Lesson D3

ECONOMIC INSTRUMENTS IN WASTEWATER MANAGEMENT

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Overview and summary

Economic instruments, such as water tariffs or pollution charges, are an important complement to technical, regulatory, and institutional tools to achieve a sustainable and efficient management of wastewater. Economic instruments use market-based, mostly monetary, measures with the objective to raise revenue to help finance wastewater services, to provide incentives to use water efficiently and carefully, to provide disincentives for the anti-social release of polluted wastewater, to make the polluter pay for the environmental damage done, and to raise awareness on the environmental and societal costs of water use and wastewater discharge. The most common economic instruments used in wastewater management are the pricing of wastewater services and levying of charges for wastewater discharge into the environment. In this lesson, different economic instruments used in wastewater management will be presented. Special emphasis will be given to the various tariff structures that are used to levy wastewater service fees. Tariffs determine the level of revenues that service providers receive from users. They are designed for different purposes, and often contain some elements to address poverty.

1. Introduction

In order to be sustainable, wastewater management does not only have to provide for the protection of human health and environmental, but also has to do this in a manner that is economically and socially feasible in the long-term. Economic instruments, such as service fees and effluent charges can complement the use of institutional, regulatory, and technical tools to foster sustainability in wastewater management.

A basic principle of economic instruments used in environmental management is the “polluter pays principle”. This principle states that anyone whose actions pollute or adversely affect the environment should pay the cost for remedial action. Consequently, activities which are less damaging will incur a lesser cost, and therefore be more economically justifiable. Linked with this principle is also the demand for full recovery of the costs linked to the provision of sanitation services and wastewater management through water users and wastewater dischargers. As explained in lesson D1 supply of wastewater management services is linked with a variety of costs. These costs include investment costs as well as operation and maintenance costs for wastewater treatment facilities and sewerage networks. Furthermore, costs accrue from pollution of surface waters in consequence of discharge of treated (or untreated) wastewater.

The use of economic instruments can help to cover the costs related to wastewater management and provide incentives for the pollution prevention. The following chapter provides an overview on economic instruments used in wastewater management and focuses on the different options for wastewater service fees.

2. Economic instruments in wastewater management

2.1 Objectives

2.1.1 Raise revenues and recover costs

The most obvious reason for using economic instruments, such as wastewater service fees or effluent charges, in wastewater management is the aim to raise revenue for financing service infrastructure or remedial actions for environmental damage. For recovery of costs of sanitation services, the polluter pays principle requires that not only the investment and operational costs of a treatment plant have to be covered, but also the costs that arise from the environmental damage linked with discharge of (treated) wastewater into surface waters.

2.1.2 Set incentives for water conservation and pollution prevention

Another objective of economic instruments is to provide an economic incentive for water users to use water carefully, efficiently, and safely in order to save water resources and prevent pollution. If discharge of wastewater into the sewerage system or the environment is linked with increasing wastewater bills, people might change their behaviour or industrial processes in order to produce less wastewater to save costs. Economic instruments can therefore contribute significantly to demand side management in water management.

2.1.3 Awareness raising and economic efficiency

Economic instruments can also be introduced in order to raise awareness on the relationship between water use and resulting environmental and/or social impacts. In order to attain economic efficiency, prices for wastewater discharge would have to reflect to consumers all the financial, environmental, and other costs that their decision to use water (and produce wastewater) imposes on the rest of the system and the economy.

2.2 Mechanisms

Various economic instruments are being applied in wastewater management with the aim to pursue one or more of the above mentioned objectives:

Pollution charges**:** In many countries charges are imposed for discharge of treated and untreated wastewater into the environment. These charges are mostly levied upon discharge of effluents from treatment plants and industry.

Fees for wastewater services / user charges: Fees or user charges are directly charged to users of wastewater services upon connection to and discharge of wastewater into the sewerage system. For households, volume of discharged wastewater is directly related to the consumption of potable water. Consequently, the fee is usually collected as a surcharge on the water consumption bill. Different regulations could be considered if large amounts of potable water are used for other purposes like irrigating the garden.

As user charges and effluent charges are the most common economic instruments used in wastewater management, these will be further explained in the following chapters. Other economic instruments in wastewater management include:

Indirect local taxes: Local governments may impose indirect taxes to generate revenue directly for the financing of wastewater systems. For example, authorities may recover sewerage investments through surcharges on property taxes. In general, these are levied only on properties with access to the sewer system, in which case the surcharge is actually a variant of the user charge. The limitation of this surcharge is that it depends on the performance of the property tax system, which is usually not (well) developed in low-income countries. In many countries, the money collected from wastewater discharge is not always earmarked for water infrastructure. It normally goes in to the national treasury, and then may be used for other services.

Discharge permits: Discharge permits may also be a tool for controlling pollution and raising revenue. In this approach, a responsible authority sets maximum limits on the total allowable emissions of a pollutant to a sewer or to the surface water. According to this limit discharge permits are issued. In the discharge permit, the charges or levies can be incorporated for cost recovery purposes. Tradable discharge permits can give polluters more flexibility in investment and operation of wastewater management systems.

3. Pollution charges

According to the polluter pays principle, wastewater dischargers should be charged for the environmental and social costs that result from disposing wastewater - such as downstream impacts of sewage discharges. Therefore, pollution charges are often levied by local or national governments on the discharge of water into the environment, i.e. mostly into surface waters. They are usually imposed on operators of treatment plants and industrial dischargers. The charges are generally calculated based on actual quantities and/or pollution loads of the effluent. There is a variety of charging systems into place to determine the pollution charges on wastewater discharge. For treatment plants the pollution charge is often calculated based on the number of inhabitants served by the plant. Further on, charges are calculated based on specific chemical, biological and biochemical parameters determining the pollution load, such as content of phosphorus, nitrogen, biological oxygen demand, heavy metals, etc. Pollution charges are therefore of special interests for industries who discharge wastewater of high pollution loads into sewer systems or directly into nature. High pollution charges will encourage reduction in effluents produced or in-house treatment by industry.

3.1 Pollution Charges in Germany

In Germany, for example, the Effluent Charges Act (Abwasserabgabengesetz, AbwAG) serves to implement the polluter pays principle. Corresponding to the Act, dischargers of wastewater must bear at least a portion of the cost of using the environmental resource water by paying for the point source discharge of (treated) wastewater into a water body. Generally, the payment of effluent charges in no way exempts one from the responsibility of treating wastewater. The charge is calculated according to the amount and harmfulness of the discharged substances, measured in pollution units (Schadeinheiten SE) and is intended to create financial incentives for reducing waste water emissions as far as possible. The effluent charge is paid to the states and these funds are tied to measures for conserving water bodies. The charge per pollutant unit per year has been raised, in several steps, from DM 12 (ca. EUR 6) in 1981 to DM 70 (ca. EUR 35) since January 1, 1997. The table below gives an overview on how pollution units are calculated.

Table 1: Contaminants and pollution units (Schadeinheit, SE)* according to the Effluent Charges Act (AbWAG)

Rated contaminants and contaminant groups	Measurements constituting one pollution unit
Oxidizable substances in chemical oxygen demand (COD)	50 Kilograms Oxygen
Phosphorus	3 Kilograms
Nitrogen	25 Kilograms
Halogen compounds as adsorbable organic halogen compounds (AOX)	2 Kilograms Halogen as organic chlorine
Metals and their compounds:	*In grams metal:*
Mercury	20 grams
Cadmium	100 grams
Chromium	500 grams
Nickel	500 grams
Lead	500 grams
Copper	1000 grams
Toxicity to fish	3000 cubic meters of wastewater divided by the dilution factor GF, by which wastewater is no longer toxic to fish

** "One SE corresponds roughly to the harm caused by the raw waste water produced by one inhabitant in one year (inhabitant equivalence)."*

4. Pricing of wastewater services

Utility services of all types have been, and continue to be, subsidised in many parts of the world. But experience shows that widespread subsidies lead to overuse of water resources, discharge of contaminated wastewater, and subsequent environmental problems. User fees that recover the cost of delivering services, such as wastewater treatment, are an essential part of the solution to this problem. It is generally agreed and widely accepted that users should, in most cases, pay for recurring operation and maintenance costs, while there are varying opinions about whether users should pay for capital costs, too, and if so, what percentage is reasonable, and how might it be paid (cash, sweat equity, smaller payments over time coinciding with crop or livestock market season, etc.). However, full cost recovery from water (see figure 1) users is not feasible or even desirable in all situations, for example for wastewater systems where the majority of users are poor.

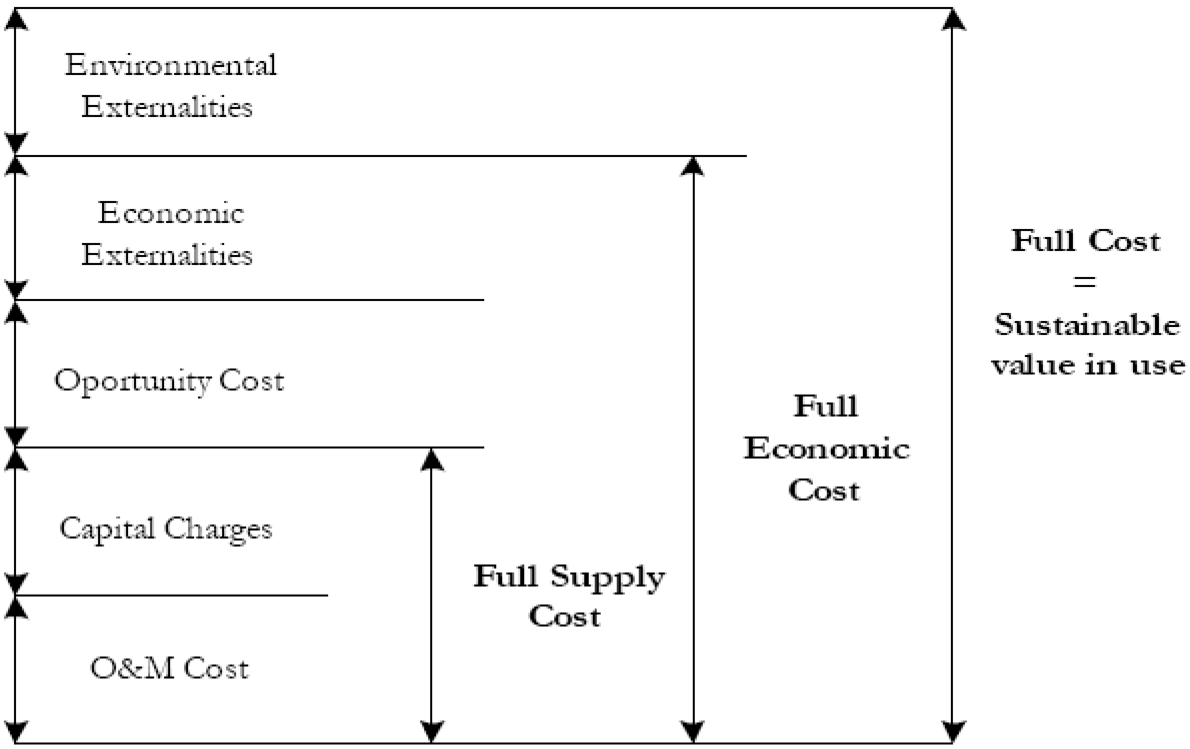

Figure 1: General principles of full cost of water (Source Klawitter 2004)

4.1 Requirements for setting wastewater service fees

When setting prices for wastewater services a range of aspects has to be considered as the goals pursued with setting prices for wastewater services are varied. They can be set either at the service provider level or by national (or local) government.

As mentioned above, one of the major aims is to **recover the costs** of service provision and sometimes also the costs resulting from environmental impact caused by wastewater discharge. The traditional approach to cost recovery considers only the financial costs of a project or programme, such as operations and maintenance (O&M) costs, capital costs and possibly investments for future growth and rehabilitation (which includes accounting for depreciation of assets over time). A wider economic perspective considers, in addition to the financial costs, opportunity and environmental costs (and benefits) to society. These include for example the costs of impacts on environment due to insufficient wastewater treatment and public health costs due to insufficient wastewater treatment. National policy then dictates whether part or all of these costs should be recovered from water users and wastewater dischargers. At a minimum, full supply costs should be recovered in order to ensure sustainability of investment and the viability of service providers. Moreover, the revenue stream should be relatively stable and not cause cash flow or financing difficulties for the utility.

The aims of wastewater charges further include the intention to send appropriate **price signals to users** about the relationship between water use and treatment costs or environmental damage, respectively, in the case of no or insufficient treatment. Price should therefore be high enough to set an **incentive to prevent pollution**, i.e. to discharge less or better treated wastewater.

Further on, some other aspects also need to be considered when setting prices for wastewater services:

- ***Affordability:*** Prices should make access to sanitation affordable for different income groups as lack of sanitation services has major impacts on human and environmental health resulting in negative effects for all members of a society. The price should, therefore, not be too high to drive consumers to unsafe alternatives of wastewater discharge.

- ***Fairness and equity:*** The demand for equity implicates that those who produce more wastewater or wastewater with a higher pollution load also pay more for sewerage and treatment. This usually means that water dischargers pay wastewater bills that are proportionate to the costs they impose on the utility. This would also be in line with the "polluter pays principle". Fairness, however, might require that the wastewater bill does not account for a disproportional large share of a household's total income.

- ***Transparency and feasibility*:** Complete fulfilment of all of the above mentioned objectives of wastewater charges would imply relatively complex tariff systems as well as intricate monitoring mechanisms (including installation, maintenance and reading of different meters). Administrative expenses for billing and monitoring payment should however be kept financially feasible. When designing tariffs (see below) it should be kept in mind that these should also be easy to explain, understand and implement.

Some of theses objectives, however, might conflict with each other. For example the affordability for poor could require low prices, which do not provide for full cost recovery, or measuring of pollution loads in wastewater might not be administratively feasible.

4.2 Tariff design options

In order to balance the varied objectives of wastewater charges, different tariff systems have been developed. A tariff is a system of procedures and elements which determines the customer's total water/ wastewater bill. Any part of that bill can be called a charge, measured in

- money per time (e.g. per month) or
- money per volume or
- money per unit pollution load.

Most tariffs are a combination of elements dependent on consumption or other factors. Usually a connection charge is further put on a customer who joins the public water supply and/ or sanitation systems.

Since water use is easier to observe or meter than is wastewater discharge and the volume of wastewater produced is related to the amount of water supplied, the cost of wastewater treatment is often included in water supply rates or tariffs.
There are different types of tariff systems that can mainly be divided into fixed charges, volumetric charges, and combinations of the both.

- Fixed Charge Tariff
- Constant Volumetric Tariff
- Increasing volumetric tariff
- Block Tariffs
- Two-part tariff (fixed + volumetric)

(Constant Volumetric Tariff, Increasing volumetric tariff, Block Tariffs: } Volumetric charges)

4.2.1 Fixed Charge Tariff

Under a fixed charge tariff structure, consumers pay a certain amount independent of quantity and quality of wastewater produced. In the absence of metering, fixed charges are the only possible tariff structure. This can be the case for example in multi-story apartment buildings where the different renters do not have metered connections to the sewerage systems. The fixed charge itself can vary across households or discharger classes depending on their characteristics. For example there can be different fixed tariffs based on different types of dischargers (industry, agriculture, households, etc.), on property values (size of floor space), number of people living or working in the connected building. Another common approach is to charge different monthly fees depending on pipes' diameters used to connect the customer to the sewerage or distribution system.

The benefits of the fixed charge tariff system lie in its simplicity; however it does not provide any incentives for water conservation and pollution prevention. An Example for a differentiated fixed charge tariff is given in the textbox below.

4.2.1.1 Fixed Charge Tariff in Uganda

In Uganda in 1995, tariffs were set by the National Water and Sewerage Corporation, which had a monopoly over service provision at that time. Water charges included all operations and maintenance costs, depreciation and capital costs and also social equity. As of April 1995, un-metered residential consumers paid flat rates that were based on the number of taps. The table below demonstrates the difference between metered and unmetered connections.

Table 2: Fixed Charge Tariff in Uganda

In Ugandan Shillings: US$1 = 1,050 shillings (1996)

Number of Taps	Amount Shillings
1 Tap	3,696
2-4 Taps	11,088
5-8 Taps	18,480
Over 8 Taps	27,720
Metered (per m3)	616

Source: IRC 2003

4.2.2 Volumetric Tariffs

In contrary to the fixed charge tariff, all of the following tariff systems base the customers wastewater bills on the amount of water used (consumption based charges) or the amount and quality of wastewater produced (effluent charges). All volumetric charges require that the consumer has a metered connection and that this meter works reliably and is read on a periodic basis. As domestic wastewater does usually not vary significantly in pollution load, it is rather uncommon to bill domestic wastewater services dependent on effluent quality. For industrial wastewater, however, pollution load differs widely and is usually considered in their wastewater bill.

4.2.2.1 Constant Volumetric Tariff

In a constant or uniform volumetric tariff, all the users pay the same price per unit of wastewater discharged - independently of the total volume of water used or discharged by the consumer. A constant volumetric charge has the advantage of being easy for the customer to understand.

4.2.2.2 Increasing linear volumetric tariff

In this tariff structure, the price per unit of water discharged increases continuously as the total amount of water used or discharged by the customer increases. Although this tariff is rarely used it is interesting as it illustrates and sends a signal to the consumer that increased water use implicates increased marginal costs.

4.2.2.3 Block Tariffs

Under a block tariff scheme, users step-wisely pay different charges for different consumption levels. With an *increasing* block tariff, the rate per unit of water increases as the total volume of consumption/ discharge increases. Higher rates are set for higher levels of use. Consumers face a low per unit charge up to a specified quantity (or block) and then for any water consumed/ discharged in addition to this amount, they pay a higher price up to the limit of the second block, and so on. An example for an increasing block tariff is given in the textbox below. The main aim of increasing block tariffs is to set an incentive to use less water. Sometimes these tariffs are also called lifeline tariffs or social block tariffs when they aim to address the needs of the poor by providing a basic level of consumption/ sanitation (for example, using the WHO guidelines of 20 litres per day for basic needs) either for free or at very low cost. The marginal costs of providing the service have then to be covered by confronting customers in the highest price block with the marginal cost prices. In many cities, however, the increasing block tariff fails to reach its objective to address the needs of the poor, because the poor often have large families or more than one family shares a connection. This results in high volumetric uses/ discharges at one connection and consequently higher prices.
Block tariffs can also be designed as *decreasing* block tariffs. With these tariffs, on the other hand, consumers face a high volumetric charge up to the specified quantity of the first block, and then for any water consumed/ discharged in addition, they pay less. The idea is to reflect the fact that large consumers often impose lower average costs on the system. However, these tariffs are ever less applied because there is a growing interest in promoting water conservation.

4.2.2.4 Increasing block tariff

In Botswana, the Ministry of Mineral Resources and Water Affairs has been responsible for national water policy since 1993. A pricing system was implemented based on principles of equity, efficiency and cost recovery. Water from standpipes was supplied free, and households with private connections were provided with a lifeline-type tariff for the first 5 m³ consumed. Ranges for consumption were grouped according to bands (blocks) – the table below shows the ranges of consumption and tariffs charged.

Table 3: Increasing block tariff in Botswana

Band	Use per month (m^3)	Tariff (US$ per m^3)
1	0-5	0.16
2	6-20	0.32
3	21-40	0.79
4	>40	1.54

Source: IRC 200

4.2.3 Two-part tariffs

While all of the above mentioned tariffs consist of only one charge, fixed or volumetric, another possibility is to combine them in a two-part tariff. A two-part water or wastewater tariff usually consists of

- a fixed monthly service charge plus
- a volumetric charge that is based on the actual consumption/ discharge.

There are many variations in the way these two components can be put together. For example, the volumetric charge can be a constant volumetric, a linear increasing or block tariff. In many cases, the fixed charge is rather low and serves as a means to recover the fixed administrative costs of service providing that are unrelated to the amount of water consumed/ discharged (such as costs for meter reading, billing, etc.). They can also be used to recover the investment costs of the utility. The revenues from the volumetric part of the tariff are then meant to cover the operational costs related with provision of the wastewater service.

4.2.4 Seasonal and Zonal Tariffs

Another option, though very rarely adopted, to structure tariffs for water and wastewater services are seasonal and zonal tariffs. These tariffs try to reflect the potential differences in costs that accrue with service providing in different seasons or local areas. For example, in the dry season, when rivers carry less water they can probably only receive less or better treated wastewater. Similarly, zonal tariff could reflect the higher costs linked with service in remote or extremely dry areas.

Local differences in costs incurring with water supply service are, for example, also reflected in the different prices (fixed charge tariffs) for water services in Lebanon and Palestine, as described in the textbox below.

4.3 Examples of Water Pricing in the MEDA Region

4.3.1 Water Pricing in Lebanon

The regional water authorities are empowered to set and collect water tariffs for domestic and agricultural use. Subscription fees for domestic water supply vary among the water boards. During the year 2001, tariffs ranged from US$ 44 per year to US$ 153 per year for a 1 m^3/day gauge subscription. Differences are partly due to water availability and distribution costs as gravity distribution is cheapest, while distribution by pumping is far more expensive. In Beirut and the Metn area, where water tariffs are highest, water is conveyed long distances and/or pumped from deep wells. In Bsharre and Dinniyeh, where water tariffs are lowest, water is available from springs and delivered by gravity.

Most households incur additional expenses to meet their water consumption. Assuming households with a 1 m^3/day gauge subscription actually receive and consume this amount of water per day; such households would be paying the equivalent of US$ 0.12-0.42 per m^3 of water. In fact, most households end up paying much more on a per cubic meter basis for two main reasons:

- Frequent and periodic water shortages (some areas report receiving water only a few hours per day) and
- Need to buy water from private haulers, at costs typically around US$ 5-10 per m^3.

As long as water meters are not installed, the price of water will remain unaffected by actual water consumption and people will pay the same amount regardless of the quantity of water actually delivered/ consumed. Users have no incentives to conserve water and wastage is much more common.

4.3.2 Water pricing in Palestine

The Municipalities and regional water authorities set and collect water tariffs for domestic use. Water fees for domestic water supply vary considerably among different localities. Tariffs ranged from US$ 0.15-0.2 to US$ 1.0-1.2. Differences are partly due to the level of services, water availability and distribution costs. In Dura and Ramallah area for example where water tariffs are highest, water is conveyed long distances and/or pumped from deep wells. In Qalqiliya and Jericho, where water tariffs are lowest, water is available in shallow wells (Qalqiliya) and/or springs (Jericho) at low pumping cost.

Some localities in the North and due to frequent and periodic water shortages (some areas report receiving water only a few hours per day) purchase water by tankers. Such localities are paying US$ 5/m3 of the additional purchased water. In some localities also water meters are not installed and the price of water remains unaffected by actual water consumption.

4.3.3 Water Pricing in Turkey

Water pricing activities of Irrigation Districts in Turkey are parallel to that of other organizations. The specific aspects for water pricing in Irrigation Districts can be gathered under the following topics:

1. The expenditures of that year to be determined by an estimated budget before the irrigation season.
2. The application of the tariff according to defined conditions to be based on qualifications of the scheme (under the responsibility of each organization) and region.
3. Making the collection in the same year and deterrence of applied penalties to recover charges, which can not be collected.

Water user organizations have to work with a balanced budget from the standpoint of revenues and expenditures. Therefore they have to determine expenditures of that year for the scheme under their responsibility and form a budget to recover these expenditures. Each association determines its own expenditure budget, which includes all kinds of expenditures necessary for maintenance of schemes and for irrigation management at the beginning of the fiscal year. In this budget, investments for irrigation schemes (machinery, equipment, and construction of new schemes, renewing of schemes) are also included. However, the capital investment cost is not included in O & M charges. Each association determines its would-be irrigable area and crop types using water user information forms and many other methods. Tariff studies prepared using estimated budget and potential irrigation figures, show differences among the water users organizations. Each association uses different methods depending on qualifications of its own scheme and region. These methods can be cited as follows:

Area based
a) Crop based (TL/da) (TL is Turkish Lira)
b) Fixed charge (TL/da)
c) Crop based depending on irrigation times (TL/da)
d) Fixed charge depending on irrigation times (TL/da)

Volumetric
a) Based on water amount consumed (TL/m3)
b) Based on water consumed hourly (TL/m3)

Water Users Organizations use mostly the “area and crop based” tariff method. This type is used mostly in gravity irrigation schemes. In pumped irrigation schemes, the volumetric method is used.

Factors which are taken into account when water user organizations choose a tariff method are:

- method should be easy and practical
- lack of data for calculations
- water charge per unit area is intended to be low.

For more details see the Turkey Country Report 2003

4.3.4 Water Pricing in Cyprus

The Water tariffs methodology used in calculating the required water tariffs for the agricultural and households sectors is described in the Loan Agreements with the World Bank (IBRD) (Government Printing Office 1988) and the Kuwait Fund (KFAED) for the financing of the Southern Conveyor Project, the largest water resources project in Cyprus. The water tariff for agriculture is calculated using the “Present Worth Value” method while for the households sector the “Balanced Budget” method is used.

For more details see:
http://www.uni-muenster.de/imperia/md/content/zufo/binder9.pdf

4.4 Conclusion

The following figures demonstrate the different prices and monthly bills for water/ wastewater services resulting from different single-part tariff structures (assuming that wastewater bills are calculated based on water consumption).

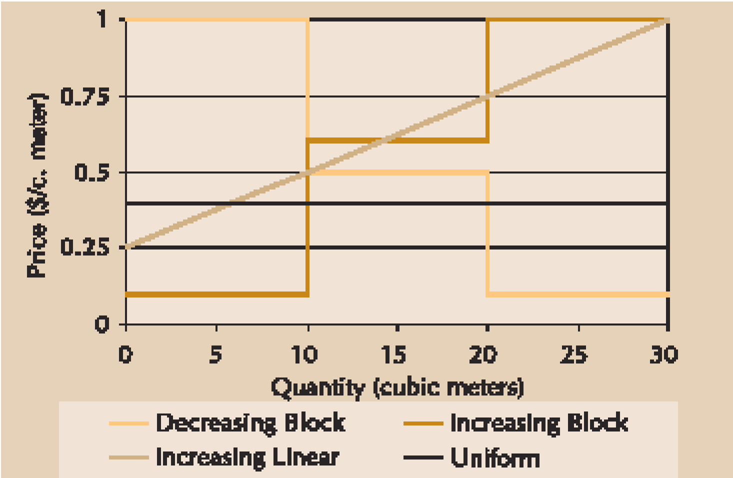

Figure 2: Price of water versus the quality of water used for selected tariff structures *(Source: WSP 2002)*

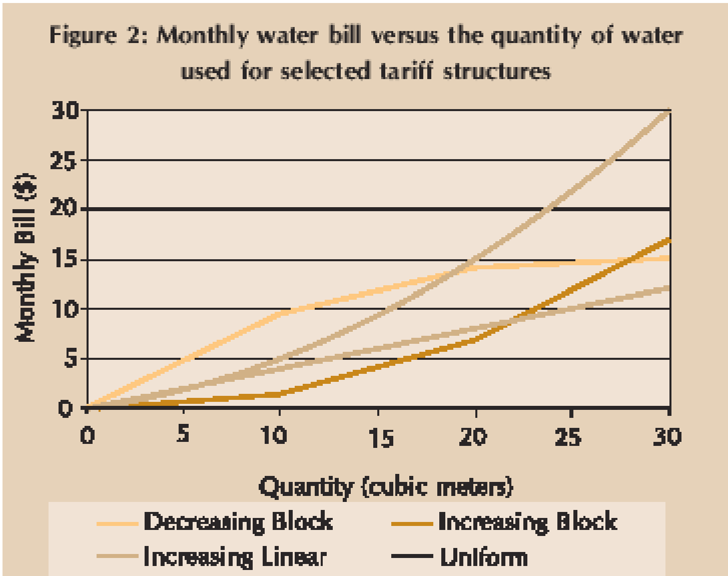

Figure 3: Monthly water bill versus the quality of water used for selected tariff structures *(Source: WSP 2002)*

Tariffs can be designed and prices set by the service provider or the local or national government. There is no consensus on which tariff structure best balances the objectives of the utility, consumers and society. Tariff design that contributes to the achievement of one objective may be detrimental to the achievement of another. In order to resolve this conflict, policy makers need to decide which objective has the highest priority and, where possible, use more than one instrument. Moreover, performance does not only depend on the choice of tariff structure but also on the level the tariff is set. Therefore setting of tariffs is very much a political process and often implicates controversy. The following table gives an overview on the advantages and disadvantages of different tariff structures.

Table 2: Summary of performance of alternative tariff structures against design objectives *(Source: WSP 2002)*

Tariff Structure	Objectives			
	Cost Recovery	Economic Efficiency	Equity	Affordability
Fixed Charge	***Adequate*** Provides stable cash flow if set at appropriate level, but utility may be vulnerable to resale of water and spiraling consumption.	***Poor*** Does not send a message about the cost of use of additional water.	***Poor*** People who use large quantities of water pay the same as those who use little.	***Adequate*** If differentiated by ability to pay, but households are unable to reduce their bills by economizing on water use.
Uniform Volumetric Charge	***Good*** If set at appropriate level, moreover revenues adjust automatically to changing consumption.	***Good*** If set at or near marginal cost of water.	***Good*** People pay according to how much they actually use.	***Good*** Can be differentiated by ability to pay, and people can limit their bills by reducing consumption.
Increasing Block Tariff	***Good*** But only if the size and height of the blocks are well designed.	***Poor*** Typically little water is actually sold at marginal cost.	***Poor*** People do not pay according to the costs their water use imposes on the utility.	***Poor*** Penalizes poor families with large households and/or shared connections.
Decreasing Block Tariff	***Good*** But only if the size and height of the blocks are well designed.	***Poor*** Typically little water is actually sold at marginal cost.	***Poor*** People do not pay according to the costs their water use imposes on the utility.	***Poor*** Penalizes poor families with low levels of consumption.

Historically, user fees are set (after technical analyses) without the involvement of those affected. However, **willingness to pay** is not a fixed item that experts can extract from historical data, but a complicated set of preferences and concerns that are only fully sorted out during a participatory process. Participation in setting charge rates can increase willingness to pay, because of an improved understanding of the benefits of wastewater treatment or an increased confidence that services will actually be delivered.

4.5 Subsidies

Some of the failures of tariff systems, especially in providing affordable services for the poor while recovering costs, can be compensated by subsidies. It is generally agreed that in poor areas of middle and low income countries, subsidies are necessary to cover basic amounts of water usage and basic levels of sanitation service for poor customers. Sanitation services may be more natural candidates for subsidies than water services, as the willingness to pay for such services is often lower than for water services, and the wider social benefit in terms of both public health and surface water quality provide an economic rationale for subsidisation.

There are different types of subsidies that achieve different purposes. Government subsidies can for example either be paid directly to the customer (demand side subsidies) or to the utility (supply side subsidies). If government finance is not an option cross subsidies can be used, where some groups of customers are charged more than the true costs of service provision, and this surplus is used to cover less expensive service provision to poorer groups (as in block tariff systems). Another possibility is to apply a uniform surcharge, of say one or two percent, on all customers' bills and use these resources to finance any subsidies deemed necessary. Some types of subsidies might be better than others, depending on the type of project, tariff structures, and other preconditions.

However, research has shown that subsidies should rather be used to promote access to basic water and sanitation services rather than providing ongoing support for consumption. One of the reasons for this is that it is often the initial, relatively high cost of getting connected to the network that prevents poor people to benefit from water or wastewater services. Their willingness and ability to pay for the regular service fees are usually much higher.

5. Effects of water pricing policies

5.1 Direct effects

First of all water tariffs and charges convey a signal to water users on the value of water. As long as water and waste water treatment do not cost anything or the price is negligibly low or charges are included into general taxes, the notion of water as a public good that must be accessible to everybody in whatever amount one may want to use will persist. But if the water user can see that for example using freshwater for gardening in summer makes the bill go up significantly he will start reconsidering whether a fresh-green lawn is really a must during the hottest summer months. While the freshwater for gardening is not the main problem of developing countries, the principles of consumers' state are comparable.

This change in consumers' state of mind is urgently needed, as water is unfortunately scarce, environmentally damaged and is not economically cheap. Explicitly, incentives for water conservation are given by metering, volumetric charges, increasing block-tariffs and a move towards Full Cost Recovery as these instruments lead to a better reflection of marginal costs in water prices. The same is true for pollution charges. The reduction of discharges of polluting substances is rewarded by lower prices. If these charges are increased, pollution damage is reduced and/or those who are harmed by discharges are compensated.

Minimum charges, significant fixed elements, flat fee tariffs and prices below cost recovery on the other hand may prevent water users from getting a signal on the value of water. Also the coverage of water costs through general taxation revenues (as is the case i.e. in Ireland) and charging of irrigation water per surface (as is practised in i.e. the southern countries of the EU) act as disincentives. They water down the conservation message pricing can convey because unnecessary consumption is not reflected in the water bill. Such methods can even promote high consumption. This is like having paid for a huge ‘all you can eat’ buffet and then only eating a slice of dry bread. Hardly anybody would do that but everybody would try to get as much food as possible for his money. For example the calculation of prices for irrigation water in Spain in proportion to the hectares irrigated together with the very low prices paid acts as a disincentive for any improvement in efficiency, such as for example the installation of new irrigation technology which is of course linked to investment. But what is astounding is the fact that big changes in the way farmers produce their crops may not even be necessary to reach a certain gain in efficiency. Considerable amounts of irrigation water are lost due to evaporation because of the time of day chosen for irrigation. There is thus a waste of water occurring just because water users are not aware of the fact that water has a value. This waste would immediately stop after the introduction of a feasible price for irrigation water because only minor changes in management and technology would be necessary to reach a big change for the environment. Nothing would even have to change for the farmers or for society. Apparently it is thus possible for farmers to react to the introduction of a comprehensive pricing scheme with a reduction in water demand without even changing their crop patterns or production method left alone giving up their business. Just by increasing efficiency and avoiding leakage they can keep their water bills from going up. This valuable opportunity for water saving without farreaching changes in the existing system should not be squandered.

Domestic water consumption can also be directed in the right way by water pricing schemes. For the CEEC countries considerable increases in real prices are reported after dramatic reductions of subsidies and this is proven to have significant effects on domestic per capita water consumption. For example in Hungary consumption has fallen between 1986 and 1997 from 154 lhd to 102 lhd (lhd= litre per head per day) after large real price increases. Available data also shows that domestic water consumption decreases after introduction of metering. However a certain threshold can be determined up to which price increases do not affect consumption levels. The best responsiveness of household water demand is reported for 'peakpricing' practises, meaning that there are temporal variations in the price, according for example to general higher consumption in the summer. Unfortunately this possibility is hardly ever used. There are reported cases though, such as in New York where the imposition of a premium summer seasonal tariff was able to reduce the peak day ratio by 14 %. (Roth 2001)

5.2 Indirect effects

Indirect effects of water pricing are primarily secondary effects resulting for example from demand responses of users to water prices. This can be for instance the conservation of wetlands or the possibility to avoid the construction of new infrastructure. The considerations can be divided into three aspects dealing with society, economy and the environment.

5.2.1 Indirect effects on society

As already mentioned above, the attempt to create a cost covering water price might lead to equity problems. As man needs a certain volume of water for sheer survival, the increase of water prices above a certain level can mean severe hardship for the less well-off. Nonetheless a really adequate pricing policy can solve these possible problems, as it will combine the achievement of environmental objectives with an increase in social equity. Regional differences in the water price due to the internalisation of environmental externalities represent another inequality. Thus equity can be affected by Full Cost Recovery pricing, but this is not really a problem of the principle itself but more of the way of its implementation.

Another possible negative effect of water pricing on society is, that as water prices rise, certain enterprises (industrial as well as agricultural) especially smaller ones might face profitability problems. While bigger firms can even out losses by installing technology to save water or avoid polluting effluents. Especially in the agricultural sector this can cause high losses to society as smaller farms are often family owned which gives them considerable social value.

Even if jobs would be lost due to profitability problems as described above, the rising demand for water saving technology will drive innovation and the creation of new jobs.

This might not be an immediate solution for rural areas. In the long run it might solve the problem though.

Furthermore the social costs accruing generally from end-of pipe solutions for pollution problems have to be considered. The investment necessary for the construction of waste water treatment plants and canalisation burdens society with costs that could be reduced if pollution would be met at the source.

5.2.2 Indirect effects on the economy

The resource water is often used inefficiently, which, as outlined above, constitutes a loss to society. Progressive water pricing policy however leads to the best allocation of the existing supply-volume. Thus it assures the best possible social welfare. Economical water users have to make sure they do not waste any water or create more than minimal pollution, as they would otherwise face high costs. Thus for example factories and irrigators have to find ways to modernise their equipment. Innovation in the branches making the necessary technology available will be a consequence and will involve the creation of new jobs if such technologies ar not only imported.

5.2.3 Indirect effects on the environment

The described efforts for more efficient water use will put an end to the over-exploitation of aquifers and the entailed destruction of wetlands. Problems of eutrophication and pollution with hazardous substances could be addressed preventively. The turn from end-of-pipe solutions to preventive and production integrated measures would bring about a whole range of possible positive effects on the environment. As less water would be used, less infrastructure for water supply would be needed. Furthermore there would no longer be a necessity for water transfers from one region to another due to excessive water use in certain areas, mainly for irrigation purposes.

Nevertheless it has to be mentioned, that not every effective solution in one region can be transferred or copied to another region without adapting it to the specific regional situation!

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