supplies water from cistern trucks originating in Amboasary-South (about 60 kilometers from Fort-Dauphin), for FMG 40,000 per 6 cubic meters tank-full. In 1992 the AES started serving small localities in areas with acute water problems, which traditionally have been served solely by private water vendors. The private water vendors were often charging exorbitant prices, up to FMG 3,000 per 220 liter barrel (US$3.40 per cubic meter) for water of often questionable quality (muddy and untreated). AES charges much less for water than the private vendors (Table 11.2).

UNICEF and the 150 Water Supply Points Project for Southern Madagascar. The 150 Water Supply Points Project, launched in March 1994 and completed in January 1995, was responsible for drilling 150 wells and equipping them with India Mark II hand pumps (Bergeron 1995). To obtain a water supply point, villages had to make a contract with the UNICEF project. Under the contract, UNICEF agreed to drill the wells and outfit them with curbs and sinks, train the water supply point committees (comité de point d'eau) and repair persons, and create a network for the sale of spare parts at fixed prices. The village agreed to provide an access route between the water supply point and the village, furnish labor, and establish and maintain a village fund of FMG 50,000 to maintain the pump (purchasing spare parts, paying for repairs, and paying for a quarterly inspection visit costing FMG 2,000 each). The water committee is responsible for managing these tasks. Each family pays a monthly contribution to the fund. Thus far contributions have been sufficient to meet 80–90 percent of expenses. The funds now average about FMG 42,500.

Agricultural water

The objectives of agricultural water policy are to maintain irrigation infrastructure, reduce the financial contribution of the state in irrigation, accelerate rural infrastructure investments, and improve the quality of life in rural areas. The specific strategies of the agricultural water policy are to:

- Establish and support water users associations (associations des usagers de l'eau) in all irrigation perimeters;
- Give responsibility for managing irrigation systems to water users associations in accordance with their abilities;
- Ensure the effective participation of water users in start-up activities;
- Mobilize resources of all subdistrict operators;
- Help the state disengage from its role in managing and maintaining irrigation networks;

- Refurbish and build rural infrastructure by making decentralized groups responsible for water conveyance in rural areas, contributing to the improvement of public health.

Table 11.2 Water tariffs of Jiro Sy Rano Malagasy, July 1991–January 1996

	July 1991	Oct. 1992	Jan. 1992	July 1993	March 1994	July 1994	Jan. 1995	Aug. 1995	Jan. 1996	Percent increases: Accum-ulated	Percent increases: Annual average
Cessions											
Consumption	1.10	1.04	1.21	1.21	1.33	1.58	1.77	1.77	1.77	60	11
Electric	1.10	1.04	1.21	1.21	1.33	1.58	1.77	1.77	1.77	60	11
Individuals											
Small consumer (100 m^3)	0.65	0.67	0.71	0.78	0.86	0.74	0.74	0.74	0.74	15	3
< 10 m^3/month	1.00	1.10	1.10	1.21	1.33	1.58	1.77	1.77	1.77	77	14
> 10 m^3/month	1.00	1.10	1.10	1.21	1.33	1.58	1.77	1.77	1.77	77	14
Administration											
< 100 m^3/month	1.00	1.10	1.10	1.21	1.33	1.58	1.77	1.77	1.77	77	14
> 100 m^3/month	1.00	1.10	1.10	1.21	1.33	1.58	1.77	1.77	1.77	77	14
Collectives (decentralized)											
Community services	0.65	0.67	0.71	0.78	0.86	0.74	0.74	0.74	0.74	15	3
Fountains	0.65	0.67	0.71	0.78	0.86	0.74	0.74	0.74	0.74	15	3
Other	0.65	0.67	0.71	0.78	0.86	0.74	0.74	0.74	0.74	15	3
Special uses											
Sale to boats	2.82	3.04	3.10	3.41	3.75	4.45	4.99	5.00	5.00	77	14
Construction	2.06	2.22	2.26	2.49	2.74	3.25	3.64	3.64	3.64	77	14
Water brute	1.17	1.10	1.29	1.28	1.32	1.67	1.77	1.77	1.77	51	10

Source: Jiro Sy Rano Malagasy 1997.

The strategies now being implemented are designed to allow users, through the water user associations (which function as financially autonomous nonprofit corporations or independent cooperatives) to take over the management of irrigation infrastructure. Irrigation water pricing reflects these goals. The collectivity, in principle, includes "persons cultivating land served by the hydroagricultural networks of the locality and all those who use its irrigation or drainage water for any other economic purpose" (ordinance 90-642 of December 19, 1990, article 2). According to article 5 of this same ordinance, its responsibilities include:

- Distributing water to the land parcels;
- Determining when and where new supply points should be opened, according to statutory procedures and with the advice of the appropriate department of the agriculture ministry;
- Ensuring that members or the enterprise properly maintain the irrigation networks and ensure their safety;
- Ensuring that laws are enforced (including the *dina*);
- Borrowing funds as needed;
- Establishing and approving annual operation and maintenance budgets;

- Managing financial resources for the benefit of irrigation users.

The ordinance also requires water users to pay the upkeep costs of irrigation infrastructure except by the express waiver of the operating structure. Annual upkeep costs are assessed on a per hectare basis, and range between FMG 25,000 and 30,000 for small irrigation perimeters (*petits périmètres irrigués*), and around FMG 45,000 for large irrigation perimeters (*grand périmètres irrigués*).

Rates of cost recovery vary according to district: they average 80–90 percent, and can reach 100 percent for large irrigation perimeters. The perimeters which have transferred responsibility for managing the irrigation networks to the water users' associations have been the most successful at covering costs. For example, the large irrigation district of Dabara, in the west-central part of the country, where the water users' associations have taken responsibility for management, is running smoothly.

Industrial water

Industries consume only a small proportion of Madagascar's water resources. Industries obtain water from a variety of sources, depending on where they are located. Jiro Sy Rano Malagasy supplies drinking water to industries situated in industrial zones or in urban areas where it is active. Industries outside these zones or urban areas obtain water from rivers, fountains, and other sources, which they treat themselves. Jiro Sy Rano Malagasy provided industries with about 3.7 million cubic meters of water between October 1994 and September 1995, which was about 7 percent of the water it supplied for all uses. There are no data available on the water consumption of industries obtaining water from sources other than the water agency.

Current debates and future prospects

The sector strategy and action plan (strategie sectorielle et plan d'action) calls for users to pay the full costs of water supplies in the future in order to ensure the sustainability of water services (CNEA 1995). The sector strategy and action plan focuses on three major issues for the future: cost recovery, incentives for private connections, and decentralization. Cost recovery in urban areas is an immediate objective. It is intended that water charges will comprise two components: an investment component (including depreciation), and an operations and maintenance component to cover recurrent costs. Since the costs of supplying water differ between cities, the water charges will also differ (CNEA 1995). In rural and poor periurban areas, users will pay in accordance with ability to pay and the level of service rendered.

Encouraging households to take private connections is another major element of the strategy. When a large proportion of a nation's population has private connections, cost recovery improves, people's quality of life is raised, and water waste declines. For urban areas, the sector strategy and plan of action recommends revising connection fees to encourage households to take private connections. For rural areas, the plan calls for implementing an effective "social connections" policy, in accordance with the principles of rational management and social equity.

Within the framework of the decentralization process now under way, the plan stresses the key role that decentralized institutions need to play in managing not only facilities and water works but also water resources. The decentralized institutions will have much more autonomy than in the past in administration and financial management.[31] This will give communities greater freedom to manage their own development. Recently, central authorities have suggested entrusting basic village structures called *fokontany* with the management of natural resources, including ground and surface water resources. This would likely give the *fokontany* influence in determining water rates.

Urban water pricing

A study is presently underway to develop recommendations for a national water pricing

[31] Law no. 93–005 of 26 January 94 concerning the general orientation of the decentralizaton policy.

system. It is certain that prices will need to reflect real operating costs. For public water supply points, two management schemes are envisaged: either the communities manage the facilities themselves, or they hire private fountain keepers to manage them.

Under the Kreditanstalt für Wiederaufbau-(KFW) financed project to rehabilitate water and sewerage systems in Mahajanga, water users will make contributions towards the upkeep of the communal water points. However, while individual contributions will likely be modest at first, water users may still resist paying for a commodity that they received for free in the past. Overcoming public resistance will require an intensive information, education, communication campaign.

Rural water pricing

The sector strategy and plan of action endorses FIKRIFAMA's rural water supply approach (and that followed by UNICEF's 150 Water Supply Points Project), and is encouraging others to replicate it. Several new projects, such as the Water Supply Sector Project (Project Sectoriel d'Alimentation en Eau) now in the process of being prepared, involve a number of actors, including UNICEF and the nongovernmental organizations of FIKRIFAMA and Caritas Madagascar.[32] This project — involving both urban water supply and rural water supply is important — being the first to successfully incorporate lessons from the past, while introducing new pricing practices in accordance with the sector strategy and action plan. It would be best to involve the water users' associations in the management of rural drinking water supply points (as is already the case with water conveyance systems built by the Rural Engineering Office), because this would make it possible both to rely on existing infrastructure and benefit from the experiences of the water users' associations in managing irrigation networks.

[32] The Water Supply Sector Project (Projet Sectoriel d'Alimentation en Eau), is being prepared with advance funds from the IDA.

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12 NAMIBIA

Pieter Heyns

Introduction

Namibia is a large country of 824,300 square kilometers and has a population of about 1.6 million people. With about 1.9 people per square kilometer, Namibia is one of the most sparsely populated countries in the world. Rural farming communities are sparsely distributed and small in number. The country is extremely arid. There are no perennial rivers in the interior of the country; ephemeral rivers flow during the rainy season. Rural communities therefore depend on groundwater for their water supplies.

Namibia became a German Protectorate in 1884. The colonists soon realized that the only way to develop urban settlements and permanent livestock farms in the waterless interior was to tap the groundwater sources or the unreliable ephemeral surface water sources. They started a concentrated borehole drilling program in 1903 and created a network of water points for livestock farming throughout the largely uninhabited interior. To develop industries, mines, and farms, the colonists had to establish large and reliable water supply schemes in areas with few available water resources. They achieved this through the development of borehole wellfields and long distance water supply systems, which relied on storage dams and water transport systems such as tanker trucks, pipelines, or canals. Water is thus a very expensive commodity in Namibia.

Central government (with local authorities with sufficient capacity) was responsible for building and managing the water supply infrastructure. Initially the government supplied the water to consumers at no charge. However, demand for water grew so rapidly that the central government was unable to fund the increasingly expensive expansion from the national budget without contributions from users. Table 12.1 presents current water supply and consumption statistics by sector in Namibia.

Table 12.1 Water supply and demand by sector, 1995

Sector	Water supplied (million cubic meters)				Percent of total
	Government	*Municipalities*	*Private Sector*	*Total*	
Domestic[a]	65	12	4	81	27
Livestock	21	n.a.	46	67	23
Mining	5	n.a.	10	15	5
Tourism	1	1	1	3	1
Irrigation	50	n.a.	79	129	44
Total	142	13	140	295	100

a Includes industrial demand. Namibia is not heavily industrialized.
n.a. means not applicable.

Present water pricing practices

The evolution of water charge systems

In 1920 the Union of South Africa, which occupied German South West Africa in 1915 during the First World War, became the Mandatory for the Territory and established an Administration. Although the German authorities and the South West Africa Administration intended to develop water supplies for the good of the country and supply the water at no charge to consumers, the need for water charges quickly became apparent. In 1954 the government, through the Department of Water Affairs, introduced a bulk water tariff of US$0.06 per cubic meter (1954 dollars) which was uniform for all bulk water consumers, regardless of location or the cost of delivering water to them.[33]

The water distributors are responsible for setting tariffs to final consumers. They typically set tariffs to cover their expenditures for bulk water (or the costs of operating their own water schemes), plus the costs of distributing the water. Consumer tariffs normally involve a fixed charge plus a volumetric charge. However since 1994 some municipalities have used block tariffs, charging a low tariff for a minimum (lifeline) quantity of water and much higher rates for larger quantities; those using larger quantities thus subsidize the consumption of the poor.

In 1969 the water supply institutions in Namibia were reorganized and the uniform bulk water tariff policy changed. The Division of Water Affairs in the Administration became a Directorate of the Department of Water Affairs in the Republic of South Africa. The Department of Water Affairs, which was referred to as a First Tier Government Authority, supplied water in bulk to the Second Tier or Communal Land Authorities and to the Third Tier local Municipal and Village Board Authorities. The Second and Third Tier Authorities were responsible for distributing the water to the consumers under their authority. The local authorities charged urban consumers for water, but not rural consumers. Instead regional authorities paid for the water of rural communities.

Between 1969 and 1971 bulk water tariffs covered only a portion of operation and maintenance costs of the bulk water supply infrastructure, and no capital costs. By 1972 bulk water tariffs generated enough revenue to cover full operation and maintenance costs, but still not enough to cover capital costs. By 1977 water charges generated enough revenue to pay some capital costs. At this time policymakers decided to charge the mining industry the full financial costs of supplying water. By 1979 it cost US$0.22 per cubic meter (1979 dollars) to supply water, but consumers still paid only US$0.15 per cubic meter: thus state subsidies still made up 32 percent of the total costs.

In 1990 Namibia became independent and the Department of Water Affairs was incorporated into the Ministry of Agriculture Water and Rural Development. Neither bulk water charges nor final consumer charges changed. However in 1993 the Namibian Government approved a Water Supply and Sanitation Sector Policy for the country and adopted an overall long-term sector policy which strengthened the water tariff policy principles already in place. This policy is based on the recognition that the overall sustainability of the water supply depends on the ability of suppliers to become financially self-sufficient, and that essential water supply services must be available to all Namibians at a cost which is affordable to the country as a whole. The policy thus requires beneficiaries receiving services in excess of basic needs to pay an increasing proportion of costs of the higher value services.

In 1994 the Government decided to commercialize some of the responsibility for water supply by creating a Water Corporation which became responsible for supplying bulk water to municipalities, villages, mines, industrial enterprises and irrigation schemes. A smaller Department of Water Affairs retained responsibility

[33] Currently the tariffs for state-supplied bulk water are levied and periodically revised in accordance with Article 66 of the Water Act, Act 54 of 1956, as applicable in Namibia, and promulgated by Proclamation No. 151 of 1971 in terms of Section 180(1) of the Water Act. Consumer tariffs are similarly levied and adjusted from time to time by the local authorities in terms of Article 30 (1) u of the Local Authorities Act, Act 32 of 1995.

for administering the Water Act and providing water to disadvantaged rural communities as part of the social responsibility of government. Policymakers decided to raise tariffs gradually starting in 1995 to achieve full cost recovery for bulk water supply schemes by 2000. Tariffs rose by 30 percent in 1995/96, and 20 percent in 1996/97. They are expected to rise 20 percent in 1997/98, and 15 percent per year starting in 1998/99 until tariffs reached levels allowing full cost recovery. (Real tariff increases are less since inflation runs at about 10 percent per year.) Thus bulk and consumer water tariffs policies now reflect the reality that water is a scarce commodity in Namibia.

The process of raising tariffs in rural areas has also been accelerated. Water tariffs must cover operation and maintenance costs between 1995 and 1998, and rise thereafter to achieve full cost recovery in nine years.

The principles of water pricing

Water tariffs in Namibia are subject to annual revision and periodic adjustment. The minister in charge of Water Affairs is responsible for ensuring that tariffs comply with government policy and that any adjustments in tariffs or tariff structures are warranted and reasonable. Regional and local councils are responsible for approving consumer tariffs. It is considered appropriate to bring sanctions against consumers who do not pay for water; however assistance should be given to those who cannot afford to pay.

Water supply institutions are responsible for establishing the appropriate consumer water charge policy in line with the national water supply policy. Currently urban consumers pay a low tariff for a specified lifeline quantity of 10 cubic meters per household per month. In some cities consumers face increasing block rates. Industries and commercial enterprises pay charges intended to cover the full financial costs of supplying water. Housing developers pay the costs of extending the supply network to the housing development.

For rural water supply, communities and authorities must agree on their respective responsibilities and commitments as a condition of government support, and state support can be withdrawn if communities do not comply with the terms of the agreements. Most communities currently pay operations and maintenance costs, although some communities receive subsidies for these. Authorities assess the ability of communities to pay for services before granting subsidies.

With such limited water resources, Namibia must prioritize the uses of water across competing demands. The first priority is domestic water supply, including water for livestock on both subsistence and commercial farms. The second priority is industrial, mining, irrigation, and recreation water supply. The state determines the degree to which individual sectors and entities should receive water based on their expected contribution to the overall development objectives and plans for the country.

Water for human consumption in the rural areas is higher priority than water for livestock, so the costs of supplying a minimum quantity of water for basic needs is subsidized by other rural water users. To prevent overgrazing by livestock, farmers pay a higher tariff for water for livestock, which includes a natural resources fee.

Water for mining companies. Between 1969 and 1984 the full financial cost of water for the mining industry was calculated by dividing amortized costs of supply by the quantity of water that mining industries estimated they would use. Unfortunately, these unit charges often turned out to be too low to generate sufficient revenue to fully cover costs because mining companies generally used less water than they had estimated. Unit prices were not adjusted, so the revenue shortfall became worse over time as mining companies became more efficient in their water use. In 1985 this method of calculating water charges was changed. Mining companies now pay a monthly lump sum which covers amortized capital costs, plus a volumetric charge which covers operation and maintenance costs. The operation and maintenance costs are variable, depending on volume consumed and hours of operation.

Irrigation water. Farmers normally pay the full financial costs of state-supplied irrigation water. However, they may pay less depending on the value of the agricultural output relative to its socioeconomic benefits. Commercial farmers who build and operate their own irrigation schemes do not receive state assistance.

Current debates and future prospects

Water tariffs

Namibia must invest in new water infrastructure to grow and develop, which will require enormous resources. Maintain the existing infrastructure will also require substantial resources. Thus policymakers have taken action to ensure that water users pay the full costs of supplying water, including capital and operation and maintenance costs.

Bulk water tariffs are now set separately for each water scheme. Capital costs are determined by amortizing the capital costs over redemption periods related to investment type—dams (amortization period 45 years), pipelines (amortization period 30 years), and mechanical/electrical installations (amortization period 15 years). The unit cost of water supply is derived by adding together the capital costs and operation and maintenance costs, then dividing the total by the quantity of water supplied.

The direct running costs of state-supplied water in fiscal 1994/95 was about US$15.8 million, or about US$0.24 per cubic meter of water supplied (irrigation water excluded). Income from water sales was US$21.1, or about US$0.32 per cubic meter. Water suppliers thus collected a profit of US$0.08 per cubic meter. Table 12.2 presents more information on costs of supplying water and revenues from water sales. The deficit between running costs and income has been eliminated since Namibia became independent.

Table 12.2 Income and expenditures for state-supplied potable water

	Expenditure and income from water sale per fiscal year					
	1989/90	*1990/91*	*1991/92*	*1992/93*	*1993/94*	*1994/95*
Potable water sold (1,000 cubic meters)	55,091	55,220	58,819	57,455	58,009	65,000
Running cost (million US$)	15.15	16.52	17.80	19.15	17.93	15.78
Unit cost (US$/cubic meter)	0.28	0.30	0.30	0.33	0.31	0.24
Income (million US$)	12.43	14.60	15.98	17.51	17.11	21.11
Unit income (US$/cubic meter)	0.23	0.26	0.27	0.31	0.30	0.32
Profit or deficit (US$/cubic meter)	(0.05)	(0.04)	(0.03)	(0.02)	(0.01)	0.08

Table 12.3 presents information on consumer tariffs by location and water source. Keetmanshoop is in the extremely arid southern part of the country (rainfall of 150 millimeters per year) and gets water from a state dam. Otjiwarongo is in the central northern area (rainfall of 450 millimeters per year) and obtains water from groundwater sources. Oshakati gets water from a huge piped water supply scheme drawing water from the perennial Cunene River on the northwestern border of the country. Rundu is next to the perennial Okavango River, and Katima is next to the Zambezi River on the northeastern border: rainfall in both places averages 600 millimeters per year). Tsumeb is a mining town; water pumped from the mine is supplied to consumers. Outjo and Grootfontein supply their own water from groundwater sources. Since these towns so not receive water from the state, they do not pay bulk water tariffs.

Table 12.3 Examples of consumer tariffs in Namibia (US$ per cubic meter)

	Bulk tariff				Consumer tariff	
	Actual cost			Tariff	Basic charge	Unit cost
	Capital	*Operating*	*Total*			
Keetmanshoop	0.17	0.32	0.49	0.32	2.71	0.44
Otjiwarongo	0.11	0.26	0.37	0.29	1.67	0.47
Oshakati	0.09	0.26	0.36	0.32	4.52	0.41
Rundu	0.03	0.18	0.21	0.23	2.22	0.29
Katima	0.03	0.18	0.21	0.22	2.22	0.29
Tsumeb	n.a.	n.a.	n.a.	n.a.	1.62	0.41
Outjo	n.a.	n.a.	n.a.	n.a.	2.67	0.28
Grootfontein	n.a.	n.a.	n.a.	n.a.	1.84	0.23

n.a. means not applicable.

In many parts of the country the water supply authorities are already using all their water resources. Developing additional water supply infrastructure is getting more difficult and expensive. It is therefore essential to implement measures to dampen demand and conserve water. Indeed some local authorities have implemented effective water demand management strategies. The media is also playing an important role in encouraging consumers to save water, and water awareness has become a regular feature in schools and community development programs. Water pricing, especially steep block tariffs have also been effective. Table 12.4 provides information on consumer tariffs involving increasing block tariffs. As proof of their effectiveness, water demand in the city of Windhoek has remained at 1990 demand levels, although its population has grown by 50 percent.

Table 12.4 Block tariffs for urban water supply

Gobabis		Walvis Bay		Windhoek	
Band (cubic meter per month)	Tariff (US$ per cubic meter)	Band (cubic meter per month)	Tariff (US$ per cubic meter)	Band (cubic meter per month)	Tariff (US$ per cubic meter)
0–10	0.52	0–15	0.35	0–10	0.51
10–60	0.59	15–25	0.41	10–30	0.73
60–20	0.72	25–85	0.59	30–60	1.02
120+	1.01	85+	1.06	60+	1.46

Block tariff bands are set in accordance with the particular circumstances of each town. Local councils determine the consumption bands and related unit costs, depending on local operating costs and the responsive of consumers to price incentives.

Windhoek is in the central highlands and receives 350 millimeters rainfall per year. The city obtains water from an integrated water supply system using groundwater, reclaimed wastewater water, and water from state dams. Gobabis, located in the wetter central eastern part of the country (400 millimeters per year), obtains water from groundwater sources supplemented with water from a state dam. In Windhoek and Gobabis the lifeline quantity is 10 cubic meters per household per month, based on the assumptions that low income households average eight persons and that each person needs 40 liters water per day. Walvis Bay is a coastal town in the Namib Desert where the annual rainfall is between zero and 10 millimeters per year. The town obtains water from the aquifer of an ephemeral desert river. The town has set the lifeline quantity at 15 cubic meters per household per month.

Irrigation water. Tariffs for irrigation water consist of a fixed levy per hectare per year used to support the irrigation boards, plus a fee per irrigated hectare, plus a unit charge which rises with consumption. A typical example is a board levy of US$15.6 per hectare per year, plus US$ 40.4 per hectare per year for the first 15,000 cubic meters, and a unit cost of US$0.004, 0.0107, 0.0218, and US$0.0327 per cubic meter for consumption between 15,000 and 20,000, 20,000 and 25,000, 25,000 and 30,000, and consumption above 30,000 cubic meters per hectare, respectively.

Conclusion

Inhabitants of this desert country have traditionally viewed rainfall and water supplies as a gift of God. In the past authorities have supplied water without charge as a social good. People are now resisting paying for water. Poor households in cities often fail to pay their water bills. However, water suppliers are not permitted to cut water services since water is essential to life. To enforce payment of water bills, authorities may cut electricity supplies instead. Households must pay their water bills before they may again receive electricity. This approach is proving an effective means of enforcing water charges.

Rural communities are still receiving subsidized water supplies. Some communities with diesel-driven borehole installations pay for fuel and related transport costs. Very few communities have yet organized waterpoint committees to collect fees from residents to pay the costs of operating and maintaining their water installations.

In Namibia periodic water shortages and droughts make it necessary to impose water use restrictions. This is an acceptable approach to managing water demand. Regional and local authorities have the power to limit industrial and agricultural water use, adjust tariffs, and impose penalties on people or entities that misuse water. It is also their responsibility to remind their constituents of the need to save water to advise them on ways to save water.

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13 NEW ZEALAND

Frank Scrimgeour

Introduction

In New Zealand, water is generally not a problem, given the country's temperate climate and its many rivers and lakes. Mean rainfall over much of the country ranges from 600 to 1,500 millimeters per year, although there are significant local variations (Duncan 1987). Historically, the government, with minor exceptions, has claimed ownership of water in lakes and streams[34] and has been responsible for allocating water to different users (Sharp 1991).

The largest users of developed water supplies are agriculture (1,140 billion cubic meters per year), and urban water schemes for both and commercial consumers[35] (480 billion cubic meters per year) and domestic consumers (280 billion cubic meters per year). In addition to consumptive uses, New Zealand rivers are widely used for recreation, to generate electricity and, to a lesser extent, to deposit wastewaters. The market for water is illustrated in Figure 13.1.

Water is priced in two markets: wholesale and retail. At the wholesale level, the government has been the monopoly supplier of water to retailers who are responsible for distributing water to consumers. The retailer has to pay the wholesale price for the water right and the infrastructure needed to harness the water and deliver it to the distribution system. The customers have to pay the retail price for delivered water. Historically, the government was also a retailer when it owned 53 community irrigation schemes, watering 160,000 hectares of land. For these irrigation schemes the government charged a nominal price for the water; revenues collected did not cover the operating costs of these schemes, let alone the capital or resource costs. By way of contrast, urban water schemes required the relevant city to fund the capital works associated with abstraction, but did not charge for them for the water rights. In many cases the local council was the government's agent responsible for allocating the rights to abstract water. The price of water to customers (the retail price) was usually based on property taxes which were assessed on either the land value or capital value of property other than land. Collecting revenues for water services this way ensured that costs were covered by local residential and business property owners without external subsidies. But this charging structure also provided no incentive to conserve water because there was little relationship between the amount of water consumed and money paid.[36]

Present water pricing practices[37]

Current institutional and policy framework

During the 1980s the government attempted to reform water institutions responsible for allocating and pricing water to encourage efficiency and protect the environment. Two principles guided the reforms: government generally should not be involved in commercial activities; and policy advice should be kept separate from the delivery of services. At the national level a ministry of environment was established to provide policy advice to the government. At the regional level regional councils were formed

[34] This has been contested, given that the Treaty of Waitangi guarantees Maori "the full exclusive and undisturbed possession of their lands and estates, forests, fishes and other property."

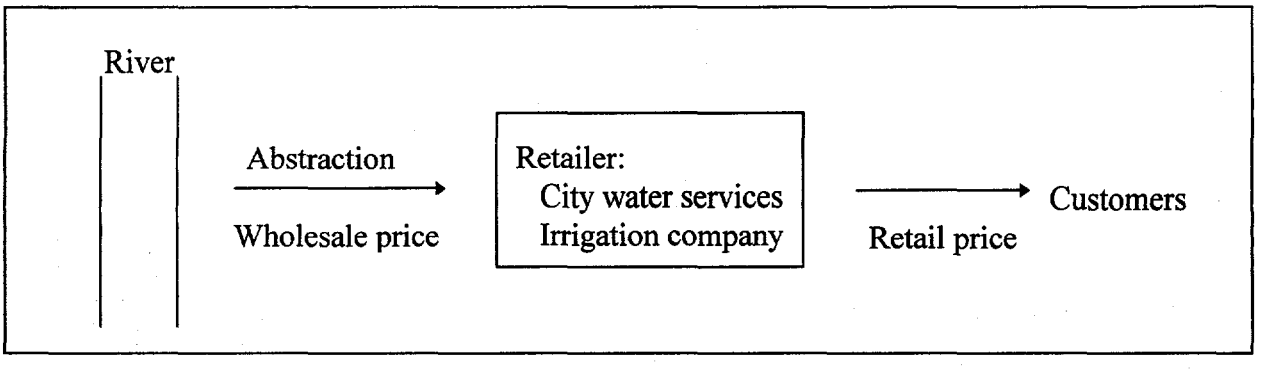
[35] This includes industrial and institutional consumers.

[36] In some cases major industrial users obtain abstraction rights (for their own use) independent of city water supplies. They pay only for abstractions rights and infrastructure.

[37] The author is grateful for information provided by 17 local authorities and one irrigation company.

and given primary responsibility for environmental protection. Under this new regime council-owned water schemes and privately- or community-owned irrigation schemes must to apply for water rights from their regional councils. The government sold its irrigation schemes to new owners, who became responsible for operating them.

Figure 13.1 Water marketing system



Regional councils. Regional councils are required to maintain accurate information on the water resources of their region and to manage these resources in line with the objectives of the Resource Management Act.[38] They in turn require users to have a "resource consent" to take surface water, divert or discharge surface water, impound surface water, or install or alter a bore. Regional councils charge for the processing of resource consent applications on a user pays basis of actual and reasonable expenses. Furthermore, once a resource consent is issued, the council monitors compliance and requires holders to pay for all actual and reasonable costs of compliance monitoring. Regional councils are also active in education to promote water conservation and the protection of water resources.

Urban water agencies. During the 1980s and 1990s most councils sought to improve the economic efficiency of their water services — primarily by reforming their institutional structures and pricing policies. Most councils created separate business units or water agencies to manage the water supply functions; these may function as departments of councils or be set up separately as local authority trading enterprises or companies wholly owned by the council. With regard to pricing, councils have attempted to make users pay all operational and capital expenses necessary to maintain the water system. They have not expected current users to pay for expansion of the system or to pay a dividend on funds invested.

Urban water agency pricing goals

Water agencies have attempted to reformulate charging mechanisms to provide consumers with incentives to conserve water. Policymakers believe that appropriate water pricing will reduce the level of investment necessary to satisfy the demands of residents and so delay the need for new infrastructure. They also hope that reduced pressure on natural waterways will help preserve them for recreation, tourism, and other nonconsumptive uses. However, water agencies recognize that provision of water at reasonable cost is important for sustaining local economies;

[38] The purpose of this legislation is to promote the sustainable management of natural and physical resources. Sustainable management is defined as managing the use development and protection of natural and physical resources in a way or at a rate which enables people and communities to provide for their social, economic, and cultural well-being the health and safety while (a) sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; (b) safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and (c) avoiding, remedying, or mitigating any adverse effects of activities on the environment (Resource Management Act 1991).

otherwise firms will find other suppliers or move. The degree of urgency agencies feel to revise pricing policies has depended on anticipated future demand (forecasts of population and economic activity) and availability of water stocks at modest cost. The desire for reform has been mitigated to some extent by concerns about social equity, the desire of most cities to maintain attractive gardens, and fears of voter rebellion against rising user charges.

Current practices of urban water agencies. More than 85 percent of New Zealanders live in urban areas; the country has 20 urban areas with 20,000 or more residents. Pricing data were obtained from 15 water agencies representing 53 percent of the urban population of New Zealand. Currently consumers face a variety of pricing mechanisms. In the sample, three water agencies charge on the basis of volume; four use two-part tariffs, involving a fixed charge and a volumetric charge; and eight use fixed charges exclusively. Table 13.1 summarizes pricing policies for domestic water for the 15 water agencies.

Table 13.1 Summary of urban residential water charges, 1995–96

	Number agencies	Fixed charges (NZ$ per year)			Metered charges (NZ$ per cubic meter)		
		Low	*Mean*	*High*	*Low*	*Mean*	*High*
Volumetric	3	n.a.	n.a.	n.a.	0.50	0.87	1.12
Fixed and volumetric	4	26	54	101	0.30	0.46	0.78
Fixed	8	65	153	266	n.a.	n.a.	n.a.

n.a. means not available

Note: All cost and price data are denominated in New Zealand dollars: US$.65 = NZ$1 in November 1995.

Most water agencies distinguish between residential consumers and industrial or commercial consumers. Some charge more for water above a specified monthly amount. Several use decreasing block charges, so that as consumption increases the marginal price to the nonresidential consumer falls. At least one city appears to charge nonresidential users substantially more than residential consumers while another city distinguishes between consumers who are rate payers and those who are not, and also adjusts the price according to season. Table 13.2 illustrates the prevalent system of charging a fixed fee to domestic consumers, and a fixed fee plus a volumetric charge to industrial users. This charge system provides adequate funding to operate and maintain the system without external assistance, but it fails to match charges expenditures to consumption. The fixed charge in this example is based on a property tax to both domestic and commercial and industrial users of approximately $0.0005 per $1.00 of capital value; commercial and industrial users receive a water allowance, and pay $0.27 per cubic meter for consumption above the allowance.

Cost for an urban water agency of using a marginal cost pricing mechanism

The introduction of volumetric pricing requires investment in meters and funds for meter reading and billing. Data available from Christchurch city are summarized in Table 13.3. The annual cost of metering is $930,000 (assuming capital costs are amortized over a period of 20 years at an interest rate of 10 percent), which is approximately 7 percent of the total cost of providing water services. The complete metering

of a city is important in the move to volumetric charges because incomplete metering generates significant conflicts between unmetered and metered users due to real and perceived inequities.

Table 13.2 Water consumption, costs, and revenues in Christchurch, 1994–1995

Consumption (billion cubic meters)		Costs (NZ$ per meter)		Revenues (NZ$ per meter)	
Residential	28.1	Operations and maintenance[a]	6.5	Residential	4.0
Commercial	9.1	Capital[b]	7.1	Commercial	8.1
Miscellaneous	1.4			Miscellaneous	1.0
Total	**38.6**	**Total**	**13.6**	**Total**	**13.1**

a Includes expenditures on head works, reticulation, quality assurance, meter reading and billing.
b Capital expenditure on water assets.

Price determination by an urban water agency

Councils are responsible for setting water prices; they must first decide on the funding target, the preferred instrument, on which consumers the burden should fall, and the impact of the charging mechanism on consumption. Thus far, most water agencies have set prices to cover current operation and maintenance costs. None have set charges high enough to yield a return on assets or capture any of the rents.

Table 13.3 Metering and its costs: Christchurch City

Number of customers	114,300
Capacity per year	40 million cubic meters
Capital cost of metering	$6,000,000
Annual reading and billing costs	$330,000
Total cost of metering per cubic meter	$.023
Total cost of metering per customer	$8.14

Having determined what current charges should cover, water agencies then have to decide whether to use fixed fees, volumetric charges, or both.[39] Councils recognize that there are fixed investment costs regardless of level of consumption and that there are also marginal costs of consumption. However:

- Relying on a fixed fee provides no incentive to adjust consumption, since the marginal cost is nearly zero. Yet, this method is still used in many areas where meters are not yet in use, or where it is thought that the costs of metering would be large relative to potential gains in efficiency.
- Using metered charges alone provides consumers with strong incentives to adjust consumption. However, the revenue stream

[39] It is usually assumed that developers will pay levies to fund the capital costs of expanding supplies due to growth.

which results from such a charging structure is less stable than that from fixed fees, and can vary significantly from year to year as consumers adjust demand in the face of different climatic and economic circumstances. Furthermore the introduction of volumetric charges may result in consumption declining by more than operating costs, creating funding problems for water agencies.

- Relying on a combination of a fixed fee and a metered charge reduces the volume-based cost (and the political costs, given that historically consumers have not paid for water on the basis of use), and reduces the variation in water agency income. However, it also reduces the incentive to conserve water. A slight variation on this combination approach is to charge a flat fee for a annual allowance.

Having determined the funding target and the type of charging structure, water agencies still have to decide who should bear the burden and whether there should be variations from a standard schedule of prices. Most water agencies distinguish between commercial and domestic consumers. Prices are sometimes higher for commercial users (due to their perceived ability to pay) and sometimes lower (for large volumes) due to the lower marginal cost of supplying large volumes. Most water agencies have debated whether to adjust charges for geographic or household variables. Although consumption varies between suburbs with different soil types, all consumers need to face incentives to adjust consumption. Pumping costs vary with the topography of suburbs but generally it is too costly to determine the different costs of supplying different suburbs to be worthwhile. With respect to different households, water agencies recognize that they do not have information about household composition and other characteristics and, even if they did, water pricing is not the best approach to address equity issues.

Having resolved all the previous issues, water agencies must accurately predict the impact of pricing practice on consumption. Water agencies can obtain estimates of price elasticity of demand from economists or by observing consumers' responses to new pricing mechanisms put in place in other municipalities.

Complicating factors associated with volume-based charges

The introduction of volume-based charges provides numerous challenges for the water agency to overcome if it is to be able to collect revenues and provide incentives to conserve. A water agency must be able to locate the pipes, account for the water, minimize illegal behavior, and implement the regime on multiple dwelling properties. Often, meters have to be installed. Where pipes have been laid many years ago, or where agencies have lost records, the installation of meters can be very costly. Accounting for the water in a system is more difficult than identifying consumers. Water may be unaccounted because meters are malfunctioning, fire services are drawing water, mains are being flushed after repair, people are connecting illegally, or pipes are leaking. It appears that in most New Zealand cities at least 10 percent, and an average of 20 percent, of water is not accounted for. Some of this is due to illegal connections to fire mains, which are generally unmetered (because of the expense of maintaining a meter that will rarely be used and because of the risk of a little used meter locking up in a fire). Even with legal connections, problems regularly occur on multiple dwelling properties which have only one water meter.[40] Unless the multiple parties can agree to a sharing arrangement, the only option for these multiple dwellings is to charge fixed fees. Separate reticulation is necessary to overcome this problem, which costs several hundred dollars per unit. Finally, about 4 percent of bills are never paid.

Political factors associated with pricing reform

The introduction of volumetric charges for water, as opposed to a property taxes based on capital or land value, is a significant political step for most cities. Community consultation for such a move is standard and requires significant interaction between councilors, agency staff, and the wider public. It is unusual for

[40] Separate reticulation and meters are being provided in new multiple dwelling properties.

such a changes to be agreed and implemented in less than one year. Although people generally sympathize with enacting water conservation programs, many are ambivalent about the "user pays" principle, and prefer that the burden falls on others than themselves. During the process of public consultation, some participants have raised technical questions in large part to stop a move to volumetric pricing. Generally, the constituency for change is small; yet those who will be adversely affected identify their costs and actively participate in the political process. Some water agencies have introduced new policies slowly to minimize the political repercussions from change while others have preferred to delay decisions until after local elections.

Irrigation companies: Current policies and practices

Irrigation companies do not receive subsidies from the government and must collect sufficient revenues from users to at least cover operating costs. As most irrigation companies are owned by farmers served, they do not necessarily set charges high enough to collect a return on capital. A typical example is the Lower Waitaki Irrigation Scheme which charges $27.50 per hectare for border dikes, $11.00 per hectare for spray irrigation, and $11.00 per hectare for assessed dryland. Sixty-six per cent of the revenues raised cover running costs while the remaining 33 percent is for emergency capital expenditures, such as repair of the wash out of a river intake. If there is no need for emergency expenditures during the year, funds collected for this purpose are rebated at the end of the year.

Current debates and future prospects

Perspectives on future pricing and institutions

As the population and economy grows, water pricing policies are likely to change at both the wholesale and retail level. Future wholesale pricing decisions rest on who owns the surface and groundwater, and their approach to charging. If Maori were to regain their water rights, they would probably price water high enough to extract some of the rents.[41] As long as ownership lies with the crown, this is less likely to occur. However, all the existing flows of some river systems have already been allocated, which raises the challenge of reallocating flows from those who have rights to new or different consumers. Allocation through bureaucracies on the basis of scientific information alone does not ensure efficient allocation because it does not take into account the value of water in alternative uses. Thus, there will likely be a move towards developing water markets and transferable permits for those wishing to abstract water. This approach will help overcome the allocation problem, but transfers the rents to the new owners unless the tradable permits are initially auctioned off or the rents are taxed away.

Future retail decisions will evolve in response to experiences with volumetric pricing. Irrigation companies are likely to introduce variations in their charges as they collect information on the relative costs of supplying water to different customers. It is also likely that more flexible arrangements will develop whereby individual consumers can resell their rights within a given time period when their demand is less than their right to consume. If nonfarmers become either part-owners or develop new schemes, prices will more accurately reflect capital costs. For urban water schemes, the challenge is to complete the metering system to allow all schemes to price water on the basis of volume used (with or without a fixed fee). It is particularly important that water agencies pay attention to fluctuations in water demand and supply. A crisis developed in Auckland during 1994 as the city's water reserves were nearly depleted due to unusual weather patterns. Officials responded by rationing water and conducting a public relations campaign to encourage consumers to conserve. Encouraging consumers to cut water use would have been easier if the volumetric charge for water had been raised while storage levels were low and re-

[41] Maori are the indigenous people of New Zealand who retain significant constitutional rights on the basis of the Treaty of Waitazi signed with British settlers in 1840. Maori currently comprise 14 percent of the New Zealand's population.

duced once normal conditions returned. As charging systems are further refined, closer attention will be paid to the cost of capital. Consumers will likely to resist paying the full costs of major new schemes, and will instead try to obtain subsidies from the city or the national government to pay a portion of the costs.

The development of more rational pricing policies is well underway within New Zealand, but there are still considerable institutional problems to be overcome. The current allocation of rents to existing consumers is a political issue which will be reviewed from time to time. As the reforms consolidate there will be further gains in the efficiency of water agencies and irrigation companies and more careful use of water by consumers. Further steps are necessary to facilitate the transfer of water between different users and to take account of the capital costs of water infrastructure.

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14 PAKISTAN

Khalid Mohtadullah

Introduction

Most of Pakistan's water comes from glaciers, snow melt, and rainfall outside the Indus Plain. Average annual inflows are about 140 million acre feet. Agriculture uses 97 percent of the country's developed water supplies (135.7 million acre feet). Cities, households, and industries consume the rest.

In Pakistan government has been responsible for developing and maintaining most irrigation systems. Farmers in the Indo Pakistani subcontinent have been paying water charges for many centuries. Initially farmers paid in the form of agricultural produce. But in 1854, when the government created the public works department to develop and maintain irrigation works and provided it with separate funds, farmers began using money to pay their water charges. In 1873 the Northern India Canal and Drainage Act-VIII was passed, regularizing irrigation water charges. The history of water pricing may be divided into two periods: pre-1959 period and post-1959 period.

Past experience

Pre-1959

Former Punjab area. The first schedule specifying irrigation charges for different crops was prepared for the Upper Bari Doab Canal in 1891. Separate schedules were prepared for other canals once they were operational (Table 14.1). For canals which operated seasonally, farmers paid one-half the levy for canals operating year-round. In 1934, after six years of stable rates, water charges were reduced to reflect the dramatic declines in agricultural prices and farm incomes that started in 1930. In 1955 irrigation charges for all canals were returned to the 1924 level (Water and Power Authority Development 1978).

Southern zone. In this region, comprising old Sindh, Khairpur, and parts of Balochistan, landlords paid a composite levy for both *abiana* and land revenue.[42] The levy consisted of a percentage of the average market prices of different commodities. Charges thus varied each year with fluctuations in agricultural prices. The levy was separated into its two components in 1959 to eliminate differences in charge systems between the southern and northern zones.

Northwest Frontier Province. In this region, the occupiers established the rates for the Kabul River, Upper Swat, and Lower Swat canals in 1931 and for Paharpur canal in 1936. The water rates in Northwest Frontier Province were fixed a level similar to those in Punjab, and remained in effect until 1959. Rates were established for each canal or project to cover its construction costs. This led to the existence of numerous rate schedules, including 21 schedules for old Punjab, 6 for Bahawalpur, and 13 for Northwest Frontier Province.

Post-1959

A new charging system was introduced in 1959. To establish the new rates, canals were classified as barrage canals (including both year round and seasonal canals) or non-barrage canals. Rates for summer (*kharif*) crops were the same regardless of whether watered with year-round or seasonal canals, but differed for winter (*rabi*) crops.

[42] *Abiana* is local term for irrigation water charges. The provincial governments determine these charges as a fraction of average costs of irrigation water supply, typically set to partially recover operation and maintenance costs. These costs are recalculated from time to time. The percentage of costs to be recovered is a political decision, and is based on a mix of market prices for various commodities that changes from time to time.

Table 14.1 Water rates for major crops, 1924 and 1934 (per sown acre)

	Water rates 1924		Water rates 1934	
	Rupees	*US$*	*Rupees*	*US$*
Sugarcane	12	0.35	1.00	0.32
Cotton	6.25	0.18	5.50	0.16
Rice	7.5	0.22	6.50	0.19
Maize	4.5	0.13	3.75	0.11
Wheat:				
Year round	5.25	0.15	4.25	0.12
Summer (*kharif*)	5.25	0.15	4.50	0.13
Winter (*rabi*)	5.25	0.15	5.00	0.14

Note: US$ = 34.6 rupees
Source: Government of Pakistan 1970.

Table 14.2 shows the increases in water charges that occurred in 1959 for various crops. Table 14.3 presents the increases that occurred periodically in different provinces between 1959 and 1993 (Government of Pakistan 1978, and 1990; Usman 1992).

Despite the increases in water charges, farmers still paid less than the costs of operation and maintenance: between 1981/82–1991/92 farmers paid 46 percent of operation and maintenance costs in Punjab, 31 percent in Sindh, 42 percent for Northwest Frontier Province, and 15 percent in Balochistan. Nationwide farmers pay only about 20 percent of total operation and maintenance costs of irrigation systems (Government of Pakistan 1990). Table 14.4 shows revenues, expenditures, and subsidies of irrigation systems in Pakistan from 1980 to 1990.

Present water pricing practices

In Pakistan there are three types of water charges for irrigation water: volumetric charges; charges which vary based on irrigation output and class of land; and flat rates. Few farmers in Pakistan pay for water on the basis of use, since little water is metered. Introducing metered charges would be expensive and would require high reliability of irrigation systems. But it could provide incentives to encourage water conservation.

Most farmers in Pakistan pay for water on the basis of irrigation output and class of land. This system is easy to understand and manage. Farmers can accurately estimate their irrigation water charges well in advance of harvest and budget for the payment, since they know the size and class of their landholdings.

In Sindh Province a flat rate charge system was introduced to simplify administration, eliminate corruption, and provide certainty to landholders with regard to their obligations. Flat rates were computed as the average charge of the previous three years (1968/69–1970/71). This amount was divided by the village cultivated area expressed in "produce index units." Total charges (or the level of taxation) equaled the produce index units. Farmers were responsible for the charges whether or not they actually cultivated their land.

The flat rate charge system had several important drawbacks. The charge system made no allowance for cropping patterns or the intensity of irrigation. This meant that farmers of high return crops, like sugarcane, rice, and cotton, paid the same water charges as farmers of low return crops, such as fodder. The flat-rate charge system also placed a greater burden on small landowners and those at the tail-end of

irrigation systems, who tended to use less water than other farmers and who in the past paid lower fees to reflect this. While it is possible that most farmers would adjust their choice of crops in the long-run, small farmers have less scope for substitution because they grow much of their output for their own consumption. Sindh's flat rate charge system was abolished in April 1980. Proposals to implement it in Punjab were never implemented.

Urban and industrial water supply

For urban and industrial users water charges may be either fixed fees or volumetric charges. Residenets of dwelling units sizes 188–250 square yards pay fixed fees averaging US$2.46–4.19 (88–145 rupees) per month. Households with metered supplies tend to pay more, about US$3.5–5.00 (121–173 rupees) per month. Tables 14.5 and 14.6 provide information on water charges for households and industries.

Current debates and future prospects

Difficulties and debates

Among the weaknesses of current water charge system for irrigation are: crop-based rates are not based on the potential return of the crop; the current method of assessing water rates has led to fluctuations in farmer incomes; collections are inadequate due to inadequate enforcement of charges; water suppliers routinely inflate their costs and underreport their revenues; and there has been inadequate expenditures for operation and maintenance leading to water losses and inefficiencies (Government of Pakistan 1990). Although there are no reliable estimates of the extent to which irrigators inflate their costs, the experience of India with similar irrigation systems suggests that true expenditures may half of the amount reported in government budgets (Wade 1982, Rao 1984). It also appears as if provincial irrigation departments are overstaffed by up to 50 percent (Wolf 1986). Rising irrigation-intensity based water rates have far greater impacts on small farmers than large farmers, and reduce the incomes of those least able to afford the losses (Chaudhry, Majid, and Chaudhry 1993; Ilyas 1994).

Other problems. Farmers are not involved in operating and maintaining the irrigation systems, making it difficult or impossible for them to substitute their labor for that of hired workers and save money (Government of Pakistan 1994). In addition, farmers do not actively participate in designing and operating irrigation systems, and as a result the systems do not truly reflect farmer demand (Government of Pakistan 1994). Finally there are considerable problems with corruption and poor execution of internal control procedures. Corrupt government officials often charge farmers fees which do not appear in the budgets (Chaudhry, Majid, and Chaudhry 1993; Ilyas 1994; Wolf 1986).

Extension services for water management

It is essential that farmers improve their water-use efficiency, especially in the arid areas of the Indus Plains, if sufficient water is to be available in the future to meet the Pakistan's growing water needs. However, currently there are no extension services to help farmers better manage and operate the irrigation works. Provincial irrigation departments have primary responsibility for the operation and maintenance of irrigation system and do not deal directly with the farmers to help them improve their water-use efficiency. Indeed they do not have expertise in this field. Provincial agricultural departments provide limited information about water requirements of crops as part of the package of services they offer on the technology of crop-production. The experts working with farmers under the provincial agricultural departments are mainly concerned with lining the watercourses and providing information to farmers through the water users' associations on proper use of irrigation water. Farmers need much more help than this if they are to make the changes necessary to truly improve water use.

Table 14.2 Increases in water rates, 1959

	Increase per acre	
	Rupees	*US$*
Wheat	0.37	0.01
Rice	1.62	0.05
Cotton	2.43	0.07
Sugarcane	6.37	0.18
Fodder[a]	0.56	0.02
Maize[b]	0.10–0.19	0.003–0.005
Pulses	same as maize	same as maize
Oilseeds	same as maize	same as maize
Minor crops	same as maize	same as maize
Gardens	same as maize	same as maize

a Total charges were set uniformly at 3.5 rupees per acre.
b This represents a slight reduction from 1959 rates in old Punjab, and slight increases in Sindh, Northwest Frontier Province, and Bahawalpur.
Note: US $ = Rs. 34.60 (current US$)
Source: Government of Pakistan 1970.

Table 14.3 Provincial periodic increases in water rates since 1959 (percent)

	Percentage increases		
Years	*Punjab and Northwest Frontier Province*	*Sindh*	*Balochistan*
1963	10	10	0
1965	10	10	10
1968	20	20	0
1969	15	15	45-56[a]
1977	25	25	40-41[b]
1980	25	25	25
1981	25	25	25
1982	0	25	0
1985	25	10	25
1991	0	0	10
1993	25	0	0

a 1970
b 1972
Source: Government of Pakistan 1978.

Table 14.4 Historical operation and maintenance expenditures and revenues per acre

Year	Cost per acre[a]		Revenue per acre[b]		Subsidy per acre	
	Rupees	*US$*	*Rupees*	*US$*	*Rupees*	*US$*
1980-81	53.77	1.94	15.53	0.45	38.24	1.10
1981-82	55.45	1.60	19.68	0.57	35.77	1.03
1982-83	59.65	1.72	20.70	0.60	38.95	1.12
1983-84	73.88	2.13	24.83	0.72	49.05	1.41
1984-85	88.25	2.55	24.73	0.71	63.52	1.84
1985-86	102.48	2.96	24.75	0.71	77.73	2.25
1986-87	124.58	3.60	25.98	0.75	98.60	2.85
1987-88	131.88	3.81	28.78	0.83	103.10	2.98
1988-89	143.73	4.15	31.08	0.90	112.65	3.25
1989-90	149.63	4.33	31.08	0.90	118.55	3.43
1990-91	158.18	4.57	31.08	0.90	127.10	3.67

a Includes operation and maintenance costs for canals, tubewells, and others.
b Includes water rates, drainage, and miscellaneous receipts.

Note: For the period 1989-91, operation and maintenance costs per acre have been projected to have risen by 5.3 percent in Punjab, 4.9 percent in Sindh, 5.7 in Northwest Frontier Province, and 6.5 percent in Balochistan. It is assumed that the receipts have been not changed over this period.

Current US$, 1US$ = Rs. 34.60.

Table 14.5 Water rates for unmetered households

Average rental value	Area of house	Water rate per month	
Rupees	*Square yards*	*Rupees*	*US$*
< 400	62	34	0.98
401-500	125	50	1.44
510-720	188	85	2.46
721-1,000	250	145	4.19
1,001-1,500	375	202	5.84
1,501-2,388	500	209	6.04
2,389-4,370	750	219	6.33
4,371-4,499	1,000	225	6.50
> 4,500	1,200	60 percent of average rental value	

Note: 1US$ = Rs. 34.60

Table 14.6 Water rates for metered supplies: Households and industries (rates per 1,000 gallons)

	Residences		Industries	
Gallons per month	*Rupees*	*US$*	*Rupees*	*US$*
< 5,000	7.35	0.21	13.65	0.40
5,001–20,000	11.70	0.34	24.40	0.71
> 20,001	15.00	0.43	35.30	1.02

Note: 1US$ = Rs. 34.60

Pricing and institutional reform issues

As the development of water supplies becomes increasingly costly it is essential to recover costs from users. Pakistan's extensive irrigation and drainage systems have been deteriorating because of inadequate maintenance and utilization beyond design capacities. To make irrigation systems financially sustainable, there is a need for new institutional approaches (World Bank 1994). Among the options being considered are market-based incentives such as volumetric charges for irrigation and drainage, and at a point in the future, tradeable water rights. Both these approaches will require major institutional changes, including new institutions which involve farmers in all aspects of irrigation system management.

The role of farmers organization will be crucial for the success of the system. The government is now taking steps to reform institutions. The provincial irrigation departments shall be transformed into autonomous bodies — provincial irrigation and drainage authorities under statutory arrangements — with authority to collect revenues and expend funds. Financially self-accounting area water boards will be created along the lines of area electricity boards, preferably around canal commands. Farmers using common distribution networks shall be encouraged to form water users groups on a pilot basis. It is hoped that these groups will play an important role in the operation and maintenance of distribution works. Based on the results of the pilot projects a model will be developed to implement nationwide.

The proposed reforms will involve farmers much more in the operation and maintenance of the irrigation systems and management of their finances. The reforms should lead to more reliable water supplies, more equitable distribution of water supplies, and higher farm output and incomes.

The next steps will depend on experience in implementing the reforms. If the pilot projects succeed, the units can increase the level of participation and extend the program to the remaining canal commands. This would be a bold decision to transform the largest irrigation system in the world.

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15 PORTUGAL

João Castro Caldas

Introduction

Public bodies or private individuals can own water resources in Portugal. Water is defined as public if it comes from lakes and lagoons, navigable channels, rivers and streams, or springs on public land. Water from springs on private land is also public if it flows to public water sources. Traditionally, there was no charge for the use of public water. However there were restrictions on its use — including a prohibition against the significant discharge of pollutants — which if violated, subjected the perpetrator to fines and penalties. Water is considered private if it comes from most sources on private lands, including lakes and lagoons (not fed by public water sources), groundwater, and springs. Public water granted in perpetuity for irrigation is also considered private. Private owners of water are free to use and manage it with few significant restrictions (Cunha *et al.* 1980).

Publicly-owned water can be granted to individual users through concessions for hydraulic projects. In these cases, the state imposes fees to cover the costs of impounding or consuming water which exceed the public benefits from the project, and fees and penalties for the discharge of pollutants.

In the early 1990s it was estimated that about 43 percent of Portugal's 16 billion cubic meters of available water resources were being utilized. Table 15.1 presents the shares of water use by sector (Direcçcão Geral dos Recursos Naturais 1992).

Table 15.1 Water use by sector (percent)

Sector	Share
Agriculture	59
Hydroelectricity	24
Industry	11
Urban	6

Past experiences

In the mid-1970s Portugal's public water system served only 46 percent of its population. The beneficiaries paid less than the costs of operations and maintenance, with municipalities paying the remaining costs using state subsidies (Frade and Alves 1991). Industries owned most of their water resources, which made it easy for them to avoid viewing water as an economic good. Water pollution was an issue in only in few subsectors (Frade and Alves 1991).

Water pricing structures for public irrigation systems illustrate some of the problems of past water pricing practices. Between the late-1930s and the mid-1970s, the government built irrigation systems to provide water to irrigate 75,000 hectares of farmland. However, irrigated area never exceeded 60 percent of plan (it is 7 percent of total irrigated area in Portugal) (Direcçcão Geral dos Recursos Hidraulicos 1987). Once the irrigation works were completed, beneficiaries were expected to pay two annual fees, set by the state and collected by farmers' associations. The first of the two fees

— intended to cover operation and maintenance costs — was distributed among individual beneficiaries in accordance with amount of irrigated land they owned. This fee was adjusted by applying a coefficient reflecting metered deliveries of water per hectare, the economic and social value of the irrigated crop, and soil quality. The second fee was meant to reimburse the government for its capital expenditures over a period of 50 years. Interest rates to farmers varied depending on soil quality: however, no farmer paid more than the incremental increase in the value of the land due to the investment. Until the middle of the 1970s, revenues were sufficient to cover operation and maintenance costs, but not to cover the capital costs (Baptista 1993).

Table 15.2 Lisbon average water prices, 1994 (Portuguese Escudo (PTE) per cubic meter)

1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
41.3	40.4	40.6	40.9	35.7	37.8	40.6	42.2	48.1	55.9	61.6	64.5	68.3

Source: Adapted from Frade and Alves 1991.

Present water pricing practices

Urban

The main development in the urban sector over the past twenty years has been growing water use per person and an increase in the percentage of the population served. Between the mid-1970s and the mid-1990s, consumption per capita rose 14.6 percent, reaching 110 liter per person per day; the percentage of population served rose from 46 to 65 percent. Thus the volume of water supplied by public systems rose by nearly 74 percent, to 410 hecto cubic meters per year.[43] This increasing demand has led state and municipal authorities to search for ways to transfer operational and investment responsibilities to the private sector, and encourage consumers to conserve water and pay for it (Table 15.2) as an economic good (Frade and Alves 1991).

Developments in Lisbon illustrate the changes occurring throughout Portugal. By the early 1990s water users were paying enough to cover nearly all system costs, including operation and maintenance costs and capital costs. Yet costs were not shared equally by all users: regulations ensured that lower-income households paid less; the largest consumers paid a larger share of the burden. For example, in 1996 the price of water in Lisbon was 22.9 PTE per cubic meter for consumption below six cubic meters per month and 179.2 PTE per cubic meters for office and commercial consumption.[44] Fixed fees also differed depending on type of consumer, from 670 PTE per month for households, to 405,720 PTE per month for large users. The volume-based prices and service fees are presented in Tables 15.3 and 15.4.

Different municipalities charge different prices and fees, reflecting different cost recovery and revenue collection policies. Indeed, average regional prices for household users can vary from 61-165 PTE per cubic meter, and the service fees from 170-670 PTE per month. Tables 15.5 and 15.6 present the prices and fees of the city of Fundão.

Industry

Most industries supply their own water, often from groundwater sources. However, the overexploitation of groundwater aquifers requires many industries to use water-saving tech-

[43] 1 hecto cubic meter = 1 million cubic meters

[44] 1US$ = 150 PTE

nologies and practices as total water consumption by industry increases. Frade and Alves (1991) estimate that at the beginning of the 1990s, industries used about 1,000 hecto cubic meters water per year, 2.4 times more water than cities. In 1996 industries in Sines, an industrial area in the south, paid 55 PTE per cubic meter for water.

Agriculture

Irrigation uses more water than any other sector in Portugal, consuming 60 percent of the total developed water supplies (Direcçcão Geral dos Recursos Naturais 1992). About 90 percent of Portugal's 660,000 irrigated hectares are watered by privately-owned and managed irrigation systems. Public investments in irrigation systems have been relatively small and have not expanded significantly recently.

The new common agricultural policy and GATT agreements, which created a common European market for agricultural products and eliminated protection of the agricultural sector, has created a new framework for farm production. Farmers' profits now depend on their ability to compete with agricultural producers in other countries. Irrigation water pricing policy may encourage farmers to use water more efficiently by encouraging farmers to grow water-saving crops and adopting more efficient irrigation technologies. The case of Sorraia illustrates the impact of price levels and structures on choice of crop grown.

Table 15.3 Lisbon water prices, 1996 (PTE per cubic meter)

Level and type of consumption	Price
Household less than six cubic meters per	22.9
Household more than six cubic meters per	79.4
Commercial and other consumption	179.2

Table 15.4 Lisbon monthly water fees, 1996 (PTE per cubic meter)

Level and type of consumption	Fee
Lowest household consumption	670
Highest household consumption	294,540
Lowest commercial and other consumption	1,330
Highest commercial and other consumption	405,720

Table 15.5 Fundão water prices, 1996 (PTE per cubic meter)

Level of consumption (cubic meters per month)	Price
Less than 5	55
5-10	70
10-15	80
15-20	170
Greater than 20	300

Table 15.6 Fundão monthly water fees, 1996 (PTE per cubic meter)

Level and type of consumption	Fee
Lowest consumption	170
Highest consumption	1,000

In 1991 farmers in Sorraia grew three main crops on 13,000 hectares irrigated with a public system: rice (46 percent of irrigated area), maize (27 percent) and tomatoes (12 percent). About 17,200 cubic meters of water per hectare were applied for rice, 7,100 for maize, and 5,400 for tomatoes. Charges for water used for rice were based on quantity alone, while charges for maize and tomatoes were, in addition, based on area cultivated and crop grown (volumetric charges accounted for 80 percent of total water charges in the case of maize and 63 percent in the case of tomatoes). Water charges averaged 1.43 PTE per cubic meter for rice, 1.78 PTE per cubic meter for maize, and 2.26 PTE per cubic meter for tomatoes. Thus, average water charges were lowest for the most water consumptive crop — rice.

Historically, prices of irrigation water have not been set to encourage efficiency. Instead prices have been set to provide subsidies for the cultivation of particular crops or to support agricultural prices. Charges for irrigation water have rarely covered operating and maintenance costs. Urban and industrial water users pay two to five times more for water than farmers. Table 15.6 presents water prices paid by various sectors for water from public water projects.

Table 15.7 Prices paid by various sectors for bulk water from public water systems, 1991 (PTE per cubic meter)

Region	Agriculture	Urban	Industrial
Sorraia	1.43	n.a.	6.8
Divor	2.50	4.5	7.0
Mira	2.65	6.0	8.0
Roxo	2.90	7.7	10.0

n.a. means not available.

Current debates and future prospects

Urban

The main goal for the urban sector is to increase the percentage of the population served by public water systems to 95 percent by 2020, compared with the current 65 percent. Another goal is to increase the supply per capita to 150 liters per person per day supply by 2020, an increase of 36 percent over the next 25 years. If these goals are achieved, water supply will exceed 900 hecto cubic meters per year in 2020, an increase of nearly 120 percent over current levels. Portugal is committed to developing a water pricing structure so that prices are sufficient to cover all costs of the system, provide incentives to conserve, and are affordable to low-income households. These objectives can be reached through a tiered pricing system, with low rates for a minimum monthly quantity for households and higher rates for higher levels of consump-

tion (Frade and Alves 1991). The movement towards privatizing urban water supply services will help in achieving the goals.

Industry

Estimates suggest that industrial water demand will reach nearly 5,000 hecto cubic meters by 2020, an increase of 400 percent over the early 1990s. This is in spite of an expected increase in the use of water-saving technologies. Water pollution will be the main problem arising from water use by industry. So far, Portuguese industry has largely been able to avoid fully internalizing the costs of its pollution, but this is not expected to continue. Water charges in the future will certainly include the costs of treating discharges, resulting in sharply higher water charges to industry (Frade and Alves 1991).

Agriculture

Irrigated area in Portugal is expected to increase by more than 200,000 hectares over the medium-term, mainly through the construction of new public irrigation systems and the rehabilitation of the existing systems. Still to be resolved is the question of how to charge for irrigation water. Decisions will depend on overall agricultural policies. With the increase in urban and industrial demand for water, it is almost certain that some water will be reallocated from agriculture, and that agriculture will be required to pay a larger share of the costs of providing irrigation water.

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16 SPAIN

Josefina Maestu

Introduction

Water in Spain is a highly valued resource. Much of Spain's history has been linked to coping with its water cycle — droughts, seasonal variations in rainfall, and floods. Water is relatively scarce and impressive public and private effort has been devoted to assuring it is available when and where it is needed. Today there are more than 1,000 dams in Spain covering more than 5 percent of its total surface area. Spain has 9,600 kilometers of irrigation channels and pipes and 5,000 kilometers of urban channels and pipes. Water capacity in Spain totals about 53,000 million cubic meters, including 40,500 million cubic meters of regulated surface water, and 14,000 million cubic meters of renewable underground water resources.

About 80 percent of the developed water supplies is used for irrigation, 11 percent is used for municipal purposes, and about 5 percent is used for industry. Groundwater sources supply about 22 percent of the water used in irrigation and 25 percent of the water used in cities. Water availability varies by region. Water scarcity is especially acute in southern Spain and the Balearic Islands: these regions have shortages even in years of average rainfall (see Table 16.1).

Table 16.1 Water resources and demand in various basins (million cubic meters per year)

Basin	*Irrigation use*	*Other uses*	*Total*	*Resources*	*Surplus or deficit*[a]
North	548	1,531	2,079	7,526	-5,447
Galicia-Costa	405	388	793	1,580	-787
Ebro	6,820	4,631	11,451	14,364	2,913
Cuencas Intenas de Catalunya	290	1,012	1,302	1,571	269
Duero	3,508	594	4,102	8,623	4,521
Tajo	1,947	1,500	3,447	7,174	3,727
Jucar	2,402	1,145	3,547	3,582	35
Guadiana	2,231	323	2,554	3,329	775
Guadalquivir	3,097	919	4,016	3,542	-474
Segura	1,626	235	1,861	1,515	-346
Sur	827	336	1,163	1,119	-44
Baleares	275	105	380	372	-8
Canarias	267	105	372	372[b]	0

a There are local deficits that lead to overexploitation of aquifers of about 6,000 million cubic meters per year.
b Including water from desalination.

Source: National Hydrological Plan 1993.

A two-tier water management system

In Spain there is a distinction between resource development, the transportation, purification, and distribution of water, and the collection and treatment of wastewater. Water basin agencies, which have evolved from user organizations established in 1926 to develop and manage basin resources, operate in 11 water basins in Spain. The agencies are responsible for developing water resources, planning, and supplying water to municipalities, industries, and irrigation associations. The local units are, in turn, responsible for distributing water and sanitation services to urban users, independent industrial users, and farmers. Municipalities are responsible for collecting and treating wastewater. However, their delivery is often contracted out to private enterprises (Zaragoza), mixed public-private bodies (Barcelona), or public companies (Seville).

Major problems today

The water deficit, currently estimated at 3,000 million cubic meters, will double over the next 10 years and triple over the next 20 years if current water use trends continue. Two key issues facing decisionmakers today are managing cyclical droughts and dealing with the increasing concentration of water demand along the coast and during the summer due to the development of tourism and irrigated agriculture.[45] The increasing social, environmental, and financial costs of developing new water supplies — the traditional supply-side solution — is leading policymakers to consider demand management measures, including the development of local water markets in places where there is significant competition for water.

Present water pricing practices

Water tariffs of basin agencies were designed in the first half of the century to increase farmers' rents with economic development objectives in mind. Subsidies ranged from 60-100 percent of the cost of waterworks; farmers were offered loans at interest rates of 1.5 percent to cover the residual investment costs. In 1985 a new law was enacted based on the principle that the people benefiting from water investments should pay their full costs, including capital and recurrent costs. Today Spain is designing a system of tariffs to provide incentives to improve water use efficiency.

At the same time, municipal water tariff structures are now being designed to recover costs and provide incentives to conserve water. Agencies now often use two-part tariffs with increasing block rates; greater transparency in water bills; and prices which differ depending on class of user, such as residential, commercial, industrial, and public uses). In addition, tariffs now often fully cover operating costs and an increasing share of capital costs

Tariffs for resource development

Water basin agencies use three types of tariffs, regulation levies, tariffs for water use, and discharge levies. Both regulation levies and tariffs for water use, are paid by beneficiaries of water infrastructure, and are designed to cover the capital investment and operation and maintenance costs of specific waterworks. These tariffs are calculated independently by each water confederation, and for each user (based on the capital and operational costs of the user's infrastructure). Urban consumers and independent industrial users pay by cubic meter, irrigation water associations pay according to hectares covered, and hydroelectric producers pay according to kilowatt hours of electricity produced. The discharge levy, intended to account for environmental externalities, is calculated individually for industrial and municipal water systems by multiplying discharge volumes by a coefficient reflecting the concentration and composition of pollutants being discharged. Table 16.2 depicts the average tariffs charged to different categories of users.[46] However, inde-

[45] The most recent drought ended in late 1995, lasted four years, and affected 12 million people.

[46] US$1=120 pesetas, March 1993

pendent valuation by each basin agency means that tariffs within and between basins are highly variable. Table 16.3 includes examples of the variation in regulation levies for different users.

Table 16.2 Average tariffs for different categories of users (US$ per cubic meter)

Irrigation Associations	Municipal supply organizations	Hydroelectricity companies
0.008	0.004	0.0008

Source: Ministry of Public Works, Transport, and Environment 1994.

Charges for water transfers. About 300 million cubic meters of water per year are transferred between the Tajo and the Jucar and Segura rivers, about 150 million cubic meters are moved from the Ebro to the north, and about 40 million cubic meters are moved from the Ebro to Catalonia. The regulation levy for the Tajo-Segura water transfer is US$0.16 per cubic meter for irrigation water and US$0.19 per cubic meter for municipal supply. This levy is comprised of an annual rental fee for the use of the infrastructure (derived by multiplying the present value of the initial investment costs by 4 percent) and the annual costs of operation and maintenance, in accordance with 1985 water law.

Table 16.3 Sample charges to different categories of users (US$)

River Basin	Irrigation		Municipal	Industrial
	per hectare per year	*per cubic meter*[a]	*per cubic meter*	*per cubic meter*
Duero:				
Almar	160	0.027	0.027	0.027
Duero	20	0.003	0.003	0.003
Pisuerga	27	0.004	0.004	0.004
Arlanzón	58	0.01	0.01	0.01
Guadiana:				
Montijo	25	0.004	0.02	0.01
Peñarroya	26	0.004	0.02	0.013
Cuenca Alta	14	0.002	0.011	0.007
Vicario	26	0.004	0.02	0.013
Tajo:				
Alberche	0.93	0.0001	0.0004	0.0004
Entrepeñas	4	0.0006	0.002	0.002
Jerte	12	0.002	0.0015	0.0015
Arrago	64	0.01	0.045	0.045

a Volumetric price equivalent to or less base charge.
Source: Ministry of Public Works, Transport, and Environment 1994.

Municipal water charges

Ninety-six percent of municipal water in Spain is metered. Water prices average about US$0.98 per cubic meter. Barcelona (US$1.75 per cubic meter) and Madrid (US$1.00 per cubic meter) have the highest water prices (Table 16.4), but there are cities with prices as low as US$0.29 cubic meter (Huesca) and US$0.12 per cubic meter (Ceuta). Variations in prices are due in part to the practice of some municipalities of including sanitation and wastewater treatment services in the price for water. In addition, 16 percent of municipalities (mainly smaller cities with direct municipal management) subsidize water.

Table 16.4 Average price of municipal water in Spain (US$ per cubic meter)

Water Supply	Sanitation	Wastewater treatment	Total
0.56	0.25	0.16	0.98

Note: Average prices weighted by consumption in different blocks.
Source: Spanish Association of Water Supply and Sanitation Survey 1994, and Segura 1995.

Different industries pay different prices for water. In small- and medium-size cities, industries face the same tariff structure and levels as domestic users. In bigger cities, industries typically pay a two-part tariff—a fixed charge depending on volume contracted, and a variable charge (increasing block tariff or flat rate) depending on volume consumed. In Barcelona, industries pay an average of US$0.86 per cubic meter, commercial users pay US$1.25 per cubic meter, and domestic users pay US$0.98 per cubic meter. Industries pay more for sanitation and wastewater treatment than commercial and domestic users, US$0.33 versus US$0.27 per cubic meter.

Types of municipal water pricing structures. In Spain, as in other Mediterranean countries where water is pricing structures that promote conservation are well established scarce (see Aguas de Barcelona 1992 for survey results). About 38 of Spain's 50 main urban centers covered in the survey use increasing block rates to encourage the largest users to conserve. Many cities use seasonal rates to encourage conservation in periods of higher water demand. The ten largest cities in Spain charge for sanitation and wastewater treatment, which makes up between 8 and 33 percent of the total tariff. Coastal cities may collect a larger proportion of revenues through fixed charges than inland cities, in order to distribute fixed infrastructure costs between permanent and nonpermanent residents.

Service quotas and consumption charges to industrial and commercial users often vary according to diameter of water meter. Charging on the basis of water meter diameter is intended to reflect the differential costs that larger users place on the design of the system. It encourages users to assess their true needs, and thereby discourages building excess capacity. Wastewater charges are set according to water use and — in cities such as Barcelona, Valencia, and Madrid — according to the pollution content of the discharges by each industry.

Irrigation water charges

Water prices paid by farmers are, in most cases, based on the area irrigated rather than on volume of water used. They are designed to cover the costs of irrigation infrastructure, maintenance and operations both of the basin authority and the irrigation association. However, farmers in traditional irrigation projects who do not benefit from public infrastructure or

who use infrastructure that has already been paid for, pay little or nothing for water. Farmers also pay fees to irrigation associations, the private costs of dams and reservoirs, pumping, and fees to cover the resource development costs of the water basin agencies.

Present pricing structures for irrigation water. There are three types of pricing structures for irrigation water: flat rates per hectare; flat rates per volume (where there is metering); and two-part tariffs involving a fixed charge per hectare irrigated and a charge per volume of water consumed. Farmers pay fees to irrigation associations, the private costs of dams and reservoirs, pumping, and fees to cover the resource development costs of the water basin agencies.

There is little information available on prices paid by farmers to their water associations. A recent study carried out in 42 irrigated areas estimated that farmers pay an average of US$84.7 per hectare per year, with a range from US$8.3 to US$266 per hectare per year (Centro de Estudios y Experimentación do Obras Públicas 1995). The Ministry of Public Works, Transport, and the Environment (1995) estimates that water associations pay between US$0.008 per cubic meter (US$60 per hectare per year) and US$0.16 per cubic meter (US$1,200 per hectare per year): the higher charges are paid by associations obtaining water from groundwater sources that need pumping or from major water transfers. However, observations show that farmers in some associations pay nothing; farmers may also pay up to US$0.5 per cubic meter in times of drought or for occasional or emergency water.

Farmers which are members of water associations (cooperatives) in Genil-Cabra (Cordoba) and San Martin de Rubiales (Burgos) pay two-part water tariffs (Segura 1995). The Genil-Cabra cooperative supplies irrigation water pumped from the Genil river to 15,000 hectares. Farmers pay a fixed rate of US$58.33 per hectare for the resource (payable to the basin authority), US$54.1 per hectare for operating and maintenance costs (primarily energy), and US$0.03 per cubic meter. The total charge averages US$258 hectare, of which US$112.5 is the fixed charge and US$145.8 is the volumetric charge.

The San Martin de Rubiales cooperative provides water pumped from the Duero river to 225 hectares. Farmers pay a fixed charge of US$129 per hectare (to cover the costs of rehabilitating existing distribution channels to prevent water losses), and US$0.05 per cubic meter.

Current debates and future prospects

Recent experience with water pricing in Spain can be summarized in terms of financial sustainability, efficiency, and equity.

Problems with the present system of water tariffs

- Tariff revenues of basin agencies are not sufficient to pay for the Clean Water Bill. Each year basin agencies collect between US$140-152 million. This is not sufficient to cover the water bill of the central government, which amounts to about 190 million dollars (including the management costs of basin confederation).
- The level and structure of tariffs does not provide incentives to Spain's largest water users—irrigation farmers—to use water efficiently. Tariffs for urban water users are more progressive and efficient.
- Charges for municipal water and sanitation services are set by regional governments. This makes it difficult to raise tariffs or to fully apply the principle that the user should pay.
- In about 16 percent of municipalities, operating costs are subsidized (Spanish Association of Water Supply and Sanitation 1992). Many of these are small municipalities with services provided by nonspecialized municipal officers. The movement toward providing services professionally and through water supply agencies (which charge enough to cover their costs) has enabled many municipalities to remove water services from their general budgets.

Debates and consensus

Views on how to charge for water range across a spectrum. Some believe that to provide incentives to conserve it is essential to move to full economic pricing of water and to encourage the development of water markets. Others argue that water is more than an economic resource, and that private appropriation of water has led to the displacement of communities.

There is a growing consensus that tariffs should generally be increased and should be similar across sectors. Tariff increases would provide signals to farmers regarding relative water scarcity, and encourage them to take measures to conserve water and reduce water losses. This would delay the need to develop new water supplies. In addition, raising tariffs would provide basin agencies with resources to finance maintenance and replacement of shared infrastructure, which would also reduce water losses.

Some analysts argue that water prices should reflect farmers' abilities to pay and should be set with consideration for their impact on agricultural production, including types of crops grown — public authorities should consider the economic and social impact of reduced production and job losses in setting water tariffs (Sumpsi-Viñas 1994).

Others challenge the assumption that raising water prices will lead to greater efficiency (Naredo, *et al.* 1994). They cite mainly empirical studies which show that changes in water use and allocation do not come about without technical and institutional prerequisites in place: water-saving technology (drip irrigation, sprinklers) must be available, users know about it, and credit lines must be available to finance their purchase. These analysts also argue that the usefulness of water prices to encourage water use efficiency and conservation depends on local circumstances. For example, in Almeria, the water price of US$0.16 per cubic meter covers all resource development costs (but accounts for only 0.03 percent of total costs), but is too low to encourage users to conserve water.

Consumer associations argue that domestic users across Spain should pay the same water tariff (as they do for electricity, telephone, gas services) because it is a public good; differences in water endowments should be solved through interregional transfers. Others, including water supply agencies, argue that tariffs should reflect the differential costs of conveying and treating water and the operational costs of different agencies.

Some political parties argue that water prices for lower income groups should be subsidized through free or low-cost provision of a monthly minimum volume of water. Others argue for subsidizing the consumption of the poor through more direct instruments.

In urban areas water bills are becoming increasingly complex, with different tariffs based on household income levels, types of industry, and, recently, family size. Water bills also include surcharges for water-related environmental services. This creates confusion and has led to some nonpayment of bills.

Conclusion

To finance the investments proposed in the Draft National Hydrological Plan (1993) and the costs of managing public water supplies requires a new tariff system. Tariffs can also have an important role in encouraging water conservation — a major priority of government. The Draft National Hydrological Plan proposes the following:

- All users should pay a basic tariff, not just those who benefit from public waterworks;
- Beneficiaries of public waterworks should pay the full costs of the water supply; polluters should pay the full external costs of their activities;
- Water tariffs should include correction coefficients to reflect relative water scarcity and externalities.

Other important trends in pricing include more transparent water accounting and clearer water bills; reduced use of cross-subsidies; and increased practice of including wastewater collection and treatment costs with water tariffs.

A major institutional reform under study is the development of water markets for allocating water, especially during droughts or in areas

where there is strong competition for water (Maestu 1996). A major step in this direction was included in the Draft 1996 National Irrigation Plan of the Ministry of Agriculture.

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17 SUDAN

Ahmed M. Adam

Introduction

In Sudan 90 percent of developed water supplies are used for irrigation. The first modern irrigation scheme was the Gezira Scheme, built in 1925. This scheme, which irrigates 920,000 hectares, started as a joint venture of the Sudan government and the Sudan Plantation Syndicate. The Sudan government was responsible for providing the water, and the Sudan Plantation Syndicate was responsible for financing and managing the project. In 1956 when Sudan became independent the institutional arrangements were changed, and responsibility for operating the scheme was split between the government, the Sudan Gezira Board, and the main water users. The government receives a share of revenue from water charges for its role in supplying irrigation water.

Water pricing in the past

In the past the government heavily subsidized irrigation, municipal, and industrial water supply. In 1981 it imposed charges for irrigation water for the first time to recover some of the costs of the irrigation system. However the government never collected more than a fraction of the intended amount. Monthly charges for domestic water were set at a flat rate according to the size of the dwelling. People with houses over 600 square meters paid the highest rates (class 1); those with houses 400–600 square meters paid less (class 2), and people living in houses less than 400 square meters paid the least (class 3). The collection experience was far better than for irrigation water since household consumers were treated individually. Table 17.1 presents information on domestic water supply charges in the Khartoum area, which are based on house size.

In some residential areas, houses have meters and consumers pay by quantity consumed. Industries also pay for water on the basis of use. Charges vary according to region. Rural consumers pay flat rates; overall charges are set to cover maintenance and operation costs of artesian wells. Table 17.2 shows water prices for metered households and industries.

Present water pricing practices

The government has recently adopted a free market approach to water supply, significantly cutting its subsidies and reducing its involvement in the sector. In July 1995 the government created the Irrigation Water Corporation, an institution independent of the Ministry of Finance. The Irrigation Water Corporation finances its activities through water user charges. In its first year of operation the Corporation had problems managing its cash flow since it incurs operation and maintenance expenses throughout the year, yet farmers generally pay only after they receive funds from selling their output, which happens seasonally. Farmers also resist paying the charges, which are now much higher than before. The Corporation needs time to convince farmers that the water charges are actually much less than under the old system, when measured as a proportion of total production costs: previously the government collected agricultural output from farmers worth 40–50 percent of total production costs, now water charges comprise no more than 6-7 percent of production costs.

Table 17.3 shows irrigation water charges for the past five years for selected irrigation schemes. Each scheme sets its charges to cover actual operation and maintenance costs. Charges vary according to the crop irrigated.

Table 17.1 Domestic water supply charges in the Khartoum area, 1992–96 (Sudanese Pounds (LS) per dwelling)

House class	July 1992 (US$=LS90)	October 1993 (US$=LS200)	January 1994 (US$=LS350)	August 1994 (US$=LS500)	May 1995 (US$=LS650)	January 1996 (US$=LS900)
1	450	800	1,000	1,500	2,250	3,000
2	275	550	750	1,000	1,500	2,000
3	175	325	500	850	1,000	1,500

Source: Director General of National Water Corporation (now Khartoum Water Corporation).

Table 17.2 Water charges for metered residences and industries, January 1996 (Sudanese pounds)

Volume (cubic meters)	Tariff per cubic meter[a]
0–15	100
15–40	75
>40	90

Note: 1US$ = LS900
Source: Ministry of Irrigation and Water Resources.

Table 17.3 Irrigation water charges, 1991–96 (Sudanese pounds (LS) per acre)

Irrigation scheme	1991/92 (US$ = LS90)		1992/93 (US$ = LS200)		1993/94 (US$ = LS350)		1994/95 (US$ = LS650)		1995/96[a] (US$ = LS900)	
	cotton	*other*[b]	*cotton*	*other*[b]	*cotton*	*other*[b]	*cotton*	*other*[b]	*cotton*	*other*[b]
Gezira	400	273	1,400	900	1,650	1,300	2,350	1800	7,900	6,000
Rahad	393	314	1,300	1,000	1,550	1,300	2,500	2000	9,500	7,200
North Halfa	346	258	1,200	800	1,500	1,300	2,290	1,800	5,700	4,250
Suki	n.a.	334	n.a.	1,332	n.a.	1,430	2,600	2,190	10,100	7,600

a In 1995/96 government founded the Irrigation Water Corporation and reduced subsidies significantly.
b Other crops are sorghum, ground nuts, wheat, and sunflowers.
Source: Ministry of Irrigation and Water Resources.

Current debates and future prospects

It is almost certain that the new Irrigation Water Corporation will collect much more revenue from farmers than was true in the past, since the new institution does not receive subsidies from the government. Clearly the willingness of farmers to pay will be based on the services they receive from the Corporation, and especially the extent to which the irrigation services increase their incomes.

Charges for domestic and industrial water supplied outside the Khartoum area will likely rise in the future as subsidies from Khartoum

state are phased out. In the past the National Water Corporation controlled water supply for the entire nation, charging uniform tariffs for all localities. This is no longer the case. Table 17.4 shows total expenditures and revenues of the old National Water Corporation from 1989–95.

Table 17.4 Finances of the National Water Corporation for 1989-95 (millions of Sudanese pounds)

House class	1989–90 (US$=LS12)	1990–91 (US$=LS15)	1991–92 (US$=LS90)	1992–93 (US$=LS200)	1993–94 (US$=LS350)	1994–95 (US$=LS650)
Expenditure	126	184	646	2,223	2,720	4,903
Revenue	130	369	782	1,887	1,917	4,960
Surplus (deficit)	4	185	136	(336)	(803)	57

Source: Director General of National Water Corporation (now Khartoum Water Corporation).

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18 TAIWAN (CHINA)

Ching-kai Hsiao and Ching-Ruey Luo

Introduction

Rainfall in Taiwan (China) is ample, but it is not evenly distributed in space or time. About 78 percent of rain falls between May and October: high mountain regions receive about 3,000 millimeters rainfall per year, while coastal plains receive about 1,500 millimeters. Some districts suffer from periodic droughts during the dry season.

Consumers use a total of about 17.6 billion cubic meters water each year in Taiwan. Agriculture uses about 77 percent of developed water supplies, urban consumers use 14 percent, and industry uses 9 percent. Of water used by agriculture, irrigation is responsible for 76 percent; the remainder is used for aquaculture and livestock.

Most water-intensive industries in Taiwan have developed their own sources of supply, and rely on municipal water systems for only relatively small amounts of water. Industries pay the costs of pumping, piping, and treatment of self-supplied water. More than 70 percent of municipal water is for residential use; the remainder is for industrial, commercial and other uses. Water demand for domestic use is increasing rapidly: daily per capita consumption has doubled over the past twenty years, from 224 liters to 450 liters. Over the same period water prices have nearly tripled, from NT$3.3 in 1975 to NT$9.0 in 1994.[47] It appears that prices are too low to significantly dampen consumers' demand in all sectors.

Present water pricing practices

Irrigation Water

Irrigation associations — corporate bodies organized by farmers under the Water Conservancy Law and Rules for Irrigation Associations — manage most of the irrigation systems in Taiwan. Farmers must be members of the associations to acquire water from them. There are 17 irrigation associations. The largest is Chianan Irrigation Association which provides water to some 78,180 hectares; the smallest is Liukung Irrigation Association which provides water to only 295 hectares.[48] Altogether the irrigation associations provide water to about 370,900 hectares of cropland, including 252,400 hectares of double-cropped fields, 23,900 hectares of single-cropped fields, 83,500 hectares of rotation-cropped field, and 11,160 hectares of upland fields. During droughts farmers sometimes pump groundwater or purchase water to supplement the allocations they receive from irrigation associations.

Irrigation water is not metered, and farmers pay for it on the basis of area irrigated and volume consumed by irrigation associations. In the past, the most important source of revenue for irrigation associations were membership fees, with revenues from construction fees for irrigation projects and governmental subsidies providing additional funds. Revenues collected from project beneficiaries were intended to cover the costs of operations and maintenance. The per hectare fees depended on crop variety, yield, irrigation cost, and broadly the benefits farmers received from irrigation. They ranged from 20 kilograms to 300 kilograms of rice per hectare per year (farmers paid the fees in cash, based on the price of rice). Although irrigation fees represented an average of only about 2 percent of total farm costs (with a range of 0.44–7.66 percent), they were reduced by 30 percent in 1990 (Table 18.1). Government made up the shortfall, providing subsidies of NT$1.437 bil-

[47] 1994 exchange rate: 1US$=27.5NT$

[48] All figures are from 1994.

lion. In 1991 the fees were reduced further to 20 kilograms of rice per hectare per year, or about NT$330 per hectare per year, assuming a rice price of NT$16.5 per kilogram (US$0.6 per kilogram). Then in 1992 the government agreed to pay all irrigation fees. The subsidies amount to about NT$1.87 billion; the central government provides NT$1.39 billion and the provincial government provides the remainder. Irrigation water authorities have never used pricing strategies to deal with water shortages. Instead, they have relied on nonpricing practices, such as irrigation practices and technologies.

Table 18.1 Per hectare cost of producing rice in Taiwan, 1993 (NT$)

	Japonica Rice		India Rice	
	First crop	*Second crop*	*First crop*	*Second crop*
Seed and seedlings	5,960	6,240	5,490	4,760
Fertilizer	5,330	5,480	5,460	5,660
Labor	25,650	26,610	25,460	30,820
Mechanization	30,950	28,020	30,460	25,300
Chemicals	3,750	4,540	3,790	5,200
Materials	432	348	356	370
Water	637	5,900	315	1,760
Total	**72,720**	**77,140**	**71,340**	**73,870**
		Percent		
Percent of total costs that is water	0.88	7.66	0.44	2.39

Rice is Taiwan's staple food, and irrigation was developed primarily to irrigate rice. When irrigation systems were first being developed, water was relatively plentiful, and no restrictions were placed on them. Rice farmers generally used continuous irrigation. But this method was very inefficient, watering only 330 hectares per cubic meter (based upon gross requirements at turnout) in most irrigation districts. In addition, water was distributed very inequitably.

As populations grew, so did the demand for rice and the water needed to irrigate paddy land. At the same time industrial and income growth increased competition for existing water resources. Since developing new water resources was costly and took time, attempts were made to increase the efficiency of irrigation water use. Rotational irrigation—which uses 25–50 percent less water than continuous irrigation—replaced the older practices in many places. However, policymakers acknowledge that developing and managing irrigation is no longer simply a matter of engineering. Conserving and reallocating water is now becoming critical, and institutional changes are essential.

Municipal water supply

Two agencies are involved in managing the municipal water supply in Taiwan: the Taipei Water Department, an agency of Taipei metropolitan government; and the Taiwan Water Supply Corporation, a public utility supported and supervised by the Taiwan provincial government. The Taiwan Water Supply Corporation was formally established in 1974 by merging

128 local public water systems to consolidate water supply in twelve public water supply districts. It serves 3.9 million households in Taiwan Province and the Kaoshiung metropolitan area. At present the Taiwan Water Supply Corporation has the capacity to supply about 2,500 million cubic meters water per year. Table 18.2 presents figures on capacity and consumption from 1990–94.

Table 18.2 Taiwan Water Supply Corporation supply and consumption, 1990-94 (million cubic meters)

	1990	1991	1992	1993	1994
Capacity	1,710	1,820	1,930	2,020	2,070
Consumption	1,340	1,420	1,470	1,570	1,630

Before the creation of the new utility, more than 60 different water rate schedules were in use among the original 128 public water supply systems; water rates could vary by as much as eightfold. The Taiwan Water Supply Corporation implemented a uniform block pricing system in 1975 and has adjusted the rates four times since. Table 18.3 presents Taiwan Water Supply Corporation water rates.

Table 18.3 Various block water rates of Taiwan Water Supply Corporation, 1975-94 (NT$ cubic meter)

	1975	1979	1982	1991	1994
Average rates	3.30	4.95	6.60	8.25	9.00
First block					
Monthly usage	<20	<10	<10	<10	<10
Rate	2.50	3.50	5.00	7.00	7.00
Second block					
Monthly usage	21–30	11–30	11–30	11–30	11–30
Rate	3.5	4.50	6.50	8.00	9.00
Third block					
Monthly usage	31–50	31–50	31–50	31–50	31–50
Rate	4.50	6.00	8.00	9.00	11.00
Fourth block					
Monthly usage	51–200	51–200	51–200	>51	>51
Rate	5.50	7.50	10.00	10.50	11.50
Fifth block					
Monthly usage	201–2,000	201–2,000	201–2,000	n.a.	n.a.
Rate	4.50	6.50	8.50	n.a.	n.a.
Sixth block					
Monthly usage	>2,001	>2,001	>2,001	n.a.	n.a.
Rate	3.50	5.00	7.00	n.a.	n.a.

n.a. means not applicable.

Taiwan Water Supply Corporation uses increasing block rates for the first four blocks and decreasing block rates for the last two. Consumers pay a flat fee for the first block, regardless of quantity used, and by volume for larger quantities. Consumers also pay fixed connection charges.

Water charges are too low to fully cover costs or to provide incentives to conserve. Furthermore, charges do not vary by season, although demand and supply fluctuate enormously over the year. Neither volumetric charges nor connection charges vary by location, although costs of supplying water can vary significantly across space. Table 18.4 presents data on unit costs of supplying water and water charges.

The Water Supply Act (enacted by Taiwan Province) sets the rules for water pricing in Taiwan: the average price of water should be based on "all water services costs, which include capital recovery and operation and maintenance costs, summed together and divided by the total quantity of water expected to be sold, to generate a unit cost." While pricing water this way would provide for full cost-recovery, it would not lead to the efficient allocation of water.

Table 18.4 Unit costs of supplying water and charges of Taiwan Water Supply Corporation (NT$ per cubic meter)

	Production cost	Sales cost	Administrative cost	Financial cost	**Total cost**	Price	Revenue
1988	4.43	1.16	0.25	0.57	**6.41**	6.28	(0.13)
1989	4.46	1.09	0.28	0.57	**6.40**	6.31	(0.09)
1990	4.83	0.89	0.29	0.59	**6.60**	6.33	(0.27)
1991	4.84	0.96	0.31	0.53	**6.64**	6.35	(0.29)

The Taiwan Assembly is responsible for regulating and approving Taiwan Water Supply Corporation's water charges. However, this body has paid insufficient attention to the financial requirements of the utility; it did not allow changes in rates between 1982-91, although the utility proposed them several times.

Current debates and future prospects

Current water charges in Taiwan are not high enough to fully cover the costs of supplying water. Irrigation associations and the Taiwan Water Supply Corporation should be given the authority to set and adjust water rates to meet their financial needs. The Taiwan people increasingly view water as an environmental good, not just a commodity, that should be used in an economically and environmentally efficient manner. Water authorities and related organizations should consider many factors when establishing the level and structure of water charges, including economic efficiency, cost recovery, environmental impact, and acceptability to users. Rate structures should allow prices to vary depending on block, season, and location of use. To assure the efficient allocation of water, pricing systems should involve marginal cost pricing.

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19 TANZANIA

Mark R. Mujwahuzi

Introduction

Tanzania is a large country with an area of about 937,000 square kilometers. While the country has a narrow coastal plain along its eastern boundary on the Indian Ocean, most of its territory covers the highlands of the great Africa plateau with elevations between 1,000–2,000 meters. Water availability varies greatly throughout the country, depending on topography, hydrology, rainfall and evapotranspiration.

Although Tanzania lies just 1.5 degrees south of the equator, it is relatively dry. Victoria, Tanganyika, and Nyasa receive about 800 millimeters of rainfall each year; most of the country receives much less. Rainfall in Tanzania is highly seasonal: water levels in lakes and rivers rise during the rainy season and recede during the dry season. River flows are intermittent in the central and northern parts of the country, where rainfall is less than 800 millimeters per year. Perennial rivers flow in the southern, western and northern highlands, where rainfall is greater than 1,000 millimeters per year.

Tanzania has abundant groundwater resources. Groundwater is rapidly becoming a major source of water in the country, particularly in the semiarid regions covering parts of Shinyanga, Dodoma, Singida and Arusha. Groundwater quality is generally good. However in some parts of the country groundwater may contain high concentrations of salt and fluoride.

Past experiences

Charging for water in a systematic way began around 1930, when the government started developing water supplies. The public works department built water supplies systems for townships, outstations, minor settlements, major administrative centers, and a few private estates and missions. Once in operation the water supply schemes were expected to be self-supporting, and water users paid for the water they consumed (Water Development and Irrigation Division 1961).

The government became actively involved in constructing rural water supply systems starting in 1945 with the establishment of the Department of Water Development. Eventually the department assumed responsibility for irrigation development, and its name was changed to Water Development and Irrigation Division.

During its first 20 years of operation, the Water Development and Irrigation Division was involved in three types of activities. The first was the development of domestic water supplies for outstations and minor settlements. Financing for these came from the central government, who owned them after construction was complete. Water users paid charges set at levels high enough to cover capital costs and operation and maintenance costs. The second was development of rural water supplies for domestic and livestock use. The rural local authorities were required to pay operation and maintenance costs but only a portion of capital costs, and set water prices accordingly. Water users paid for water when they collected it at the kiosk (Lwegarulila 1975). The third was development of water supplies under prepaid contracts. Clients, who were other government departments, local authorities, missions, and even private estates, paid the full capital costs of the water system in advance of construction (Warner 1970).

In 1965 the central government assumed full responsibility for capital costs of rural water systems, and the cost-sharing arrangement ended. Local authorities remained responsible for operating costs. Water Development and Irrigation Division performed maintenance and repairs in exchange for an annual deposit of 1 percent of total capital costs of all projects in areas under their jurisdiction (Warner 1970). In 1969 the central government took on the responsibility for all operation and maintenance costs of rural water

projects, and abolished all rural water user charges (Lwegarulila 1975). Urban consumers who had house connections or who obtained water from metered public kiosks continued to pay for water. Eventually the government also stopped charging for water dispensed from public kiosks in cities and towns (Warner 1970).

Present water charging practices

From 1971 to 1991, when a new water policy was adopted, rural users did not pay for water. And while urban consumers continued to pay for water, collections were too low to cover even operation and maintenance costs. This was because tariffs were low, billing and collection performance was poor, and unaccounted for water losses were large (Swere 1994; Ministry of Water 1995).

Political economy of water charges

In 1981 the government established the National Urban Water Authority through an act of Parliament. The agency, which commenced operations in 1984, was meant to operate all the country's urban water systems. But currently it operates only the systems in Dar es Salaam and its two satellite towns, Kibaha and Bagamoyo.

The National Urban Water Authority was expected to be financially self-supporting. However revenue from charges fell well short of the costs of producing and distributing water, and the water institution recognized that tariffs had to be raised. Yet the power to raise tariffs was vested in the Cabinet, not the agency. The Cabinet did not act because of the political difficulty of raising tariffs. Therefore in its first years of operation the water authority operated at a loss and accumulated huge debts. Eventually it stop-ped paying the power company and the government store which supplied it with chemicals. In 1988 the Cabinet finally agreed to raise tariffs to cover the costs of production, and introduced a differential rate structure. Im-mediately thereafter the National Urban Water Authority was able to meet its financial ob-ligations through user charges. However as elec-tricity rates and chemical prices rose the operating deficit reappeared and debts mounted once again. In September 1992 the water institution's ag-gregate liabilities to the Tanzania Electric Supply Company and Ministry of Water Central Store (which supplied the chemicals) amounted to about 2.4 billion Tanzanian shillings (Tshs.) (1US$ = 335 Tshs.). With operating losses and accumulated debts, the only way that the National Urban Water Authority was able to survive was by reducing payments to creditors and by relying on the Treasury for import support to purchase chemicals.

In 1991 to help the water authority become financially self-sufficient policymakers proposed that the National Urban Water Authority Board be empowered to increase tariffs by up to 10 percent without prior approval of the Cabinet, and that the minister responsible for water be empowered to approve tariff increases of up to 15 percent without prior approval of the Cabinet (Swere 1994). In 1992 the government decided to decentralize the power of setting and approving tariff changes. Since September 1992 the water authority board has had the authority to raise tariffs by up to 10 percent two times a year, for a total cumulative increase of up to than 21 percent per year. The minister responsible for water can increase tariffs by up to 15 percent two times a year. Thus the water authority in conjunction with the ministry can effectively increase tariffs by up to 32 percent a year. The minister must grant a special concession for tariff increases above this level.

The water policy adopted in 1991 changed Tanzania's approach to financing both urban and rural water systems. The water policy requires that urban consumers pay the full costs of water supply and that rural dwellers pay at least a portion of the costs. A number of municipalities, including Arusha, Moshi, and Tanga, are implementing the new guidelines. Table 19.1 presents water tariffs for Dar es Salaam, effective May 1996.

Table 19.1 National Urban Water Authority's tariff structure for Dar es Salaam, 1996

Customer category	Old tariff *(Tsh. per cubic meter)*	New tariff *(Tsh. per cubic meter)*	Percentage increase
Domestic	54.00	154.00	185.00
Institutions	89.00	177.30	100.00
Commercial	178.00	216.00	15.00
Industries	221.40	254.60	15.00
Irrigation	221.40	254.60	15.00
Brickmakers	221.40	254.60	15.00
Expatriates	US$ 4.40	US$ 5.06	15.00

Note: April 30, 1996: 1US$ = 550 Tshs.; May 1996: 1US$ = 606 Tshs
Source: National Urban Water Authority 1996.

The present tariff structure results in cross-subsidization among different groups of customers: commercial and industrial users pay more, and subsidize domestic and institutional consumers.

Revenue collection for urban water systems operated by regional water engineers

Regional development directors, through regional water engineers, are responsible for collection of water charges in all towns other than Dar es Salaam. Revenue collection follows the government's financial regulations of "appropriation-in-aid." Water charges are meant to supplement the government's financial contributions to urban water suppliers for operation and maintenance costs. Table 19.2 presents government-set water tariffs for cities and towns other than Dar es Salaam.

The regional water engineers have not been particularly effective or efficient in collecting water charges. Many consumers do not pay their bills either because they do not receive them or because they simply ignore them. People who do pay may wait months or even years after receiving the bill before remitting payments. In the past government provided subsidies to water suppliers to enable them to meet their expenses. Therefore poor revenue collection performance did not affect the operations of water suppliers. However, now that water suppliers are financially autonomous, they can no longer rely on government subsidies to cover shortfalls.

Revenue collection in schemes operated by urban water supply and sewerage engineers

Like the regional water engineers, the semi-autonomous urban water and sewerage boards — established July 1, 1994 in Arusha, Moshi and Tanga — are having difficulty collecting water charges. However the agency is aggressively trying to identify water users and has introduced a computerized water billing system. These efforts are yielding results and revenue collections are rising. In Arusha, for example, the water supplier is visiting all buildings to identify its industrial, commercial, and domestic customers. It has discovered numerous illegal connections, and has started billing the occupants. As a result the department has collected Tshs. 354 million during the first year of operation. This is a tremendous achievement: in 1993-94 the water supplier collected only Tshs. 110 million (1993: US$1.00 = Tshs. 479.87; 1994: US$1.00 = Tshs. 523.45). The water boards are also starting to sell water from kiosks and standpipes by the cubic meter. Ward executive officers have been given the responsibility for operating and maintaining all water kiosks and standpipes in their wards, collecting fees from users, and relaying the revenue to the water board.

Table 19.2 Urban water tariffs, 1992 (Tshs. per cubic meter)

Category	Rate
Domestic	21.98
Industrial	92.31
Institutional	35.16
Commercial	72.53
Agricultural	92.31
Expatriate	407.14

Note: US$1.00 = Tshs. 335.00.
Source: Swere 1994.

Tariffs for rural water supplies

The water policy of 1991 requires rural consumers to pay the costs of operation and maintenance and the costs of expansion. Individual communities are free to decide how they wish to raise the revenue.

Water-right application fees and water-user fees

In addition to water charges, users must also pay to obtain the right to use water through water-right application fees and water-user fees. In the past water rights were issued once and for all for a fee of only Tshs. 50. With inflation these fees shrunk to represent less than the cost of the paper used to prepare water-right certificates. Policy-makers have recently set new fees for water-right applications. And in 1994, through the water utilization general amendment regulations, it introduced a new water-user fee for various user categories. Table 19.3 shows the water-right application fees and the new water-user fees.

Future prospects

To improve financial performance of water suppliers, the initiatives creating autonomous urban water and sewerage institutions should be strengthened. The water boards which manage water systems should have the power to set tariffs to cover operation and maintenance costs without having to clear them with the ministry responsible for water affairs. Furthermore, tariffs should reflect all the costs involved in supplying water.

In addition, water suppliers should take action to enforce water charges. They should disconnect customers who do not pay; charge late fees and interest charges for people who submit payments past the deadline; vigorously follow-up with people or organizations in arrears and personally contact the heads of entities which are major consumers; provide performance-related incentives to encourage water utility employees to deal with revenue collection more efficiently; and aggressively track down illegal connections.

Table 19.3 Water user fees under the amended legislation, 1994 (Tshs.)

	Fees
Water-right application for domestic/livestock/fish farming	7,000
Water-right application for irrigation/power/industrial/commercial	40,000
All other applications	7,000
Appeals to the minister	35,000
Water user fees	
Domestic, livestock, fish farming, district centers, rural: 100 cubic meters	20
Irrigation: 1,000 cubic meters	15
Power royalty per installed capacity	25
Industrial/mechanical: 100 cubic meters	50
Commercial regional centers: 100 cubic meters	40

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20 TUNISIA

Zekri Slim, El Echi Med Lazhar, and Sghaier Mongi

Introduction

Tunisians have had long experience managing water in the arid and semi-arid North African environment, dating back to 1000 B.C. The Phoenicians, Carthaginians, Romans, Arabs, and Turkish all constructed water works, the remnants of which can still be found scattered throughout the country. Among the treasures are the Roman aqueduct between Zaghouan and Tunis, the Aghlabid pools in Kairouan, and the man-made underground galleries called *foggara* in the southern part of the country. These civilizations all had an influence on the legislation and institutions that currently govern water resource management in Tunisia (Caponera 1976).

The introduction of new technologies for surface water exploitation begun during the 1950s with the construction of large hydraulic projects intended to meet the rapidly rising demand for water for irrigation, industry, and urban use. A water management strategy was adopted to increase water supply while protecting groundwater resources from overuse and salinization through the intrusion of seawater.

Between 1962–71 public investment in water systems comprised 27 percent of total investment in agriculture. Between 1982–91 this percentage climbed to 41 percent of agricultural investment (Mallek 1988, Sghaier 1995).

Past experiences

Water from public infrastructure

The government has financed most irrigation infrastructure in Tunisia. Public infrastructure includes dams and canals conveying water to the farm gate. An agrarian reform in the early 1950s led to the creation of the "perimétres publiques irriguées." The creation and management of the perimétres publiques irriguées and water use is subject to special legislation (Laws number 58-63 June 11, 1958; number 6-60 July 26, 1960; number 63-18 May 27, 1963; and number 71-9 February 19, 1971) (Abdelhadi 1995; Caponera, 1976). Under the legislation farmers are obliged to make contributions, in cash or kind, to pay the costs of the irrigation systems. The size of the contribution is determined as a proportion of the incremental increase in the value of the irrigated land. Thus farmers are required to pay at least a portion of irrigation system costs. Implementing this legislation was neither easy nor automatic. Indeed it was only partially implemented in the perimétres publiques irriguées of Basse Vallée de la Medjerda (Ministère de l'Agriculture 1980).

The first attempt of set water tariffs in the modern era occurred in 1969. L'Office de Mise en Valeur de la Vallée de la Medjerda introduced a charge of 0.004 TD per cubic meter (US$0.0076 per cubic meter) (Ministère de l'Agriculture 1980). This tariff was set to recover maintenance and operating costs. It was hoped that the water charges would encourage farmers to view water as an economic good rather than a free good and use scarce water resources more efficiently.

Ben Khelil completed Tunisia's first comprehensive study on water pricing in 1971. He estimated two types of costs using 1970 prices: operation and maintenance costs and total irrigation costs. He adjusted operation and maintenance costs, which included energy and labor costs, for each perimétres publiques irriguées depending on the profitability of the crop being grown. Thus for example in the Cap Bon region, an orange producing area, water cost about 0.0108 TD per cubic meter (US$0.0206 per cubic meter); in the Haute Vallée de la Medjerda, a vegetable producing region, water cost about 0.0043 TD per cubic meter (US$0.0082 per cubic meter). Total irrigation costs included capital costs in addition to operation and mainte-

nance costs. Khelil estimated the total cost to be 0.030 TD per cubic meter (US$0.057 per cubic meter) in the Cap Bon region, and only 0.012 TD per cubic meter (US$0.023 per cubic meter) in the Haute Vallée de la Medjerda. However tariffs were never set to equal total costs.

In 1971 the objectives of charging for water were made more explicit:

- Farmers should pay the true costs of water to reflect resource scarcity.
- Water charges should not be set at levels that would constrain the development of irrigation.
- Water charges should be part of an integrated development strategy (L'Office de Mise en Valeur de la Vallée de la Medjerda 1976).

Implementation of the proposed water charge policy faced some difficulties, especially on land which was served by irrigation systems but which farmers which not using fully. Policymakers believed that high water charges were discouraging farmers from using the irrigable land intensively. To increase the use of irrigation water l'Office de Mise en Valeur de la Vallée de la Medjerda proposed a two-part tariff structure, comprising a fixed charge per hectare and a charge per cubic meter. The fixed charge was intended to encourage farmers to irrigate all their land with irrigation potential. It was estimated to be 69 TD (US$55) per hectare per year (1986 prices), set to cover capital costs. Operation and maintenance costs were about 0.033 TD (US$0.026) per cubic meter (1986 prices) (Ministère de l'Agriculture, 1986a). However the two-part tariff was never implemented. The fixed charge per hectare was considered too much for farmers to pay in relation to their returns. In addition, the law governing perimétres publiques irriguées stipulated that capital costs be paid at the time the project was constructed, not annually.

A second study estimated the total cost of water to be 0.0573 TD per cubic meter (US$0.0455 per cubic meter) including investment costs (1986 prices). It concluded that the productivity of water varied widely by crop, and that the incremental income generated by applying water exceeded the cost of water, except when water was used to grow forage or legumes. On the basis of this study authorities proposed implementing a charge system with tariffs differentiated by crop (Ministère de l'Agriculture, 1986b).

Since the 1980s the government has considered charging farmers for water to recover investment costs and has examined the capacity of farmers to pay (Ministère de l'Agriculture, 1980). The total cost of water was estimated to be 0.008 TD (U$0.004) per cubic meter and 600 TD (US$300) per hectare per year for a period of ten years in Basse Vallée de la Medjerda (1979 prices). A more recent study suggests that returns to farmers would not fall significantly if they started paying the full operation and maintenance costs of irrigation (Ministère de l'Agriculture 1985). The study also proposed covering investment costs by charging either a fixed rate per hectare or folding the investment costs into the per meter charge for water. The study estimated the total cost of water to be 0.045 TD (US$0.037 per cubic meter) and the operation and maintenance cost to be 0.006 TD (US$0.005 per cubic meter) for the Basse Vallée de la Medjerda (1985 prices). The study concluded that recovering the full costs of the irrigation investment would be impossible. In fact the requirement of the law that farmers pay investment costs was never implemented, and farmers paid only the per cubic meter charge. The charges were set quite arbitrarily and fluctuated from year to year (Ministère de l'Agriculture 1985).

Prior to 1991 l'Offices de Mise en Valeur were in charge of managing irrigation water. However the Commissariats Regionaux de Développement Agricole took over this responsibility in 1991. L'Offices de Mise en Valeur were financially autonomous state-owned enterprises. They provided most of their services on a commercial basis, but they also provided public services, such as extension, for which the government paid. L'Office de Mise en Valeur de la Vallée de la Medjerda, established in 1958, was the first of these institutions. Among its objectives were: studying, constructing, maintaining, and extending the irrigation network; maintaining perimétres publiques irriguées (32,000 hectares and 3800 farmers); providing

extension services to farmers; putting inputs and outputs on a market basis; collecting water charges; and providing short-term-credit from the public budget (Ministère de l'Agriculture 1983; World Bank 1985).

Present water pricing practices

In 1989 the Tunisian parliament approved laws (number 89-44 March 8, 1989) to create new Commissariats Regionaux de Développement Agricole — public institutions with financial autonomy, Offices de Mise en Valeur, and Offices de Développement Agricole — under the Ministry of Agriculture. The new institutions are responsible for managing and maintaining the irrigation infrastructure within the perimétres publiques irriguées and organizing water distribution. The Commissariats Regionaux de Développement Agricole uses three types of water charges: a lump sum per hectare when metering is not available; a per cubic meter tariff for perimétres publiques irriguées with meters; and a two-part tariff with a fixed per hectare component and a volumetric component. Although the water code requires that the institution use rising block prices to encourage farmers to use water more efficiently, this has not yet been put into practice (Abdelhedi 1995). The law also stipulates that the Commissariats Regionaux de Développement Agricole must establish contracts with farmers or farmers' groups, containing detailed information about the water source, farm area, cropping system, and the method of water charges used.

Associations d'intérêt collectif have recently been created to manage part of the public infrastructure. The associations manage areas irrigated with groundwater in oases and some areas irrigated with tubewells, which comprises about one-third the total irrigated area in Tunisia. The development of associations in the areas which depend on public infrastructure has been very slow. For example in the governorates of the northern part of the country where the most important irrigation dams are situated — Ariana, Béja, Bizerte, Jendouba — the number of associations in charge of irrigation water management grew from 25 to 37 associations between 1993–95. This represented only 7.7 percent of the 481 associations d'intérêt collectif in the country. Establishing associations is difficult for two main reasons: often irrigation infrastructure is degraded and requires considerable new investment (for example Basse Vallée de la Medjerda), and farmers are accustomed to receiving the assistance and services from the Commissariats Regionaux de Développement Agricole. A recent survey of farmers in areas with public infrastructure revealed that 12 to 33 percent, depending on the region, supported the move giving water management responsibility to associations (Ministère de l'Agriculture,1995b).

In 1988 the Agricultural Structural Adjustment Program introduced a program to gradually increase irrigation water charges to fully cover operation and maintenance costs of irrigation systems by 1995. This required a 9 percent increase in real charges and a 15 percent increase in nominal charges by 1995. The program is nearly completed. However the four years of drought that occurred since 1988 have made it impossible to implement the program completely. Table 20.1 presents nominal and real water prices between 1983–1994. The table also shows the annual average increases in water prices for the governorates where the Commissariats Regionaux de Développement Agricole are responsible for water management. These figures show that water prices increased by only 1 percent a year between 1983–94 in the governorate of Ben Arous. However water prices rose by 11 percent per year in the governorate of Jendouba over the same period.

Table 20.2 presents the operation and maintenance costs and water prices in selected governorates. The change in the ratio between costs and prices shows the steady progress being made towards fully recovering costs from farmers. The table shows that prices are higher than costs in some governorates with important irrigated areas, for example in Bizerte, Béja, Jendouba, and Monastir. By contrast water prices are only 62 percent of costs in the governorates of Gafsa, Kasserine, Kebili and Sidi Bouzid. The gradual shifting of responsibility to associations will help to improve cost recovery and at

the same time better the quality of service provided to farmers.

Groundwater

Groundwater is used for irrigation in the central, southern and Cap Bon parts of Tunisia, where average rainfall ranges between 100 and 250 millimeters per year. Historically nongovernmental organizations were in charge of water management in the oases. These organizations successfully managed water when there was enough water to fully meet demand, due to the existence of clear water rights and reasonable management rules (Ministère de l'Agriculture 1995a). In 1933 to make the southern associations (associations d'intérêt collectif and groupement d'intérêt hydraulique) official, the French administration passed a law allowing farmers to constitute associations d'intérêt collectif (Caponera 1976).

The groupement d'intérêt hydraulique for planning activities provided technical assistance to the associations. The associations relied on their own financial resources to explore for water, construct infrastructure, and establish the rules and the share for each member. The most important rule of the associations was to give each of its members formal water rights. The amount of water granted by the water right depended on farmer's financial contributions to explore for and convey water: land ownership and water rights were not related. Owners could sell or rent water rights.

The water code of 1975 transformed the water right to a water-use right, a system which remains in effect today. Farmers in the oases cannot sell or rent the water. Instead they have the right to use water in proportion to the land they own (Abdelhedi 1995). This fundamental change had an important influence on associations d'intérêt collectif. Members no longer felt the need to organize into the associations. Furthermore in other parts of the country the government provided the funds for water supply. By contrast farmers in the oases had to pay for the irrigation systems themselves.

In 1970 the "Plan Directeur des Eaux du Sud," a strategic study conducted by the Ministry of Agriculture, showed that the costs of providing water exceeded the financial capabilities of existing associations. As a result the government intervened through the Offices de Mise en Valeur and later the Commissariats Regionaux de Développement Agricole. The interventions ultimately encouraged farmer dependency, and marginalization of association activities (Ministère de l'Agriculture 1995a). Currently there are some 160 associations in the southern part of Tunisia managing water for an area of about 21,700 hectares. Two charge systems are in use: a fixed per hectare annual charge, and a hourly charge. One of the main objectives of the government program promoting associations is to give responsibility to them to manage irrigation infrastructure in the oases and recover the costs of the irrigation system, including investment costs, through water charges.

Groundwater prices vary widely between regions and within the same region. For example in 1993 the price of water in the Kebili and Gueliada oases was 124 TD (US$124) per hectare per year. In the Souk el Biaz oasis it was 538 TD (US$538) per hectare per year. Revenues covered 44 percent and 21 percent of operation and maintenance costs and depreciation costs, respectively. These huge differences in prices for water are mainly due to the different costs of producing and distributing water due to the presence of economies of scale. Some oases cover very small areas, so labor costs per hectare are very high (Ministère de l'Agriculture 1991, and 1995a).

Domestic and industrial water charges

Currently 15 percent of developed water supplies in Tunisia is used for urban and industrial needs. Households use about 60 percent of water for these purposes, industry uses 13 percent, and tourism uses 6 percent. Public standpipes account for 21 percent of water consumption. All urban households have access to clean water, but only 57 percent of rural households do. Half of the groundwateris exploited directly by farmers, based on traditional use rights.

Table 20.1 Nominal and real irrigation water prices, 1983-1994 (Tunisian dinars per cubic meter)

Governorate		1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	Percent increase per year	Total percent increase 1983-94
Ariana	nominal	0.018	0.018	0.020	0.021	0.023	0.027	0.030	0.033	0.038	0.044	0.051	0.060	12	233
	real	0.037	0.034	0.035	0.035	0.035	0.038	0.039	0.041	0.044	0.048	0.054	0.060	5	64
Barous	nominal	n.a.	n.a.	n.a.	0.035	0.037	0.041	0.042	0.045	0.050	0.058	0.060	0.062	7	77
	real	n.a.	n.a.	n.a.	0.058	0.056	0.058	0.055	0.056	0.057	0.063	0.064	0.062	1	8
Nabeul	nominal	0.015	0.020	0.025	0.032	0.032	0.034	0.034	0.037	0.045	0.047	0.050	0.054	12	260
	real	0.031	0.038	0.044	0.053	0.049	0.048	0.045	0.046	0.052	0.051	0.053	0.054	5	77
Bizerte	nominal	0.018	0.018	0.020	0.021	0.023	0.027	0.030	0.033	0.038	0.044	0.051	0.060	12	233
	real	0.037	0.034	0.035	0.035	0.035	0.038	0.039	0.041	0.044	0.048	0.054	0.060	5	64
Beja	nominal	0.018	0.018	0.020	0.021	0.023	0.027	0.030	0.033	0.050	0.050	0.056	0.063	12	250
	real	0.037	0.034	0.035	0.035	0.035	0.038	0.039	0.041	0.057	0.054	0.059	0.063	5	72
Jendouba	nominal	0.010	0.014	0.016	0.020	0.022	0.024	0.026	0.030	0.058	0.058	0.058	0.064	18	540
	real	0.020	0.026	0.028	0.033	0.033	0.034	0.034	0.037	0.066	0.063	0.061	0.064	11	214
Siliana	nominal	0.010	0.015	0.017	0.020	0.023	0.026	0.028	0.032	0.039	0.046	0.049	0.057	17	470
	real	0.020	0.028	0.030	0.033	0.035	0.037	0.037	0.039	0.045	0.050	0.052	0.057	10	180
Sousse	nominal	0.014	0.016	0.018	0.021	0.024	0.030	0.033	0.038	0.043	0.050	0.058	0.068	15	386
	real	0.029	0.030	0.031	0.035	0.036	0.043	0.043	0.047	0.049	0.054	0.061	0.068	8	138
Monastir	nominal	0.014	0.016	0.018	0.021	0.024	0.030	0.033	0.038	0.043	0.050	0.058	0.068	15	386
	real	0.029	0.030	0.031	0.035	0.036	0.043	0.043	0.047	0.049	0.054	0.061	0.068	8	138
Mahdia	nominal	0.014	0.016	0.018	0.021	0.024	0.030	0.033	0.038	0.043	0.050	0.058	0.078	17	457
	real	0.029	0.030	0.031	0.035	0.036	0.043	0.043	0.047	0.049	0.054	0.061	0.078	10	173
Kairouan	nominal	0.012	0.015	0.018	0.020	0.020	0.023	0.026	0.030	0.034	0.040	0.046	0.046	13	283
	real	0.024	0.028	0.031	0.033	0.030	0.033	0.034	0.037	0.039	0.043	0.049	0.046	6	88
Kasserine	nominal	0.010	0.012	0.015	0.018	0.023	0.023	0.023	0.025	0.025	0.030	0.038	0.038	13	280
	real	0.020	0.023	0.026	0.030	0.035	0.033	0.030	0.031	0.029	0.033	0.040	0.038	6	87
Sidi	nominal	0.010	0.012	0.012	0.018	0.020	0.024	0.026	0.028	0.033	0.038	0.042	0.042	14	320
Bouzid	real	0.020	0.023	0.021	0.030	0.030	0.034	0.034	0.035	0.038	0.041	0.045	0.042	7	106
Gafsa	nominal	0.006	0.008	0.008	0.009	0.012	0.012	0.014	0.014	0.018	0.020	0.020	0.020	12	233
	real	0.012	0.015	0.014	0.015	0.018	0.017	0.018	0.017	0.021	0.022	0.021	0.020	5	64
Kebili	nominal	0.010	0.014	0.014	0.015	0.017	0.017	0.019	0.019	0.019	0.023	0.027	0.033	11	230
	real	0.020	0.026	0.024	0.025	0.026	0.024	0.025	0.023	0.022	0.025	0.029	0.033	4	62
US$/TD		0.679	0.779	0.835	0.794	0.829	0.858	0.937	0.800	0.920	0.880	1.000	1.000		

Table 20.2 Operation and maintenance costs and water charges, 1990–1994 (Tunisian dinars per cubic meter)

	1990			1991			1992			1993			1994		
	Cost	Price	Cost/ price	Cost	Price	Cost/ price	Cost	Price	Cost/ price	Cost	Price	Cost/ price	Cost	Price	Cost/ price
Ariana	0.053	0.033	63	0.055	0.038	69	0.065	0.044	68	0.058	0.051	88	0.062	0.060	97
Ben Arous	0.070	0.045	64	0.084	0.050	59	0.129	0.051	40	0.080	0.060	75	n.a.	0.062	
Nabeul	0.049	0.037	76	0.066	0.045	68	0.078	0.047	60	0.069	0.050	72	0.068	0.054	79
Bizerte	0.044	0.033	75	0.057	0.038	66	0.087	0.044	51	0.071	0.051	72	0.056	0.060	107
Beja	0.042	0.033	79	0.047	0.050	106	0.050	0.056	112	0.058	0.059	102	0.058	0.063	109
Jendouba	0.037	0.030	81	0.053	0.058	110	0.044	0.058	132	0.037	0.058	158	0.035	0.064	183
Siliana	0.063	0.032	51	0.063	0.039	62	0.033	0.046	139	0.033	0.049	148	n.a.	0.057	
Sousse	0.058	0.038	65	0.056	0.043	77	0.051	0.050	98	0.075	0.058	77	0.096	0.068	71
Monastir	0.064	0.038	60	0.072	0.043	59	0.089	0.050	56	0.065	0.058	89	0.054	0.068	126
Mahdia	0.093	0.038	41	0.090	0.043	48	0.111	0.050	45	0.117	0.058	50	n.a.	0.078	
Kaairouan	0.054	0.030	56	0.052	0.034	65	0.052	0.040	78	0.065	0.046	71	0.049	0.046	94
Kasserine	0.056	0.025	45	0.056	0.027	48	0.144	0.031	22	0.105	0.038	36	0.071	0.038	54
Sidi Bouzid	0.066	0.028	43	0.071	0.031	43	0.086	0.037	43	0.079	0.042	54	0.068	0.042	62
Gafsa	0.110	0.014	13	0.043	0.018	42	0.034	0.020	58	0.035	0.020	57	0.035	0.020	57
Kebili	0.040	0.019	48	0.033	0.019	58	0.037	0.023	63	0.038	0.027	71	0.054	0.033	61

Table 20.3 shows real and nominal water prices for 1983–1992 (Lahoual, et al. 1993). The prices include a component representing 60 percent of wastewater treatment costs. Urban and rural consumers pay the same prices for water.

The last row of Table 20.3 shows the nominal cost of producing and distributing water. This figure does not include capital costs. Industries, public standpipe users, the tourist sector, and domestic consumers using more than 150 cubic meters of water pay prices which slightly exceed the costs of water. By contrast domestic consumers using less than 20 cubic meters per quarter receive significant subsidies: they paid only 28 percent of the total costs in 1992. The demand for water in the lowest (and least expensive) consumption band has grown about 3 percent a year due primarily because of new subscriptions (demand per household fell by about 4 percent between 1983–92). By contrast demand has fallen by 1.8 percent for consumption above 150 cubic meters per quarter. In some cases the demand has shifted towards alternative cheaper sources of water, especially groundwater used to water gardens. Some households use groundwater without treating or boiling it before using it, which can cause illness.

Industries, tourist businesses, and standpipe users are also quite sensitive to water prices, and shift to alternative water sources or employ more efficient technologies whenever they can. Between 1983–92 industrial water demand has fallen by 3.3 percent per year and tourist sector water demand has fallen by about 4.6 percent per year. Although the current price structure leads to much greater water use efficiency, it has also led to financial problems for the water suppliers due to the drop in demand among consumers who subsidize other users.

Table 20.3 Nominal and real prices for urban and industrial water (Tunisian dinars per cubic meter)

		1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	Percent change
Domestic												
(cubic meters)												
<20	nominal	0.080	0.080	0.080	0.080	0.084	0.088	0.099	0.106	0.095	0.095	1.93
	real	0.150	0.138	0.129	0.121	0.118	0.115	0.120	0.121	0.100	0.095	-4.97
20–40	nominal	0.086	0.086	0.090	0.090	0.094	0.117	0.132	0.137	0.132	0.135	5.14
	real	0.162	0.149	0.145	0.136	0.132	0.153	0.160	0.156	0.139	0.135	-1.97
40–70	nominal	0.111	0.118	0.129	0.129	0.135	0.150	0.165	0.162	0.158	0.161	4.22
	real	0.208	0.204	0.207	0.195	0.189	0.196	0.200	0.184	0.167	0.161	-2.83
70–150	nominal	0.178	0.193	0.221	0.22	0.229	0.242	0.26	0.272	0.258	0.326	6.95
	real	0.334	0.334	0.355	0.333	0.320	0.316	0.315	0.309	0.272	0.326	-0.29
>150	nominal	0.279	0.312	0.370	0.381	0.406	0.437	0.461	0.481	0.484	0.524	7.25
	real	0.524	0.540	0.595	0.577	0.568	0.571	0.559	0.547	0.511	0.524	0.00
Public standpipes	nominal	0.303	0.339	0.410	0.416	0.447	0.466	0.494	0.513	0.542	0.565	7.17
	real	0.569	0.586	0.659	0.630	0.626	0.609	0.599	0.584	0.572	0.565	-0.08
Industrial	nominal	0.308	0.346	0.419	0.426	0.459	0.477	0.506	0.526	0.559	0.577	7.22
	real	0.578	0.598	0.674	0.645	0.642	0.623	0.613	0.598	0.590	0.577	-0.03
Tourism	nominal	0.340	0.374	0.385	0.430	0.470	0.480	0.510	0.562	0.573	0.582	6.15
	real	0.639	0.647	0.619	0.651	0.658	0.627	0.618	0.639	0.605	0.582	-1.02
Cost	nominal	0.217	0.236	0.269	0.267	0.280	0.297	0.311	0.322	0.320	0.340	5.12

Note: The domestic consumption figures are for a period of three months.

Source: Lahoual, *et. al.* 1993.

Reused wastewater

Since 1960 Tunisia has had experience using secondary treated wastewater for irrigation. Currently some 100 hecto cubic meters of wastewater per year undergo secondary treatment and are made available for irrigation, with certain restrictions. In 1993 about 2,425 hectares were irrigated with treated wastewater. It is estimated that by 2010 treated wastewater will be used to irrigate about 28,500 hectares (Zekri et al. 1995). Prices of treated wastewater vary widely between regions (Table 20.4). In regions which have a long history of using treated wastewater for irrigation, such as Ariana, prices tend to be equal to prices of conventional water. This is inequitable, since farmers using treated wastewater can grow only a limited set of crops. In regions where the use of treated wastewater is new, such as Kairouan, wastewater costs much less than conventional water. Its low price is intended to encourage farmers to use treated wastewater for irrigation. Without strong price incentives farmers are reluctant to do so, fearing potential environmental and health impacts and disliking the restrictions placed on crop choice.

Table 20.4 Prices of secondary treated wastewater for irrigation (Tunisian dinars per cubic meter)

		1991	1992	1993	1994	1995	Average percent increase
Ariana	nominal	0.041	0.044	0.051	0.060	0.069	13.90
	real	0.050	0.051	0.057	0.064	0.069	8.51
Ben Arous	nominal	n.a.	n.a.	0.048	0.050	0.055	7.04
	real	n.a.	n.a.	0.054	0.053	0.055	0.99
Kairouan	nominal	n.a.	0.023	0.027	0.027	0.032	11.64
	real	n.a.	0.026	0.030	0.029	0.032	6.56

Source: Ministère de l'Agriculture 1995b.

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21 UGANDA

Hillary Onek

Introduction

Uganda has abundant sources of water supply including streams, natural wells and springs, lakes, rivers and underground aquifers. In Uganda prices of water have tended to be influenced by social factors. Before the National Water and Sewerage Corporation took over water supply and sewerage services in 1972, water charges were set mainly to satisfy the desires of the urban inhabitants, and consumers were paying no more than a token fee for water. Water charges were incorporated into house rents (house rents were also heavily subsidized). Very few people benefited from these subsidies, however. Many of those who did were civil servants living in towns. Water charges did not come close to reflecting the costs of supplying water.

It is estimated that only about 40 percent of the people living in rural areas (where 90 percent of Uganda's people live) has access to safe drinking water supplies, mainly from boreholes with handpumps and protected springs. Rural people without access to safe drinking water obtain water from unimproved and often unsafe sources, sometimes far from their dwellings.

There are currently about 34 urban centers in Uganda with some form of piped water supplies. About half the residents of the nine major towns with water systems operated by National Water and Sewerage Corporation—Entebbe, Gulu, Jinja, Kampala, Lira, Masaka, Mbale, Mbarara and Tororo—obtain their drinking water from the piped water network. Most of the water supply installations in urban areas not served by National Water and Sewerage Corporation have virtually ceased to function due to the near absence of financing. It is estimated that only 15 percent of the inhabitants in these towns have adequate water supplies.

The National Water and Sewerage Corporation was established in 1972 with the objective of operating urban water and sewerage systems within Uganda on a nationally self-supporting and sustainable basis: some towns and subscribers may cross-subsidize others, but overall the water utility must be financially viable. The Corporation is responsible for financing its recurrent expenses and minor capital expenditures, and does not receive subsidies for these. It does receive grants and loans for major development works, through the government from agencies such as International Development Association, Kreditanstalt fur Wiederaufbau, Austria, Germany, and the European Union.

The government of Uganda owns The National Water and Sewerage Corporation. The Minister of Natural Resources has the power to designate the National Water and Sewerage Corporation responsible for any of Uganda's urban water systems through statutory instruments. Initially the Corporation was responsible for the water and sewerage systems of Uganda's three largest towns, Kampala, Jinja, and Entebbe. The Corporation then took on the responsibility of operating the water supply systems in six additional towns, bringing the total to nine. In these towns, 50 percent of water supply is distributed to residences, 21 percent to industries and commercial enterprises, and 29 percent to government offices and other institutions.

Water pricing practices in the past

In 1971 water was declared a gift of God and made available to consumers free of charge. But in 1984 the government changed its policy, and established a tariff system. The water charge system was based on the following principles: water is a scarce good so prices should be set to encourage consumers to conserve; water utilities should be financially self-supporting; prices should ensure social equity; charge systems should be easy to understand and administer; and charges should be different for different categories of users.

Commercial users pay three times as much per cubic meter than persons obtaining water public standpipes. The rationale is that water used for commercial and industrial purposes is an input to business activities and generates profits. Charges also reflect the different levels and costs of providing services: supplying water through standpipes is far less costly than piping water to individual users.

Tariffs are reviewed each year as part of the budgeting process. Expected revenue from tariffs is compared with planned expenditures, and both are adjusted so that revenues cover costs. Increases in tariffs are made only after considering the unit costs of production, affordability, and the level of inflation since the last tariff increase. Table 21.1 shows increases in water tariffs since 1989. Table 21.2 provides detailed tariff data.

Table 21.1 Increases in water tariff increases since 1989 (percent)

	Percent increase
March 1989	360
November 1989	60
May 1990	69
September 1991	16
August 1992	45
Introduction of Commercial Transactions Levy[a]	25
August 1993	20
March 1994	60
Since March 1994	0

a Commercial Transactions Levy: government tax of 15 percent applied to all water and sewerage bills starting in July 1993, all proceeds from which are forwarded to the government of Uganda.

Important features

Tariffs were set to differentiate between different categories of consumers, with poor urban households paying the lowest rates. Unmetered charges were set according to the number of taps for residences, and the number of consumers for institutions and government offices.

In the past all consumers other than public standpipe users were charged a fee for sewerage equaling 50 percent of their water charges, whether or not they were connected to the main sewage systems. However starting in June 1990, the National Water and Sewerage Corporation introduced a new charge system which differentiated between category of consumer (domestic, institutional and government, and industrial and commercial consumers). At the same time, it introduced a tiered tariff for industrial and commercial users and a minimum charge for enterprises with meters depending on the size of the connection. In September 1993, the utility introduced minimum charges for government/institutions and industry/commercial users and for public standpipes.

Starting in September 1993, the two bands for assessed government/institutional and industrial and commercial categories — 250-500 users (number of persons drawing water from the connection) and more than 500 users — were combined into a single category: more than 250 users.

In Uganda there is little irrigation, and none which is publicly-supported. Irrigators tend to grow crops generating high returns such as flowers and fruits. The country enjoys abundant rainfall, and irrigation is not needed for subsistence crops.

Present water pricing practices

Currently, water charges are based on a number of principles. One is full cost recovery;

all operation and maintenance costs, depreciation and capital costs are included in the tariff. Another is social equity. Water charges for the less privileged are about one third charges to more affluent commercial and industrial users. Standpost consumers pay 400 shillings per cubic meter (US$0.38) while commercial and industrial consumers pay 1,056 shillings per cubic meter (US$1.00). Commercial consumers must also pay surcharge of 100 percent for sewerage while standpost consumers do not.

Table 21.2 Tariff schedule, 1989–94 (Uganda shillings)

	Dec. 1989	June 1990	Sept. 1991	Sept. 1992	Sept. 1993	April 1995
Public standpipes						
Unmetered (per month)	5,520	9,375	10,800	15,700	18,750	30,000
Metered (per cubic meter)	74	125	145	210	250	400
Domestic use						
Unmetered (per month)						
1 tap	736	1,250	1,440	2,100	2,310	3,696
2-4 taps	2,208	3,745	4,310	6,250	6,930	11,088
5-8 taps	3,312	5,620	6,460	6,930	11,550	18,480
over 8 taps	4,968	8,430	9,700	14,070	17,325	27,720
Metered (per cubic meter)	112	190	220	320	385	616
Institutions and government						
Metered[a] (per cubic meter)	133	225	270	395	475	760
Major industrial and commercial						
Metered (per cubic meter)						
First 500 per month	243	315	380	550	660	1,056
501-1,500 per month	243	380	455	660	790	1,264
> 1,500 per month	243	425	510	740	890	1,424
Minor industrial and commercial						
Metered (per cubic meter)	243	315	380	550	660	1,056

a For institutions and government offices without meters, monthly consumption is estimated.
Note: Minimum charges, connection fees, reconnection fees, penalties, and sewerage charges are not included.
(US$ = 1,050 shillings).

Unmetered residential consumers pay flat rates, but commercial and industrial consumers pay increasing block rates. Flat rates are based on the number of taps for domestic consumers. The lowest rate per month is 3,969 shillings (US$3.75). Commercial consumers pay 1,056 (US$1.00) shillings per cubic meter for the first 500 cubic meters, 1,264 shillings (US$1.20) per meter for the next 501–1,500 cubic meters per month, and 1,424 shillings (US$1.35) for consumption over 1,500 cubic meters per month.[49]

[49] The exchange rate in June 1996 was about 1,050 Uganda shillings = US$1.

Successes

Because of the move to full cost recovery, the National Water and Sewerage Corporation has been able to sustain its operations and even expand its manpower development programs. Revenues have risen, so the Corporation is developing its operational capacity. Because of its good performance, the government has given the Corporation responsibility to operate the water and sewerage systems in three additional towns, bringing the systems under its management to twelve. The number of consumers the utility serves has grown from 30,000 accounts in 1993/94 to approximately 59,000 accounts by the end of 1995. Because water is more available and affordable, public health and hygiene in the towns where the utility operates has improved.

Residential consumers especially like the flat rate charge system, since it makes budgeting fairly easy. They are therefore much more able and willing to pay than in the past. The increasing block pricing strategy for industrial and commercial consumers is working effectively. While the Corporation is a monopoly and can therefore set prices at any level it pleases, it has chosen to keep its tariffs affordable and has avoided consumer resentment.

In some of smaller urban centers where the Corporation operates, such as Gulu and Lira, poor inhabitants sometimes prefer to collect water free of charge from the nearest wells and borehole pumps — even when they can afford to pay for water from taps. This because the labor of the people who collect the water, usually children, is valued at very low levels.

Difficulties

The attitude that water is a free gift of God still persists and not all consumers pay their water bills in a timely manner. It is difficult to stop vendors from charging excessive prices at standposts since the Corporation does not currently license them. This discourages some consumers from using the standposts. Measures are currently being taken to regularize standpost vending and control the prices vendors charge.

Many consumers do not understand or are willing to pay the surcharge for sewerage, and arrears are high. While the utility has the authority to disconnect nonpaying consumers and take them to court for outstanding charges, it still does not fully utilize its powers. Many consumers believe that it is fairer to raise charges per cubic meter of water than to raise minimum charges. Finally consumers view reconnection fees, imposed on consumers who are disconnected for nonpayment of water bills as excessive. Currently these charges range from 38,280 shillings (US$36.25) for households to 125,300 shillings (US$118.37) for consumers with 1/2 inch pipes. This discourages potential consumers from applying for water connections. However, changing the tariff structure is difficult and cumbersome: tariffs cannot be set or changed without government cabinet approval.

Current debates and future prospects

Pricing

The Corporation is currently reviewing its tariff structure. Among the options being considered are abolishing minimum charges and replacing them with volumetric charges based on actual meter readings; charging flat fees for sewerage rather than basing the fees on water consumption; reducing or reformulating the new connection and reconnection fees in order to encourage more consumers to join the Corporation network; licensing public standpost vendors to reduce or eliminate the rent which unregulated vendors currently extract from the system; and introducing a flat monthly service fee.

The Corporation is currently enjoying a monopoly on water supply and sewerage services. However, it may be appropriate to privatize some of its activities to improve its efficiency. For example, the private sector could handle bill processing and collection, leaving the Corporation with responsibility only for producing and distributing water.

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22 UNITED KINGDOM

Judith Rees

Introduction

The United Kingdom is well endowed with water resources, but rainfall is not well distributed in relation to population. Annual rainfall in Scotland, Northern Ireland, Wales, northwest and southwest England, all of which are relatively sparsely populated, averages more than 1,000 millimeters per year (1,400 millimeters in Scotland), but is less to the south and east. East Anglia, for example, receives about 610 millimeters rain per year, and the densely-populated Thames region receives some 700 millimeters. In the drier south and east, the abstraction of water (excluding water for power stations, fish farms, and others with 100 percent return flows) is already close to exceeding 1-in-50 year drought rainfall levels. Indeed, in the Thames area abstraction exceeds this threshold, when considering the high levels of water reuse.

Good data on abstraction are available only for England and Wales; abstractions in Scotland and Northern Ireland are not licensed and measured. Over England and Wales as a whole, 80 percent of abstracted supplies (25,860 million liters per day) is taken from surface water sources. But in southeast England and East Anglia groundwater is more important, providing 50 percent of supplies. Excluding abstractions from tidal sources and those for uses with 100 percent return flows, the public water supply sector uses 80 percent of abstractions, industry and power stations use 17 percent, and agriculture uses 3 percent (Water Services Association 1995, Department of Environment 1994).

Abstraction charges

Traditionally, public water supply agencies, industries, and farmers obtained riparian rights under common law to abstract water from below, on, or adjacent to their property. This common law system remains in force in Scotland and Northern Ireland, where water resources are relatively plentiful. There are no charges for abstraction.

In England and Wales a license system has gradually replaced the common law approach since 1945. Since 1968 abstraction charges have been levied. Until 1993 the charging schemes varied by region. The 29 catchment-based river authorities initially determined the rates; after the 1974 reorganization of the water industry, the 10 multi-purpose regional water authorities took over this responsibility.

Typically, charges comprised annual fixed access fees (or minimum charges) — designed to recover the basic administrative costs of the licensing system — plus unit charges levied on the quantity of water authorized for abstraction. Charges were not generally based on actual use. However, in some areas concessions were made to spray irrigators, who paid a proportion (normally 25 or 50 percent) of the charges for authorized abstraction, and became liable for further payments in years when actual usage exceeded that proportion.

Authorization (or availability) charges were calculated by establishing a basic price per authorized unit and then adjusting the price using weights to take account of factors such as season, source, return flow rates, river quality, and the degree of support provided to maintain river flows. By law, the regional water authorities could set charges high enough only to recover resource management costs; charges were typically too low to act as a demand management tool.

Piped water charges

Historically, domestic water supply was provided to all as a universal service, regardless of ability to pay. Virtually all domestic, and many commercial properties, paid for water according to the rental (ratable) value of the prop-

erty, the normal basis for assessing local government taxes. Under this system charges are not related to consumption so consumers have no incentive to conserve. However, industry and some commercial enterprises had meters, and paid on the basis of quantities used.

Until the late 1980s all regions of the United Kingdom used this system. This is no longer the case. Today the different regions use different charging systems. In Scotland, charges were briefly based on the "community charge" (poll tax), a fixed annual fee assessed on each adult occupying the property. Charges are now based on the council tax liability of properties, which is established by assessing asset values and placing properties into one of eight charge bands. In Northern Ireland some properties are metered, but most pay for water as part of their local council rates. In England and Wales the privatization of water suppliers in 1989 initiated a move away from basing water charges on local tax assessments. Indeed a law was passed requiring all companies to implement new charging systems by 2000. In the meantime properties pay for water on the basis of historic ratable values, although new properties are normally metered.

Present water pricing practices

Abstraction charges in England and Wales

Following the privatization of the water and sewerage utilities, the resource conservation and river management functions of the regional water authorities were transferred to the National Rivers Authority. In 1996 the National Rivers Authority became part of the Environmental Agency. It was widely accepted that the inherited abstraction charging schemes lacked consistency and failed to "bear any relationship to the full costs imposed by particular abstractions, including the costs imposed on the environment" (Department of the Environment 1992). However, the national scheme introduced in 1993, while removing the inconsistencies, is far from setting charges which reflect the impact of individual abstractions on water resources and the environment. Moreover, it is not effective as a demand management tool since, in accordance with the 1989 Water Act and subsequently the 1991 Water Resources Act, the National River Authority cannot set charges higher than are needed to recover costs properly charged to the water resources account. In practice this means that charges are low since the National River Authority undertakes relatively little capital investment in river flow management; water companies undertake most such investments.

The national scheme imposes an application charge for all new or revised licenses and an annual charge based on the authorized abstraction volumes. Annual charges are calculated from a standard formula, $V \times A \times B \times C \times SUC$, where:

V = Licensed volume.

A = Source factor. Abstractions from sources where there has been capital investment are multiplied by a factor of 3; abstractions from sources where there has not been capital investment (including all ground water) are multiplied by a factor of 1; and abstractions from tidal waters are multiplied by a factor of 0.2.

B = Season factor. Year-round, factor of 1; summer only, factor of 1.6; winter only, factor of 0.16.

C = Loss factor. High loss, factor of 1 (spray irrigators); medium loss (public water supplies, most commercial and industrial use), factor of 0.6; low loss (mineral and vegetable washing, nonevaporative cooling), factor of 0.03; very low (power generation, fish farms, effluent dilution), factor of 0.003.

SUC = Standard Unit Charge. This varies by year and by region, depending on National River Authority regional expenditure. SUCs for 1995–96 ranged from £6.29 per 1,000 cubic meters in Yorkshire to £16.22 per 1,000 cubic meters in Northumbria.[50]

While the use of standardized national factors is administratively simple and give the appearance of fairness (abstractors are treated the

[50] £1 = US$1.61.

same way regardless of location), less attention is now paid to the spatially differentiated costs and impacts of abstraction. An abstractor taking water from an overused catchment or depleted aquifer will pay the same amount as one utilizing a source with excess capacity. And, given the prohibition against charging more than is needed to recover cost, charges levied on winter only, surface, or tidal abstractions, which have negligible effect on resource availability, limit the National River Authority's ability to charge more for abstractions in water-short areas and low-flow periods. Other difficulties arise due to the use of authorized quantity as the sole measure of volume. Industries and private water companies have no incentive to conserve (through recycling or increased leakage detection), since their charges are unaffected unless they forego part of their license — which they are reluctant to do since licenses normally have a significant asset value and may be difficult to obtain or renew if water demand changes in the future.

The national scheme also takes no account of the value of return flows: water companies are placed in a single loss factor category regardless of the water return point. Thus, there is no incentive to make such returns in upstream parts of the catchment, where they could add to river flows and be made available for reuse. Further, the regionally-based standard unit charges reflect past investments and have little to do with current water availability. The highest charges are in Northumbria, a region with a large resource surplus. Areas with the lowest margins between effective rainfall and actual abstractions have charges which are 14 percent lower (Anglia), 36 percent lower (Southern), and 51 percent lower (Thames) than Northumbria.

Piped water charges

Since water suppliers were privatizated water charges have increased markedly. Between 1989 and 1994–95 unmetered household bills increased between 50 and 150 percent (in nominal terms) depending on the water company. In addition, unmetered sewage bills rose between 52 and 122 percent. The rate of increase was slowed in April 1995, when the Director General of Water Services established new limits on annual price increases under the retail price index ± an adjustment factor "k" system of price controls.[51] The government set the limits to be effective during the first five years of private operations. Today average water charges are still not high by international standards: average household bills are currently £99 per year for water and £112 for wastewater, although there are wide variations among companies. However, the steep increases, coupled with the high profits made by private companies, means that water price levels have become a politically contentious issue, in addition to the long-standing debate over charging methods.

The government, the economic regulator, and the National River Authority and Environmental Agency all favor the introduction of metering and tariffs based on consumption to promote efficiency, equity, and environmental sustainability. It is recognized, however, that introducing universal metering immediately would be prohibitively expensive: installing internal meters on existing properties would cost about £165 per property, and installing the more common external meter would cost £200. Annual operating costs would amount to approximately £13 (Ofwat 1995). These expenses, which the consumer must ultimately bear, can only be justified economically and socially where metering is the cheapest method (in economic and environmental terms) of maintaining supply and demand balances. These conditions will apply in resource-scarce areas where incremental supply costs are high. A number of companies have begun selective metering programs (for example, Anglian, Mid Southern, Severn Trent), including those which target high peak users such as sprinkler users and swimming pool owners. In addition all companies have optional meter schemes, and allow custom-

[51] The "k" is a number specific to each company, and indicates the company's allowable changes in annual charges. At the time of privatization in 1989, the Secretary of State set the adjustment factors. However, in 1994 the Director General of Water Services reset them. They will continue to be revised every five or ten years.

ers to choose their payment methods: under most schemes the customers pay a subsidized rate for meter installation, although some companies (for example, South East Water) will install them free of charge.

The droughts of 1989–92 and 1995–96 have highlighted the need to treat water as an economic good and to employ demand management measures to help achieve supply and demand balances. However, opposition to raising prices remains strong, and the government has not made the installation of meters compulsory. Although the percentage of households and businesses with meters has grown considerably since 1991–92 — from 2.8 to 7 percent of households and 66 to 76 percent of businesses — over 72 percent of all piped water is still provided on an unmeasured basis.

Some people oppose metering on ideological grounds, viewing water as an essential, universal right, others are reluctant to contemplate the redistributive effects which would result from metering, still others are concerned for the health and hygiene of low-income families, and some are suspicious that metering will be an excuse for water companies to increase prices and profits. Although some water companies have announced their intention to progressively introduce metering (for example, Anglian and South East Water) there are still many within the industry who doubt that the costs can be justified by reductions in demand and delayed development of new capacity. Some authorities are reluctant to accept the greater instability in revenue that metering potentially brings, and prefer to retain fixed annual fees.

There is now considerable evidence in the United Kingdom that metering does reduce consumption. In a large-scale trial conducted in the Isle of Wight, average daily demand fell by 22 percent between 1987 and 1992; importantly, metering also significantly reduced peak demand (Binnie 1992). In smaller-scale trials conducted from 1989–92 in 11 districts using a variety of different tariff structures, average annual demand per household fell by approximately 11 percent: in dry summers monthly, weekly and daily peaks were reduced by 25-35 percent (Department of Environment 1993, National River Authority 1995). More recently, comparison of consumption during the hot summer of 1995 among metered and unmeasured users showed that metering largely removed the peak-use component (Mid Kent Water Company 1997, personal communication; Folkstone and Dover Water Company 1995).

Current debates and future prospects

Abstraction charges

Although the government favors the use of economic instruments for environmental management, it is by no means certain that it will allow their use to manage water demand in the near future.

It is widely accepted that current charges provide little incentive to conserve. Recent research suggests that raw water may be seriously underpriced: in the Thames region it is estimated that the abstraction charges cover only 10 percent of the cost of incremental expansion, let alone the costs of environmental externalities. However, there is considerable political opposition to increasing water charges. As the water companies account for 81 percent of consumptive abstraction (the remainder is for fish farming, mineral washing, and nonevaporative cooling) it is inevitable that their customers would pay most of the increase in raw water costs. The National River Authority and Environmental Agency are, however, investigating the practical implications of introducing incentive charges. Their introduction will depend on the willingness of the government to change the law and remove the current prohibition on collecting revenues in excess of costs.

Studies are also being conducted on the potential role of tradable permits in improving water use efficiency: tradable permits are thought to be less politically contentious than environmental taxes. However, permit trading is not without problems. For example, if currently unutilized or underutilized licenses are traded, resource shortages could be exacerbated; if trading increased consumptive use, moved water between catchments or shifted the location of return flows, environmental damage could arise.

It is likely that policymakers will be cautious before introducing tradeable permits, but trials could be undertaken in the near future.

Piped water charges

No one expects an immediate move to metering and charges based on use. But if current trends continue, the proportion of metered households will increase to 14 percent by 2000 and 33 percent by 2015. And progress could be more rapid. Following the 1995–96 drought, a number of companies started to require sprinkler users and swimming pool owners to use meters; others have introduced free meter optional schemes, which have proved attractive to customers, especially those with high property assessments. However, much will depend on politics and the attitude of the new Labour government. A decision will have to be made soon about allowable charging methods for nonmetered households after 2000: the law prohibits the use of property assessments as the basis of water charges after that date. Although the current government has announced its intention to allow the current system to continue and refuses to allow the use of the new council tax as the charging base, it has not yet introduced legislation to change the law. The Labour government may allow the use of a council tax based system.

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23 UNITED STATES

Richard W. Wahl

Introduction

In the United States, state agencies, rather than the federal government, generally grant rights to use water for a particular purpose at a specified location. These state agencies charge fees for filing and processing new permits and for reviewing and processing changes in the use of existing water rights, but do not charge for the use of the resource. However, once water rights are in private hands, private parties generally can sell or lease them, with certain restrictions, to other water users. In such secondary markets, the price would normally reflect a value for the resource.

Water is provided to final users through a variety of institutional arrangements. Urban residents normally receive water from local water districts (city, county, or other special water district). Industries may receive water from urban water districts, or may have their own sources of supply; large industries in rural areas are particularly likely to have their own supply sources. Farmers often receive irrigation water from irrigation districts that construct and maintain water storage reservoirs and delivery canals for shared use. Most urban and agricultural water districts are organized under state laws which limit the charges they can impose to no more than their costs. Accordingly, most districts price their water to cover costs of delivery, including the costs of building and maintaining facilities within the district. Where districts purchase some, or all, of its water from a larger "umbrella" district or a state- or federally-financed water facility, prices also include payments made to the external water authority.

A district needing to increase its water supplies would compare the cost of developing new facilities to store and deliver water using its own water rights with the cost of purchasing water from other sources. Therefore, in places where there are functioning wholesale markets for water, the market price will be determined by the costs of designing and constructing new storage and delivery facilities, the costs of purchasing water rights, the legal and engineering expenses of transferring those water rights to new users, and the costs of obtaining permits for any new facilities, and the demand of final consumers. Of course, the demand of final consumers will to some degree depend on the availability of alternative water supplies which they can exploit themselves, such as rivers, groundwater, or rainwater collected in impoundments.

In places where there are water markets, owners of water rights can sell water. Districts, industries, and individuals aware of these opportunities can price water to themselves at the regional market value of water; that is they can husband the resource at its opportunity cost. Opportunities for selling water are not normally available to urban water users, but may be available in varying degrees to individual farmers within in an irrigation district. This is because farmers use larger blocks of water and because their supply is typically a larger fraction of an agricultural district's supply.

Revenues through tax assessments

Both urban and agricultural districts may obtain revenues from tax assessments based either on the value of property or the number of acres of land owned. In the past, these assessments were used to provide financial security for district water suppliers. Such assessments on land were based on the rationale that all property owners within a district enjoyed a benefit from the availability of water — reflected in the increased value of their land — even if they did not use the resource. Water districts were formed with legal authority to place liens on the property of owners who failed to pay their assessments.

Charges based on property assessments provide no incentive to conserve the resource, and among urban water districts this practice has been declining. For example, the percentage of revenues collected through property taxes by the Metropolitan Water District of Southern California fell from over 80 percent before 1950 to less than 50 percent since 1970. The district expects this percentage to decline still further (Metropolitan Water District of Southern California 1990).

Federally subsidized irrigation water

One special case deserves mention: in order to promote settlement of the arid western United States, the United States Congress established the Bureau of Reclamation in 1902, and offered interest-free loans for the construction of irrigation water systems. Subsidies grew from levels of around 14 percent near the beginning of this century to levels of over 90 percent in the 1980s, principally because Congress extended repayment periods (Wahl 1989). As a result, irrigation districts receiving water from Bureau facilities, which supply water to about 20 percent of the irrigated acres in the West, were able to price water at far less than the economic cost of delivery. Urban and hydropower users received smaller subsidies, by paying positive but below-market interest rates.

Present Water Pricing Practices

The rest of this chapter focuses principally on issues of pricing water to final consumers, rather than on wholesale water markets, although pricing in the latter is clearly influenced by the former.

Water rate structures

Nearly all water districts charge for water on the basis of their average costs. Costs for wastewater treatment may be included in charges for water, particularly for residential urban customers. The practice of setting prices to reflect average costs derives principally from the legal requirement in most districts that charges must be set to recover costs, but no higher; water suppliers are not profit-making enterprises. Rate structures employed by water districts include flat-rates, declining block rates, and increasing block rates. Specific rates and block sizes are typically differentiated among various customer classes, such as residential, commercial, industrial, and public uses (such as parks and municipal buildings) (Beecher, Mann, and Landers 1990; American Water Works Association 1991; American Water Works Association Research Foundation 1997). Declining block rates, once justified as quantity discounts, have been criticized as wasteful by economists and others, and over the past three decades have been employed less and less.

Since the most economical water sources are typically developed first, the long-run marginal costs of expanding water supplies are generally increasing. Therefore, pricing water at average cost leads to undervaluation and overuse. But, just how to employ long-run marginal cost pricing remains controversial and problematic for both practical and theoretical reasons. Some utilities in water-short areas use increasing block rates. But, flat rates by customer class are the most common. A growing response intended to reflect the higher costs of facility expansion is the use of "tap" fees, under which new residential subdivisions or businesses are charged a one-time system connection fee to defray a portion of the cost of increasing system capacity.

In the past, some agricultural districts have charged different rates based on the cost of delivering water to different locations within their districts, while others have charged uniform rates. The Westlands Water District in California, for example, has historically charged more to users on higher elevation lands, because pumping costs are higher and the price of water purchased from the federal Central Valley Project is higher (Table 23.1).

State or federal legislation may contain general exhortations to conserve water, but legislation rarely mandates rigorous examination of rate structures. Nevertheless, both urban and agricultural water districts are becoming more aware of the economic consequences of water

pricing. An analysis of different rates structures by urban districts has become more common, and an increasing number of water utilities have tried to modify their rate structures to avoid disincentives to conservation (such as declining block rates) and, in some cases, to incorporate incentives for conservation.

Prominent examples of incentive pricing have been instituted by a few irrigation districts in California's Central Valley seeking to reduce the application of irrigation water to lessen the outflow of contaminated drainage water from their districts (Thomas and Leighton-Schwartz 1990; Wichelns 1991). For example, in 1988 the Broadview Water District increased its charges for water used above 90 percent of historical averages by 2.5 times, from US$16 per acre foot[52] to US$40 per acre foot, where water application rates are computed by crop.[53] In 1987 the Pacheco Water District adopted a similar a system of crop-specific tiered rates, with water in the first tier costing US$36 per acre-foot and water in the second tier costing US$60 per acre foot. In 1989 the Central California Irrigation District adopted a tiered rate that is independent of the crops grown: charges for water almost tripled (from US$5.50 per acre foot to US$15.00 per acre foot) for water volumes above 3.25 acre-feet per acre.[54] In 1989 the district lowered the second tier to US$10.00 per acre foot because it was collecting more than needed to recover costs.

All districts receiving water from the large federal Central Valley Bureau of Reclamation project are required to use incentive pricing under the Central Valley Project Improvement Act of 1992 (Title XXXIV of Public Law 102-575). The Act establishes a three-tiered rate for water prices: higher rates are charged for water above 80 percent and 90 percent of historical contract amounts. Water rates in the Central Valley Project vary by region, based on the services provided, such as project storage, canal conveyance, and additional pumping charges, and based on the account balances of individual districts. Table 23.1 illustrates depicts typical rates.

Umbrella districts

Another issue in establishing incentive prices is the relation between regional umbrella districts and their member water districts. For example, the Metropolitan Water District of Southern California is the residual supplier of water to some 27 member agencies. These agencies obtain water from their own sources in addition to the Metropolitan Water District. The Metropolitan Water District has argued that it may do little good for it to price water at long-run marginal cost if its members do not. Any increase in prices which the Metropolitan Water District establishes for new supplies will be significantly diluted if member agencies average the new fees with the those reflecting the costs of obtaining water from other sources. The contractual relations between umbrella districts and their members is an area that needs to be addressed if incentive pricing is to be fully effective.

Subsidy reform

There have been several attempts to reform the subsidized pricing of irrigation water of federal projects. Proposals to raise prices have had little success because districts have long-term contracts for water. Furthermore, districts have allies in the United States Congress supporting their efforts to prevent rate increases.

One significant exception is the Central Valley Project Improvement Act. Established to protect the fishery and recreational resources in California rivers and estuaries, this legislation adopts a three-pronged approach: reallocating some water for instream use; increasing charges to water districts through the introduction of tiered rates and a flat surcharge of US$6 per acre-foot (Table 23.1); and placing additional revenues in a fund to buy water from the affected districts and other sources (Wahl 1994).

This legislation illustrates the complex links between conditions external to a district and its own pricing structure. In addition to

[52] 1 acre foot = 0.4 hectare.

[53] Unless otherwise noted, all prices are in 1988 US dollars.

[54] 1 acre foot = 1235 cubic meters.

raising federal charges to Central Valley Project irrigation districts, the legislation reduces deliveries to districts and facilitates the marketing of district water for both commodity and instream uses. These latter provisions may lead districts to reexamine their internal pricing structures.

The adoption of policies to facilitate market transfers of water may prove an easier route to encouraging more efficient use of water than legislatively mandating pricing reforms, particularly for subsidized irrigation water on federal projects (Wahl, 1989). Over the long-term, the existence of markets should lead districts to value water internally at its external opportunity cost — if not to formally price water at that level. The Bureau of Reclamation adopted such a policy in 1989, and applied it to all of its projects. The Bureau of Reclamation is now preparing a study of incentive pricing, that may lead to the adoption of guidelines for irrigation districts to use in setting prices.

Table 23.1 Rates and surcharges for irrigation water attributable to the Central Valley Project Improvement Act (1994 US$ per acre foot)

	Before Act	After Act (US$6 surcharge, plus tiered rate)		
		Up to 80 percent	*80–90 percent*	*90–100 percent*
Anderson Cottonwood Irrigation District, Northern Sacramento River	7.94	13.94	17.19	20.43
Colusa County Water District, Tehama Colusa Canal	24.51	30.51	59.38	88.25
Westlands Agricultural Water District, Delta Mendota Canal	18.52	24.52	46.63	68.73
Westlands Water District, San Luis Canal	33.46	39.46	63.85	88.23
Madera Irrigation District, Madera Canal	25.04	31.04	42.08	53.12
Delano Earlimart Irrigation District, Fraint-Kern Canal	21.15	27.15	37.60	48.05

Pricing of the resource

It is unlikely that states will begin to impose a resource charge for the abstraction of surface water, given the long history of not doing so. However, there have been some initiatives at the state level to charge for water extracted from groundwater sources — largely to limit the use of the resource. Arizona's Groundwater Management Act of 1980, in addition to other measures, imposed taxes on pumping that were expected to increase over time. In other locations in the West, local and state governments have instituted a variety of measures to allow use and recharge of groundwater basins. The measures primarily establish rules for depositing and withdrawing water and involve charges only to cover costs of engineering, administration, and water losses.

Market incentives to individuals within districts

Since most final consumers of water obtain their water from districts, a continuing issue is likely to be the freedom individuals have to sell their water allocations to others — and profit from the sales. This issue is especially important in irrigation water districts, where individual water allocations may be large. The Central Valley Project Improvement Act facilitates user-initiated transfers (which are not addressed by California state water law), and requires that districts complete a review within 90 days.

Current debates and future prospects

The future of water pricing in the United States is likely to reflect two basic trends:

- *Greater attention to incentive pricing.* Because of increasing competition for limited water resources, water suppliers and state and federal administrators and law-makers are likely to pay increasing attention to water pricing incentives internal to districts, to assist in institutionalizing regional markets for water, and to find other means to lower the transactions costs of water transfers. With the ongoing declines in federal funding for major facility construction, regional institutions, both intrastate and interstate, may evolve to address a variety of pressing water management issues, including the provision and pricing of agricultural drainage services, the development of water markets, the protection of the environment, and the administration of interstate water compacts.
- *Increased demands for instream uses.* The increased competition for water will also require water institutions to pay more attention to the need to provide water for instream uses — recreation, fisheries, and habitat for endangered species — and the need to control irrigation drainage to prevent pollu-tion. In addition to promulgating regula-tions to protect instream environments, policy-makers may experiment with estab-lishing public funds to buy water from willing sellers for such uses. These devel-opments will have impacts on future water pricing at the wholesale and retail levels.

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24 CAPITAL COST RECOVERY: WORLD BANK EXPERIENCE IN IRRIGATION PROJECTS

Anne Marie del Castillo

Introduction

The World Bank has encouraged governments and others to recover irrigation system costs from users for many years. The Bank has maintained that users should pay fees to cover both operations and maintenance costs and a portion of capital costs. Most Bank-supported irrigation projects include arrangements to recover operations and maintenance costs and a few have incorporated measures to recover a portion of capital costs.[55]

Although they have often been ignored, most Bank loans contain covenants to ensure that water charges are appropriate. However the loan covenants, particularly those dealing with recovery of investment costs, have often been quite vague, making it difficult to determine whether or not a country has complied with the covenants (World Bank 1986a). Nearly half of the covenants dealing with investment costs that were reviewed by the World Bank's Operations Evaluation Department contained wording on cost recovery levels such as "as much as possible" or "a reasonable portion of investment costs." Some merely stated that a study would be undertaken to determine what should be done. In very few cases were significant capital costs recovered. Nevertheless because of the covenant's wording it is not possible to state with certainty that the covenants were violated.

The same review found that covenants requiring the recovery of operations and maintenance costs had not been complied with in at least two-thirds of the irrigation projects reviewed (World Bank 1986a). The proportion of operations and maintenance costs recovered generally ranged between 15 percent and 45 percent of total costs.

Bank policy

Two World Bank documents, the Vice President's policy note, "Financing Operations and Maintenance in Irrigation" (1984), and the *Water Resources Management: A Policy Paper* (1993) spell out the official Bank policy regarding cost recovery. The Vice President's policy note states:

> The longer term objective of cost recovery should be to have a system of resource mobilization that will finance capital costs, so permitting the replication of investments. Long-term objectives should also include capturing rents from those who benefit directly from irrigation, unless there are specified reasons (for example, equity or regional development goals), why governments choose not to do so.

The note requires that at project appraisal: there are assurances that sufficient funds are available for operations and maintenance; there is adequate recognition that the longer-term objective is to have a system of resource mobilization that covers capital costs, thus permitting investment to be replicated; resources are mobilized from the parties who benefit directly from irrigation, unless there are specified reasons why governments choose otherwise; and the effects of the proposed fiscal system on farmers' incentives is analyzed.

According to the *Water Resources Management - A Policy Paper:*

[55] Operations and maintenance costs are the annual costs of operating and maintaining the irrigation facilities. Capital costs are those associated with the initial construction, upgrading and major rehabilitation of irrigation facilities.

For irrigation, ...prices reflecting opportunity costs are desirable, but cost recovery fees that ensure the financial viability of water entities are a more realistic immediate objective. Since such fees are often significantly below the opportunity cost, they reduce, but do not eliminate the misuse of water resources. Therefore, in the interim, other mechanisms such as water trading or administrative reallocation are needed. The evidence suggests that farmers want and are willing to pay for, reliable supplies of irrigated water. However, the practical problems of pricing for irrigation services are sometimes complex (p. 49).

One way to circumvent some of these issues is to measure the water delivered to a water users group, which, in turn, is responsible for delivering water to farmers and collecting fees (p. 50).

The record of nonpayment and noncollection of fees for water is long and well-documented. It reflects two problems: weak incentives to collect and limited willingness to pay because services are poor. In many cases the record of poor collection can be attributed to lack of political determination to enforce collection and limited motivation of agencies to collect, since they are not required to cover their costs..... Failure to recover costs and to reinvest in the systems leads to a vicious cycle whereby service declines with collections....and consumers, in turn, become less willing to pay for poor-quality services provided. Conversely, high collection rates often reflect decentralized management and enforced financial autonomy and accountability of water entities, which in turn deliver high-quality services for which consumers are willing to pay (p. 54).

Bank experiences

There are a number of Bank-supported irrigation projects that have been underway long enough to provide information on actual cost-recovery experience. Experience from projects in Brazil, Chile, Korea, Mexico, and Peru are reviewed below.

Brazil

In accordance with the existing federal irrigation law of 1979 and its regulations (decree 89496), farmers who benefit from irrigation schemes must pay water charges. In Brazil irrigation water charges consist of a two-part tariff containing a volumetric water charge to cover operation and maintenance costs, and a per hectare water charge to recover the public investments in off-farm irrigation infrastructure. In addition, the government is entitled to recover from small farmers public investments to acquire land and on-farm equipment. According to the terms of the loan, costs are recovered over 25 years at an annual interest rate of 6 percent.

The five-year Brazil National Irrigation Program: Northeast Irrigation 1 Project includes provisions for recovery of investment costs (World Bank 1990). According to the project's financial study of farm models, beneficiaries would be able to pay the capital costs of the irrigation system over 25 years, in addition to land and costs of improving their farms. The financial analysis assumed that farmers would pay investment costs, operation and maintenance costs of off-farm infrastructure, and, for farmers with less than nine hectares, costs of extension services.

Under the project the newly created irrigation districts would collect water charges and use the revenues to pay the Regional Development Company and the National Department of Drought Related Works for operation and maintenance of the main irrigation works and to finance their services. The Executive Secretariat for the National Irrigation Program is moving towards improving the enforcement of water charges through existing legal measures, including making beneficiaries' land rights contingent on the payment of water charges.

The Regional Development Company and National Department of Drought Related Works have issued satisfactory legal regulations to en-

sure that beneficiaries are charged for investment and operation and maintenance costs, beginning in the first year of cultivation. The charges would increase gradually over a period of four years, and stabilize in the fifth year.

The government provided assurances at negotiations on two key issues. The first was that water charges would be set at levels sufficient to fully recover operation and maintenance costs and public investment costs for off-farm infrastructure in real terms, plus finance charges of 3 percent annual interest. The second was that water charges would be adjusted progressively beginning in the first year of cultivation according to a methodology acceptable to the Bank. The proposed water charges would be reviewed with the Bank prior to making the adjustments.

Chile

The Chilean approach to managing irrigation systems, along with agricultural services in general, is characterized by its strong market orientation. Its irrigation system is designed within the context of a water rights market, an approach many consider to be the most advanced in Latin America.

The Irrigation Development Project in Chile makes provisions for recovering capital costs (World Bank 1992). The costs to be recovered are based on the cost of investment, net of taxes, to be estimated after the final design has been completed. The investment costs would be divided by the total number of water rights (*acciones*) within the project: beneficiaries would pay the costs in proportion to their share of water rights. Grace and repayment periods would be negotiated on a project-by-project basis. However grace could not exceed four years, and repayment could not extend beyond 25 years. Repayment would be indexed by the "development unit" (*unidad de formento*, a government standard used to index public benefits, which in 1995 was equivalent to US$30), or the wholesale price of wheat. Farmers could choose whichever method they preferred. However, farmers choosing the development unit method would pay a rate of interest 1.5 percent lower than farmers choosing the wheat index. The rate of interest could not be less than the rate on long-term paper issued by the central bank.

The level of direct cost recovery would be negotiated with the beneficiaries for each investment. It would be between 100 percent and 50 percent of the cost of the investment, net of taxes. If the investment benefited small farmers in marginal areas, the level of direct cost recovery could be below 50 percent. Within each subproject, commercial farmers would be required to pay a minimum of 50 percent and small farmers a minimum of 23 percent. Cultivators of small household plots and farmers in extreme poverty could pay less than 25 percent of the capital costs.

It is too early to assess the performance of this project in cost recovery. However, its success will depend upon the effectiveness of the public agencies in collecting water charges.

Korea

In many Bank irrigation projects in Korea, such as the Miho Watershed Development Project (World Bank 1986b), the Yong San Gang Irrigation Project Stage I and II (World Bank 1980b), and the Ogeso Area Development Project Stage 1 (World Bank 1980a), the Korean farmland improvements associations or water users' associations are responsible for recovering costs from farmers for projects completed and transferred to the associations. When taking over projects, Korean farmland improvements associations are required to pay between 30 percent and 100 percent of its capital costs. Repayment is over 35 years at an annual interest rate of 5.5 percent with an initial grace period of five-years. The government provides a grant for the whatever capital costs are not paid for by farmers. Farmland improvement associations set irrigation charges at levels to cover all operating and maintenance costs and their share of the capital costs, amortized over 35 years. Records indicate that farmland improvement associations have been very successful in collecting charges from farmers and repaying the government loan.

In the Korean Paju Irrigation System Project, water charges consist of two components: one to cover operations and maintenance and one to recover capital costs of the project (World Bank 1980a). The operations and maintenance charge varies among the five districts or subprojects which comprise the Paju Irrigation System Project, but is uniform within districts. The operations and maintenance fee comprises two distinct components, one for administrative costs and one for costs of operating the irrigation system (for example pumping, and operation of reservoir and canal gates). The average per hectare administrative cost is applied uniformly throughout the Paju, but irrigation costs are calculated separately for each district.

To calculate water charges to recover capital costs, authorities classify land into four grades intended to reflect differential benefits from the project. The highest charges are applied to newly irrigated land which is consolidated as a result of the project. The next highest charges are applied to newly irrigated land, not yet consolidated. Lower charges are applied to land that had irrigation facilities before the project, but which is consolidated as a result of the project. The lowest charge is applied to previously irrigated land, not yet consolidated.

Mexico

Provisions for capital cost recovery are incorporated into the *Ley de Contribucion de Mejoras pro Obras Publicas Federales de Infrastructura Hidraulicos,* which requires beneficiaries to pay up to 90 percent of the reimbursable costs of the investment. Farmers pay water charges semiannually or annually for a maximum of 40 years. Charges are adjusted semiannually to reflect changes in the consumer price index. The National Water Commission (*Comision Nacional de Aqua*) calculates the reimbursable costs, which are defined in the same law. Charges may be reduced by presidential decree based on the ability to pay.

The National Water Commission set the goal of recovering 30 percent of new construction capital costs under the US$400 million Irrigation and Drainage Project (World Bank 1991). This was a substantial increase over the little to zero capital cost recovery required in earlier projects. The commission's commitment to recovering a portion of capital costs is clear through its efforts in several districts in the northwest and north regions of the country: water users are paying 15 to 25 percent of capital costs for ongoing rehabilitation and modernization works.

Peru

The existing legislation in Peru defines two classes of water tariffs, one for agricultural use and the other for nonagricultural use (Supreme Decree 003-90-AG 1990). In general the tariffs do not reflect the true cost of water. For agriculture the volumetric water tariff includes three components. The first is a "water users' association" component (*ingresos de la junta de ususarios*) intended to raise funds to finance operations and maintenance, the conservation and improvement of common irrigation infrastructure, and the operating budget of the *Adminsitrador Tecnico*. The second is a water levy (*canon de aqua*), calculated as 10 percent of the first component. Revenue from this levy goes to the agricultural development fund, *fondeagro*, or to special irrigation projects. The third is an amortization component to recover the cost of public investments in irrigation storage infrastructure. This is also 10 percent of the water users association component, except when special projects authorities decide otherwise.

Except in very few cases irrigation water tariffs are unrealistically low and do not raise sufficient funds for proper operations and maintenance of the irrigation systems (the amortization component is usually not recovered). Recently government policy for irrigation has focused on improving efficiency by giving full responsibility to water users for operations and maintenance of their irrigation systems, and recovering 80 percent of investment costs for deferred maintenance works, including the rehabilitation and modernization of existing systems (World Bank 1995).

The project contains provisions for the recovery of 100 percent of total investment costs

for rehabilitation. Commercial banks will extend credit to users at market rates through a line of credit financed by the World Bank for this purpose. Recently approved legislation gives ownership of irrigation infrastructure to the users, who repay the loan to the banks. Depending on the system and the nature and scope of works required, small farmers (those with less than 3 hectares) may not be able to repay the rehabilitation costs in addition to the higher operations and maintenance charges. Where this is true, more profitable farmers within the same water users association will pay more to insure full cost recovery.

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25 WATER USER ORGANIZATIONS AND IRRIGATION OPERATION AND MAINTENANCE: FINANCIAL ASPECTS

Geoffrey Spencer and Ashok Subramanian

Introduction

In most countries state agencies have traditionally been responsible for water resources development and management. Increasingly, however, water users are taking on an expanding role in managing water systems and in financing irrigation operations. Consequently, there is considerable interest in how water users' organizations work and the ways they manage and finance water systems.

Why are water users' organizations involved in irrigation financing?

In many developing countries government allocations for operation and maintenance and rehabilitation of irrigation systems are well below the expenditures necessary to sustain water supply systems in perpetuity. User fees generally are insufficient to fill the gap due to unrealistically low fees for water services and low levels of collection, because of administrative weaknesses and user unwillingness to pay for poor water services (World Bank 1986). Other obstacles to sustainably managing irrigation systems are the rising share of staff salaries and benefits in total operation and maintenance budgets at the expense of works expenditures, and the absence of a direct management link between user payments, service provision, and operation and maintenance expenditures.

Realizing that irrigation system operations are unsustainable and reacting to pressure from finance ministries, irrigation agencies are devolving management responsibilities — including financing of operations — to water users' associations. The underlying principle is that beneficiaries of water services should pay the costs of the desired services. Consequently organized groups of water users, like the water users' associations, have a role to play in setting service levels and negotiating the terms and scope of user fees (Jones 1995).

Do water users now pay for irrigation services?

The size and extent of user financing in countries today is often difficult to pinpoint. Among the reasons are the indirect manner through which country's collect contributions, often through taxes on irrigated land sent to the treasury, the difficulty of ascertaining just what the operation and maintenance expenses are and how much users are charged, and the difficulty of linking all types of user payments — including cash and in-kind contributions and taxes — to irrigation services.

In addition cost categories and criteria for allocating costs are not standardized, so it is difficult to make cross country comparisons of who pays for what (costs in this context include recurrent costs of operation and maintenance and administration and replacement costs, but not capital cost for enhancement or modernization).

Figure 25.1 places countries in a government–user contribution matrix in accordance with their relative shares in financing irrigation operation and maintenance. The data come from country and World Bank reports on irrigation projects. The data were cross-checked with published literature wherever available. A country's position in the matrix is based on nationwide experience and the authors' assessments of the relative contributions of the public and private sectors towards expenses. While a country may have some systems financed largely with user contributions, this alone is not sufficient to qualify it for placement in the lower right hand part of the figure.

The top left-hand corner of Figure 25.1 depicts countries with a large government role in financing irrigation operation and maintenance. Prominent irrigating countries like India and Pakistan are in this category. Users in informal or formal water users' associations are responsible for tertiary watercourse level operation and maintenance. The irrigation agency is normally responsible for operation and maintenance above this watercourse level. In the countries in this part of the figure users pay about 30 to 50 per cent of operation and maintenance costs. Although there are a few examples of systems for which users pay 100 percent of the operation and maintenance costs, in most countries the public sector irrigation agency is the primary financier of operation and maintenance. All countries in the upper left-hand corner of the figure are increasingly collecting a larger proportion of funding from users.

The middle section of Figure 25.1 depicts countries where government and user contributions are relatively similar. Users in countries in this category are fully responsible for watercourse operation and maintenance. Users are also expected to pay some fees to the irrigation agency for its services. In the Philippines and Morocco governments manage large-scale surface systems. Users contribute about 50–75 per cent of operation and maintenance costs. The case of Colombia is different. Here water users are assuming responsibility for operation and maintenance in an increasing number of irrigation districts.

The bottom right-hand corner of Figure 25.1 depicts countries with a relatively small government role in financing irrigation operation and maintenance. In Mexico users are responsible for the operation and maintenance of tertiary and secondary canal systems. The government is responsible for managing the main systems with contributions from water users' associations. But, progressively, federations of water users' associations are being formed and taking over the responsibility of managing operations and maintenance upstream (Gorriz, Subramanian, and Simas 1995). In Chile water users' associations are responsible for the operation and maintenance of entire systems including headworks and diversion weirs. In Mendoza, Argentina water users' associations have full financial responsibility for operation and maintenance and administrative costs, but they receive subsidies for rehabilitation and modernization works. In Nepal farmers have traditionally managed a majority of irrigation systems. The government manages the few large scale systems but is progressively handing responsibility for their management to water users' associations. In all these countries water users' associations recruit their own staff, collect water use fees, and pay for operation and maintenance. A system of checks and balances has been instituted to ensure that water users' associations are accountable to their members and that the government agency is accountable to the water users' associations.

What are the lessons of experience?

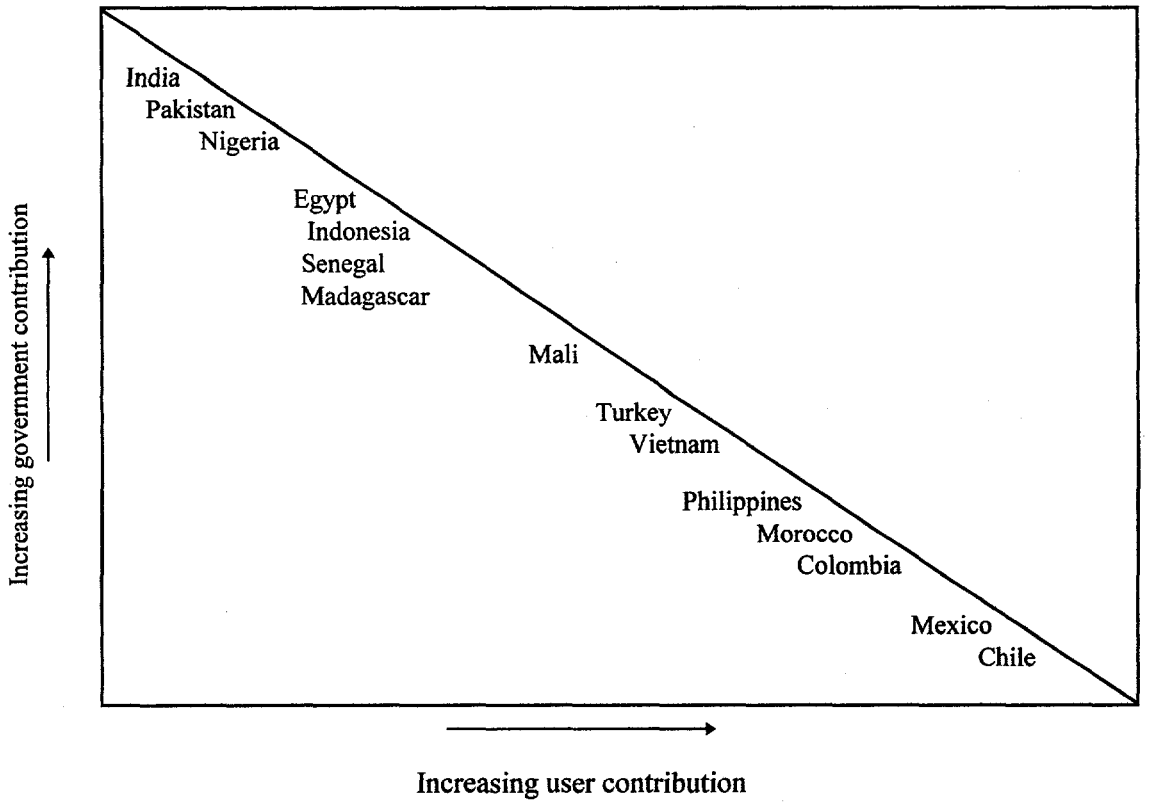
Country experience shows that five key issues or activities must be addressed if water users are to successfully manage and finance irrigation systems.

Determine operations and maintenance costs

In conjunction with determining service levels, analysts must estimate operation and maintenance costs for system level and type of service, specifying expenditure categories — staff, material, equipment, vehicles, and overhead costs. In some countries staff costs comprise up to 50-60 per cent of total operation and maintenance costs. At times of budgetary pressure, cuts are most likely to be made in the non-staff portion of the budget, such as works.

The managing agency must complete an exercise to identify the full range of services it provides — irrigation, water in bulk, water supply, flood control, drainage, and others — and allocate costs to each service category. Annex 25.A1 lists a range of services agencies are likely to provide and gives an illustration of cost analysis carried out in Haryana, India (World Bank 1983).

Figure 25.1 Indicative mix of government and user contributions to operation and maintenance (national average)



Information on costs of services and benefits to be derived from the project must be provided to project beneficiaries. Mexico carried out a successful program to disseminate information and train farmers and agency staff. Topics covered in the program included water management, system operation and maintenance, accounting and financial management, and organizational issues for water users' associations. Egypt has developed a program to deliver information through the Irrigation Advisory Services, constituted exclusively for water users' organizations. The service advises the water users' associations on the costs of irrigation services and options for setting and collecting service fees.

Involve users in defining service levels

Irrigation water is a valuable input into agriculture production. Quantity, quality, timing, and duration are critical variables of irrigation water supply. Therefore it is crucial that water users' associations are involved very early in designing the project so that the level and type of services provided truly reflect farmers desires. If users are involved in determining service levels, they are much more likely to value and pay for the services. In the past, operating rules of the system were usually taken as given and users were generally not expected to pay for capital or operation and maintenance costs.

In Mexico water users' associations are becoming involved in water management. Here managers hired by water users' organizations prepare irrigation plans at the level of the *modulo,* each covering about 5,000–8000 hectares. The managers take into account cropping plans, conveyance losses, and the need to distribute water equitably. The plans are then discussed with the national irrigation agency to determine the final allocation of water. Water

users' associations pay the full operation and maintenance costs at the secondary level and below. They also pay a portion of the operation and maintenance costs of higher levels of the system.

In Mali in the Office du Niger, joint committees have been established for operation and maintenance in every region. The committees comprise 5 to 10 representatives of producers and 5 to 10 representatives of the office. Committees decide on types of services, manage expenditures (including procurement matters), and set water service fees. The committees also directly manage and make decisions on the use of 50 percent of the user fees collected for operation and maintenance.

In Chile the national federation of water users' associations was involved in designing a World Bank supported irrigation project (World Bank 1992). The federation and local water users' associations played an active role in preparing the project and were involved in discussions of service options and costs at all times. Later water users' organizations were given the right to approve all investment proposals and other project components.

In the past the general norm has been to involve water users informally at the project design stage, when service levels and costs are determined. However, water supply and sanitation sector managers have been experimenting with establishing formal methods using focus groups and participatory approaches. Surveys, focus groups, and contingent valuation techniques have also been used in selected sites to assess demand and willingness to pay for services, with considerable success (Whittington, *et. al.* 1992).

Assess user willingness and capacity to pay

Users will be willing to pay for services to the extent that they derive benefits from the project through improved reliability of water services, better access to water of the preferred quantity and quality, and increased returns from agricultural production. For the user these benefits must substantially outweigh the opportunity costs of participating in meetings of the water users' organizations, increases in service fees or water charges, and costs of new responsibilities for operation and maintenance.

In the Philippines system rehabilitation, improved operation and maintenance, and the decentralization of management of the late 1970s and early 1980s led to the expansion of irrigated area and to equitable distribution of water during the dry season. This in turn raised the output of dry season rice by 10 per cent in the sample area studied. Incremental costs of irrigation projects are often less than 20 to 30 percent of the incremental income generated from the projects. Farmers are much more willing to pay for irrigation operation and maintenance if they receive higher incomes from the application of water. Of course income also depends on output price policy, market access, and agricultural extension services, so these may have to be reviewed and strengthened to allow farmers to derive the full benefits of the project. In some cases water users' associations may find that incremental income gains from the use of installed technology (for example, pumping stations) will not outweigh the costs of operation and maintenance and replacement (Johnson, and Reiss 1993). Thus farmers may be unwilling to assume new responsibilities.

Water users' associations may also generate income from sources other than user fees. For instance some irrigation districts in the western United States rely on revenue from power sales to balance their irrigation budgets. In China water users' associations earn income from the sale of fish and the collection of fees from fishermen and recreational water users. These diverse sources of income may be particularly important during periods of bad weather, such as droughts and floods, when crop output and farmer incomes may fall.

Determine appropriate charging mechanisms

There are a number of alternative charging mechanisms available for agencies and water users' associations to use in structuring charge systems. Fee structures should be equitable, administratively simple, and easily understood

by both users and people who administer and collect the fees.

User fees. User fees are generally calculated on the basis of irrigated area. This method has the advantage of being relatively simple to understand. However because the fees are not related to volume of water consumed, farmers have no incentive to use water efficiently. The use of volumetric charges solves this problems. However in many places measuring water use may be difficult. Often agencies use a combination of the two methods. In Mexico for instance the National Water Commission (*Comision Nacional de Aqua)* charges the water users' associations for quantity taken at the turnout of the secondary canal. In turn the water users' associations charge individual members on the basis of area irrigated and type of crop. Water users' associations also use other charging methods such as setting fees by the season, but this clearly favors the high volume user. Many countries use two-part tariffs structures—comprising a fixed fee to cover fixed overhead expenses, and a variable fee based on use. This structure has the advantages of providing a reliable stream of income for water suppliers, while retaining incentives for consumers to conserve. Designing charge systems should be a topic in training programs for water users' organizations, so that farmers learn the implications for efficiency and equity of using various charge systems.

Property taxes. Water charges collected through property taxes are based on the value of the irrigated land. Land with access to irrigation and drainage systems is almost always worth more than land without such access. Landowners pay some proportion of their property value in taxes. The problem with this method is that the treasury generally collects land taxes and the taxes are not transparently linked to the provision of irrigation services. Also valuing and revaluing land demands enormous administrative resources. In some places permanent tax committees have been set up to regularly review and decide upon the basis and rate of taxation.

In-kind contributions. Farmers sometimes contribute labor, materials, or both instead of money to pay operation and maintenance costs. In Vietnam the provincial and national governments finance new irrigation systems up to a command area of 150 hectares. Below this level farmers are responsible for building the channels, although the government provides surveys, designs, and materials in some instances. Once schemes are completed and given to farmers associations, each member must provide up to 20 person days per year to maintain the tertiary as well as secondary systems.

Replacement of assets. A significant cost of irrigation services is depreciation of the assets used to store, transfer, and deliver water to users. Assets range from minor tools and equipment, buildings and housing, motor vehicles and heavy equipment, canals and drains, pumping stations, and sometimes major structures such as dams. In some places, for example Vietnam, cost estimates (and hence of user fees) include depreciation costs. However depreciation costs are usually neglected in calculating the costs of water services regardless of whether irrigation agencies or water users' associations provide irrigation services.

The value of assets declines at different rates: each year owners lose a significant non-cash value as assets depreciate, even with adequate maintenance. Without proper maintenance service life will be shortened, and depreciation will accelerate. Therefore agreements between irrigation agencies and water users' organizations should include standards for operation and maintenance carried out by water users' organizations. In Mexico the hydraulics committee at the district level approves the annual operation and maintenance program proposed by the water users' organizations. Provision is also sometimes made for collecting and retaining disaster funds by water users' associations.

Care of assets is vital if water system performance is to be sustained.[56] Maintenance and ongoing replacement programs for all assets

[56] Increasingly countries are requiring in-kind and cash contributions to pay for capital costs. This helps ensure that designs of irrigation systems are cost effective, and designed appropriately for demand. It also generates a sense of ownership among project beneficiaries.

need to be planned and implemented in an effective and economical manner. It is essential to collect adequate data about the location, age, condition and serviceability of all assets for this. Water users' associations often need training and assistance to prepare an asset inventory and formulate an effective maintenance and replacement program. It may be important to assure that water users' associations' have access to credit for equipment purchases as they assume the responsibility for the assets.

Provide direct links between user fees and services

In some places farmers may be reluctant to pay user fees because they do not see a link between their contributions and the irrigation agency and its services. Often another agency, such as the finance ministry, collects the revenues, ultimately delivering them to the consolidated fund of the treasury. The finance ministry usually allocates funds to the irrigation agencies without linking them to revenues collected.

In the future the money cycle must be made transparent. Determining costs is a first step. It is also essential that the irrigation agency has the autonomy (and the responsibility) to organize irrigation financing (Small, and Carruthers 1991).

Ideally water users' associations collect fees for services provided and manage the lower parts of systems (Subramanian, Jagannathan, and Meinzen-Dick 1997). They are entirely responsible for managing the water system and financing a portion of the irrigation infrastructure. They pay for water delivered in bulk from the agency, which cover the agency's operation and maintenance costs for the parts of the system under its control. Under this arrangement the agency and the water users' organizations agree on mutual rights and responsibilities. Water users' organizations keep transparent accounts and conduct regular audits to show their members that the financial management of the organization is sound. They hold general meetings when members discuss financial performance including the accounts and audits.

If the government manages the system using fees collected from users, water users' associations should still collect the fees. The associations can collect fees at lower cost and apply sanctions to enforce payment more easily than government agents. Experience from the Philippines shows that water users' associations are highly effective if they are organized and have a role and incentive to collect the fees. In India pilot projects in Maharashtra allow water users' associations to retain a proportion of collections as a bonus. As a result fee collection markedly improved. Better fee collection does not solve the problem of high costs of agency provision of services, due to high staff costs.

Annex 25.A1 Water services categories and costs in Haryana, India

In Haryana, India the irrigation department manages water supplies for irrigation, cities, rural villages, industry, and power stations. It also delivers bulk water to New Delhi. The government is implementing a general policy to recover the costs of each of these services from the beneficiaries. The cost recovery plan consists of two steps. First analysts allocate to users as precisely as possible their share of the costs. Second they quantify services either in terms of the annual volume supplied or the area benefiting from drainage and flood control or other services. They use the two factors — cost and quantity — to calculate the unit costs for each particular service (Table 25.A1). The rate factor represents the relative value of bulk water supply to cities, rural villages, industry, power, and cattle ponds, and reflects the priority of services in times of shortage and the customer group's ability to pay. Thus municipalities pay twice as much as rural village consumers, and industries pay four times as much. The figures presented in the table are based on preliminary estimates made during the preparation of the Haryana Water Resources Consolidation Project and are being updated. These figures are used here for illustrative purposes only.

Table 25.A1 Costs of water services in Haryana

	Quantity (millions cubic meters)	Total annual expenditure (millions US$)[a]	Rate factor	New rate (US$/1,000 cubic meters)	New total revenue (millions US$)	Existing rate (US$/1,000 cubic meters)
Bulk water supply						
Urban	330.57	0.32	2	1.76	0.60	0.53
Rural villages	414.45	0.40	1	0.88	0.38	0.53
Industry	211.00	0.23	4	1.76	0.85	0.88
Power plants	160.00	0.15	4	3.38	0.56	2.11
Subtotal	**1,116.02**	**1.11**			**2.38**	
Agriculture						
Bhakra system						
Flow systems	5,666.00	7.48		1.22	6.95	0.40
Lift systems	118.00	0.16		0.62	0.07	0.21
Lift commands	71.50	0.09		1.22	0.09	0.40
Subtotal	**5,855.50**	**7.73**			**7.12**	
Western Jamuna system						
Flow systems	4,530.57	6.64		1.36	6.17	0.37
Lift systems	232.00	0.34		0.68	0.16	0.18
Lift commands	256.50	14.83		53.75	13.79	0.37
Subtotal	**5,019.07**	**21.81**			**20.11**	
Cattle ponds	182.55	0.19	1	0.96	0.17	0.17
Deliveries to New Delhi	413.20	0.38	4	3.46	1.43	
Grand Total	**12,586.34**	**31.22**			**31.22**	

a Projected, based on need.

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