Water Pollution Control - A Guide to the Use of Water Quality Management Principles
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P*ublished on behalf of the* United Nations Environment Programme, the Water Supply & Sanitation Collaborative Council and the World Health Organization by E. & F. Spon

ISBN 0 419 22910 8

Chapter 6* - Economic Instruments

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6.1 Introduction

In 1972 the Organisation for Economic Co-operation and Development (OECD) adopted the polluter-pays-principle. This principle, which was later adopted as official policy by the European Union (EU), expresses the central notion of environmental economics, i.e. that the cost of pollution should be internalised. Since the principle was introduced it has been extended to include resource use and, thus, the polluter and the user should pay (OECD, 1994b). The introduction of the polluter-pays-principle has also stimulated growing interest world-wide in applying economic instruments. When properly applied they have, in theory, the potential for encouraging cost-effective measures and innovation in pollution control technology. Moreover, water quality is one of the few environmental policy areas where economic instruments already play a significant role in OECD countries and in transitional economies. The purpose of this chapter is to review the most commonly used economic instruments for controlling water pollution, to highlight practical considerations in applying them to water pollution, to suggest criteria for selecting the most appropriate instruments, and to discuss implications for applying them in developing countries and in transitional economies that do not already use them.

6.2 Why use economic instruments?

Economic or market-based instruments rely on market forces and changes in relative prices to modify the behaviour of public and private polluters in a way that supports environmental protection or improvement. They represent one of the two principle strategic approaches to pollution control. The other main approach is regulatory, often referred to as "command and control" (CAC). Regulatory tools influence environmental outcomes by regulating processes or products, limiting the discharge of specified pollutants, and by restricting certain polluting activities to specific times or areas. Another means of influencing polluter behaviour is through persuasion. In the case of polluting industries, this approach may involve voluntary agreements to undertake pollution control measures. In the case of consumers, it may involve public education and information campaigns to influence patterns of consumption and waste disposal. This approach is applied in countries such as The Netherlands, Japan and Indonesia.

Since the inception of environmental policy in most industrial countries, governments have tended to use these instruments as their main strategy for controlling pollution. Many countries, however, are becoming aware that regulatory instruments are inefficient for achieving most pollution control objectives, and that the level of expenditure required to comply with increasingly stringent environmental laws and regulation is becoming a major cost of production. In the USA, for example, the US Environmental Protection Agency (EPA) estimates that the proportion of Gross National Product (GNP) devoted to environmental protection can be expected to grow from 1.7 per cent in 1990 to nearly 3 per cent by the year 2000, and that most of these costs will be borne by the private sector (US EPA, 1991). An increasing number of governments are, therefore, investigating alternative mechanisms to achieve the most cost-effective means for controlling pollution that will not place excessive financial burdens on businesses and individuals, and that will not undermine economic development.

In contrast to regulatory instruments, economic instruments have the potential to make pollution control economically advantageous to commercial organisations and to lower pollution abatement costs. They can be applied to a wide range of environmental problems and can involve varying degrees of incentives, information, and administrative capacity for effective implementation and enforcement. The principal types of economic instruments used for controlling pollution are:

- *Pricing.* Marginal cost pricing can reduce excessive water use and consequent pollution as well as ensure the sustainability of water treatment programmes. Water tariffs or charges set at a level that covers the costs for collection and treatment can induce commercial organisations to adopt water-saving technologies, including water recycling and reuse systems, and to minimise or eliminate waste products that would otherwise be discharged into the effluent stream. In Thailand, for example, many hotels along the country's eastern coast are treating and recycling their water for landscape irrigation because the cost of freshwater now exceeds the cost of treatment (Foster, 1992). Before considering the use of other instruments in environmental policy, it is advisable for countries to evaluate their water pricing policies because such policies can encourage over-use and water degradation.

- *Pollution charges.* A pollution charge or tax can be defined as a "price" to be paid on the use of the environment. The four main types of charges used for controlling pollution are: (i) effluent charges, i.e. charges which are based on the quantity and/or quality of the discharged pollutants, (ii) user charges, i.e. fees paid for the use of collective treatment facilities, (hi) product charges, i.e. charges levied on products that are harmful to the environment when used as an input to the production process, consumed, or disposed of, and (iv) administrative charges, i.e. fees paid to authorities for such purposes as chemical registration or financing licensing and pollution control activities.

- *Marketable permits.* Under this approach, a responsible authority sets maximum limits on the total allowable emissions of a pollutant. It then allocates this total amount among the sources of the pollutant by issuing permits that authorise industrial plants or other sources to emit a stipulated amount of pollutant over a specified period of time. After their initial distribution, permits can be bought and sold. The trades can be external (between different enterprises) or internal (between different plants within the same organisations).

• *Subsidies.* These include tax incentives (accelerated depreciation, partial expensing, investment tax credits, tax exemptions/deferrals), grants and low interest loans designed to induce polluters to reduce the quantity of their discharges by investing in various types of pollution control measures. The removal of a subsidy is another effective tool for controlling pollution. In many countries, for example, irrigation water is provided free of charge, which encourages farmers to over-irrigate, resulting in salinisation and/or water logging.

• *Deposit-refund systems.* Under this approach, consumers pay a surcharge when purchasing a potentially polluting product. When the consumers or users of the product return it to an approved centre for recycling or proper disposal, their deposit is refunded. This instrument is applied to products that are either durable and reusable or not consumed or dissipated during consumption, such as drink containers, automobile batteries and pesticide containers.

• *Enforcement incentives.* These instruments are penalties designed to induce polluters to comply with environmental standards and regulations. They include non-compliance fees (i.e. fines) charged to polluters when their discharges exceed accepted levels, performance bonds (payments made to regulatory authorities before a potentially polluting activity is undertaken, and then returned when the environmental performance is proven to be acceptable), and liability assignment, which provides incentives to actual or potential polluters to protect the environment by making them liable for any damage they cause. This chapter only addresses fines because they are the most commonly used enforcement incentives, particularly in the area of water pollution control.

Although economic instruments have several advantages over direct regulation, applying them to pollution control does not, and should not, preclude the use of regulatory instruments. In most cases, economic instruments supplement the existing regulatory framework, with ambient standards remaining the objectives for both. By selecting the right mix of regulatory and economic instruments, and in some cases other types of instruments such as property rights or educational approaches, policy makers can combine the positive elements of both approaches.

The main advantage of the regulatory approach is that, when properly implemented and enforced, regulation affords a reasonable degree of predictability about how much pollution will be reduced. In theory, the advantages of economic instruments are:

• They allow commercial organisations and individuals to respond flexibly and independently in line with market prices in order to meet environmental management objectives at the least cost.

• They provide a continuing incentive for commercial organisations to reduce pollution and therefore to develop and adopt new pollution control technologies and processes to minimise waste.

• They have the ability to raise revenue (in the case of charges) in order to finance pollution control activities.

- They accommodate the growth of existing industries and the entry of new ones more than would otherwise be possible under a regulatory approach.

- They reduce compliance and administrative costs for both government and industry. For example, the use of environmental taxes or tradable permits eliminates the need for government certification of production processes and technologies. They also eliminate the government's need for large amounts of information to determine the most feasible and appropriate level of control for each regulated plant or product.

The advantages of economic instruments offset the main drawback of the regulatory approach, i.e. regulatory tools can be economically inefficient and excessively costly to implement. For example, under the regulatory approach, all commercial organisations would be subject to the same emission standards regardless of their pollution abatement costs. Ideally, only the larger polluters would install pollution control equipment; the large scale of their operations makes the cost of pollution control per unit of output lower than that for small-scale polluters. The regulatory approach also tends to discourage innovation in pollution control technology. It gives little or no financial incentive to organisations to exceed their control targets. This is a particular disadvantage where the development of a new control technique could be subsequently held as the future standard but without allowing any opportunity to benefit from the innovation. Moreover, compliance in most cases depends on the enforcement capacity of the regulatory agency and the number of organisations or individuals being regulated. The greater the number of organisations or enterprises to be regulated, the more difficult it is to enforce the regulations properly. Economic instruments, by contrast, are better suited to a larger number of point and non-point sources of pollution.

While economic instruments can be more cost-effective than regulatory instruments and more appropriate for dealing with numerous point and non-point sources, the economic or market-based approach to pollution control also has its own drawbacks. The major weaknesses of economic instruments are:

- Their effects on environmental quality are not as predictable as those under a traditional regulatory approach because polluters may choose their own solutions.

- In the case of pollution charges, some polluters opt to pollute and to pay a charge if the charge is not set at the appropriate level.

- They usually require sophisticated institutions to implement and enforce them properly, particularly in the case of charges and tradable permits.

In addition to these drawbacks, both government agencies and individual polluters have resisted the introduction of economic instruments. Regulatory agencies, for example, have objected to them largely because they afford them less control over polluters. Industry and other polluters have resisted them because they feel that they have greater negotiating power over the design and implementation of regulations than they do over charges. Industries also view economic instruments as additional constraints (where they supplement existing regulations). For example, charges impose a financial burden beyond the cost of complying with regulations. A further deterrent to using economic instruments is their, often complicated, implementation requirements. The main

difficulties relate to setting prices for environmental resources and estimating the full extent of environmental damage.

6.3 Applying economic instruments

Despite the general resistance of countries to using economic instruments in environmental management, water pollution control is one of the few environmental policy areas where they have played a relatively significant role. Charges for the collection and treatment of water are well established in most industrial countries. In many countries, charges also are applied to polluters who discharge their effluent directly into open water. In addition, combinations of direct regulation and economic instruments, particularly charges, have produced positive results in terms of revenue raising and pollution control.

The remainder of this section discusses how specific instruments are used in controlling water pollution. Among these instruments, water pricing, effluent charges, user charges, and subsidies are the principal economic instruments used in this respect by both industrialised and developing countries.

6.3.1 Pricing

Water pricing policies can be an effective tool for reducing pollution; not only by promoting water conservation, but by raising funds to support pollution control programmes. Mexico City, for example, has increased the price for industrial water consumption. This has discouraged the establishment of water intensive industries in the Mexico City Metropolitan Area (MAMA) and encouraged water conservation by making recycling an attractive proposition. It has also promoted the use of water saving technologies (World Bank, 1994). As has been demonstrated in Mexico City, where wastewater standards are defined in terms of pollutant concentrations, pollution charges and standards should be co-ordinated carefully with water prices to ensure effective pollution control. If water prices are low, polluters can meet the standard by dilution - leading to higher water use without reducing the overall pollution load.

6.3.2 Effluent charges

Several countries apply effluent charges in order to finance necessary measures for wastewater collection and purification, and to provide financial incentives for reducing discharges of effluent. The charge can be based either on the actual quality and quantity of wastewater (determined through yearly or more frequent monitoring by the responsible administrative body or through self-monitoring by the polluter), or on a substitute based on information on the output, treatment levels and number of employees within an organisation. In some cases, a flat rate is charged. Successful implementation of a charge system depends on four key factors (OECD, 1991):

- Recognising the fundamental characteristics of the environmental problem.
- Choosing a competent authority to legislate, implement, and monitor the tax.
- Establishing a suitable tax base.
- Setting an appropriate tax rate.

The experience of most of countries applying water effluent charges, e.g. France, Germany, Italy, and Central and Eastern European countries, indicates that charges are set far below the level required to induce polluters to reduce their discharges, although they do raise revenue for pollution control purposes. By contrast, in The Netherlands, the water effluent charge, which was designed as a tool for revenue raising only, has also served as an incentive because of the high charge rates. The Netherlands also adopted the following approach to reduce the need for large amounts of information to assess the fees to be charged:

- Households and small industrial polluters producing less than 10 pollution equivalents (pe) are not charged for the actual pollution they cause. Having relatively few opportunities to limit discharges, this category of polluters is of minor importance to the instrument's regulating power. The great benefit is that this allows the executive bodies to reduce drastically the amount of information required. Fixed rates are used instead.

- Charges for medium-sized polluters (10-100 pe) are not based on samples of their effluent but according to a coefficient table prepared by experts. This permits the probable amount of pollution to be estimated accurately for each branch of industry or sector on the basis of easily obtainable data, such as the amount of water used by the production plant and the amount of raw materials it processes. Nonetheless, the incentive to reduce pollution remains intact. Companies that believe they are overrated on the coefficient table can request their effluent to be sampled and then charged on the basis of the results (Braceros and Schuddeboom, 1994).

As demonstrated by effluent charge systems in numerous countries (Box 6.1), these systems are most successful when combined with regulation, when applied to stationary pollution sources and when marginal abatement costs vary amongst polluters (the wider the variation, the greater the cost-saving potential). Other determinants of success are the feasibility of monitoring effluents (either by direct monitoring or proxy variables), the ability of polluters to react to the charge, the ability of pollution control authorities to assess appropriate fees, and the potential for polluters to reduce emissions and to change their behaviour. Russia's pollution charge system demonstrates how administrative weaknesses can undermine environmental effectiveness (Box 6.2).

In Mexico, an effluent charge is directly tied to regulation, but its design and implementation could also be improved. The Federal Water Charges Law in Mexico establishes water pollution charges applicable to all discharges to national waters that exceed the applicable standard. The charges are based on volume of flow, discharges of conventional pollutants (suspended solids and chemical oxygen demand (COD)), the costs of pollution abatement and regional water scarcity. The charge, however, does not take into account the effluent's toxicity or the quality of the receiving body of water. The objective of the pollution charge is to encourage organisations to comply with effluent standards, and only those organisations that do not comply are subject to a charge. Those that do not comply but have a plan to control emissions can obtain an exemption for up to two years. The tax base has three components: the excess of COD emissions above the standard, the excess of suspended solids emissions above the standard and a volume component. The volume component is applied whenever the organisation is in violation of any of the pollutants for which it is subject to a standard, even when that organisation is in compliance with COD and suspended solids. For each of these three components, there are charges that depend on the zone in which the firm is located.

Box 6.1 Examples of effluent charge systems

Brazil

In Brazil, four States are experimenting with effluent charges in the form of an industrial sewage tariff based on pollutant content. Although the formulae adopted to define the tariff levels vary among States, cost recovery is the objective in all cases. In the State of Rio de Janeiro, the local environmental protection agency Fundaçao de Tecnologia de Saneamento Ambiental (FEEMA) is responsible for tax collection. It is creating an effluent charge to be approved by the State government. The charge will be levied on all polluters and will be based on the volume and concentration of the effluent, including BOD and heavy metals. Tariff rates will be calculated to recover the budgetary needs of the State agency. In the case of Rio de Janeiro, the budget of the state agencies is so low, at present, that the administration relies on revenue raising approaches to fulfil its funding requirements. Revenues are usually distributed for such functions as pollution abatement, financing of administrative costs, monitoring enforcement and educational campaigns.

France

To manage its water resources and to halt or reduce growing river pollution, the French government decided in 1964 to apply economic instruments to supplement its regulations. At the same time, the planning and financing water management responsibilities of the country were devolved to new operational agencies, i.e. river basin committees and water agencies. These institutions, created in the six river basins, play an essential role in water planning and controlling domestic and industrial pollution. The creation of these agencies made it necessary to take a consistent approach to pollution so that charges could be established on the basis of a small number of clearly defined variables. Initially the basis for the fee consisted of two variables: the weight of suspended matter and the weight of organic matter. Both were considered priorities, representing the most visible type of pollution, and the means to tackle them were also known. Much later, when new pollution variables began to cause concern or when techniques for evaluating and eliminating them became available, the basis for assessment was gradually extended (e.g. to include salinity, nitrogen, phosphorous, halogenated hydrocarbons, toxic and other metals). In each case, the aim was to use charges as an incentive to reduce pollution caused by the variable in question and to avoid charges being transferred to users who are not responsible for increased levels of pollution. The rates are set by each agency board and approved by the corresponding river basin committee. Their values are determined in such a way that the income from charges balances the financial assistance provided, while avoiding excessive discrepancies between charges to the various charge payers. The charge is also a source of information about users' activities, offering more precise knowledge of how water is used and a better understanding of the natural environment. The quantities of pollution discharged by a user, which is impractical to measure for each one, are assessed at a flat rate according to a national scale based on the type of activity (in the case of industry) or number of inhabitants (in the case of urban centres). The amount of pollution produced by a particular industrial establishment is measured only at the operator's or agency's request. When this occurs, measurements are taken by a laboratory approved by the agency and the costs are borne by the party making the request. The agencies also are authorised to promote measures to conserve water supplies. In addition to the pollution charge, therefore, a charge is levied on the basis of the volume of water taken by each user. Charge payers may choose between a flat-rate assessment of the volume of water they use and metering (the income from this type of charge is generally much less than the income from pollution charges). The law gives agencies a dual role in promoting water protection in their particular river basin, providing financial assistance for works of common interest and conducting studies and research in water-related matters. In the same way, polluters are taxed when their activity is harmful to the environment and polluters

receive an award, in the form of subsidies, when their actions are beneficial to the environment.

Germany

The German Effluent Charge Law authorises States to levy charges on direct discharges of specified effluents into public waters. Commercial organisations and households discharging into municipal sewerage facilities are not charged directly. The pollutants considered for the purposes of effluent charges are settleable solids, COD, cadmium, mercury and toxicity to fish. In setting the charge base, the law established the right to discharge and includes all of the physical, chemical and biological data and monitoring procedures pertaining to wastewater quality. For each organisation, the State also specifies a total discharge based on historical volumes of wastewater allowable per year. Since the effluent charge is combined with a permit procedure, the maximum effluent level is also specified. The actual effluent discharged by the organisation must be of a quality equal to, or higher than, the minimum requirements laid out in the regulation. The taxable base is specified in terms of concentration per cubic meter of discharge volume or per tonne of product produced. An organisation's discharge is then converted into damage units using coefficients provided in the law. The tax liability is determined by multiplying the number of damage units by the tax rate per damage unit. This tax rate is revised annually based on an established increment. To provide an incentive to limit pollution loads, higher charges are imposed per damage unit if organisations exceed the permit limit. These excesses are allowed only twice a year. Lower Charges per damage unit are used to compute the total tax liability for those who discharge below permit limits.

Korea

The emission charge system combines elements of regulation and market-based incentives and applies to both air and water discharges. The charge is applied to organisations who are operating facilities that do not meet emission/effluent standards. The charge rate, however, is not directly linked to the level of excess discharges, nor is there an upper limit on the amount of the levy. In practice, however, charge rates have sometimes been set lower than the operating costs of a pollution treatment facility and so organisations have been known to under-use their treatment plants at the risk of being detected and fined. Another limitation of the system is that it does not encourage over attainment.

The Netherlands

The charge on water pollution can be imposed on everyone who emits waste, polluting or noxious substances directly or indirectly into surface water, or into a collectively-used water purification plant. The charge can be levied by public authorities or by Water Boards, i.e. non-governmental bodies governed by councils in which affected interests are represented. The charge can be based on the quantity and/or quality of the pollutants. In practice, the charge is applied to discharges of oxygen consuming substances and heavy metals (only for emissions into non-State waters). Both kinds of pollution are expressed in so called "population equivalents" (pe). The number of pes for households and small enterprises is fixed by the authorities. The emissions of larger organisations are assessed by means of a table of emission coefficients, or can be measured individually. Only in the latter case is an incentive effect to be expected. The water pollution charge has primarily a financial purpose; it is intended to finance the costs of water purification. The charge rate for authorities is relatively low because the State does not exploit its own water treatment plants. Apart from being an important source of finance for water purification plants, the water pollution charge also has had a strong incentive effect. In the 20 years since its existence, both the quality of water and the number of treatment plants have risen considerably.

Sources: Hahn, 1989; Cadiou and Duc, 1994; Freitas, 1994; O'Connor, 1994

Box 6.2 Administrative problems in Russia's pollution charge programme

In 1991-92, Russia adopted pollution charges for air emissions, water effluents and waste disposal. The rates were determined on the basis of maximum permitted concentrations and reflected the desire to mitigate environmental health and other pollution risks. Although, initially, the charges were intended to induce optimum pollution levels, charge rates were calculated to generate enough revenues to finance critical projects, such as the construction of water treatment facilities and the clean-up of hazardous waste sites. Within this context, the charge system worked to the satisfaction of national and local authorities. However, several administrative weaknesses in the programme undermined its capacity to encourage effectiveness in changing polluting behaviour. These weaknesses can be summarised as follows:

- The lack of an appropriate system (equipment, methods, personnel) for monitoring discharges.

- Inadequate equipment and expertise of inspection personnel responsible for identifying and punishing violators.

- Inability to enforce the collection of charges due to uncertainty and contradictions in the legislation.

- Absence of a clear assignment of responsibility between the federal and territorial levels.

- Absence of clear regulations spelling out how to distribute environmental costs among polluters, the federal and regional budgets, and the federal and regional environmental funds.

- Unresolved questions regarding economic liability for environmental damage resulting from an enterprise's previous and current technologies.

- Insufficient institutional support, including a lack of special staff training and a special implementation programme.

- Excessively complicated charge systems, partly because of the inclusion of hundreds of types of pollutants and the need to calculate precise charges.

- Erosion of the pollution charges by inflation. The 500 per cent increase in charge rates in 1992 was insufficient to offset inflation.

Nevertheless, the pollution charge system has become the cornerstone of environmental protection programmes in Russia. Since 1992, agreements between polluters and the environmental protection authorities have created the legal basis for the collection of charges. Such agreements specify the permitted level of discharge, base rates and penalty rates for each pollutant discharged, as well as the schedule of charge payments.

Source: National Academy of Public Administration, 1994

In practice, the implementation and impact of Mexico's effluent charge have been very limited. The total revenue collected from the charge in 1993 was only US$ 5.6 million, a very small proportion of the potential revenue. Just for one region, the potential tax yield is estimated to be US$ 35 million and would induce a pollution abatement of more than 70 per cent (World Bank, 1994). Although Mexico's water pollution charge is a positive initiative, its design and implementation can be improved in two ways. Firstly, separate

charges for suspended solids are not necessary because the abatement of other substances (e.g. COD) normally leads to a relatively high abatement of suspended solids. Secondly, the volume component could be removed because it provides an incentive to increase pollutant concentrations because it is the largest component when estimating the pollution charge. Additional ways to improve the charge would be to include charges for heavy metals and to exclude suspended solids, as well as to vary the charge according to the quality of the receiving water body.

Although effluent charges are among the most commonly applied economic instruments, experience in many countries indicates that they are often set at too low a level to act as an effective deterrent to pollution. Most polluters prefer to pay the charge rather than to change their polluting behaviour. Consequently, the principal function of most effluent charge systems is to raise revenue. In several countries where charges are widely applied (e.g. China, Japan, Indonesia, Korea, Poland, Russia, Thailand), governments deposit revenues from pollution charges and taxes into environmental funds that provide loans and grants to municipalities or to local enterprises for the purchase of abatement equipment and the introduction of clean technologies (Box 6.3).

Box 6.3 Examples of environmental funds

China
To help bring industrial pollution under control, a revolving loan fund was established that provides below-market financing for pollution control efforts by local, mostly small and medium size enterprises. The loans are financed by proceeds from waste discharge fees. The basic fee is charged for releases up to a specified concentration, above which a penalty fee is imposed. The funds are administered by the provincial or municipal environmental protection bureau and directed by a board of representatives from the local economic planning, finance and environmental bureaus. To qualify, the industrial enterprise and target pollutants must be listed as part of the area's pollution control strategy. Loans are extended for 50-80 per cent of project costs; grants are for 10-30 per cent of costs.

Korea
The Environmental Pollution Prevention Fund is financed, in part, from Government contributions and, in part, from fines (or pollution charges) levied on organisations found to be exceeding emission standards. The fund, which was established in 1983, is administered by the semi-governmental Environmental Management Corporation. The resources for the fund are used to provide long-term, low-interest loans for pollution control investments, as well as to compensate pollution victims.

Thailand
In October 1991, Thailand launched an Environmental Fund with an initial capital contribution by the Government of roughly US$ 200 million. Partial grants and low interest loans from the fund are made available to municipalities, sanitary districts and private businesses which are required to set up treatment facilities. The city of Pattaya is the first to use this fund for its central wastewater treatment plant.

Indonesia
A Pollution Abatement Fund was established to provide US$ 300 million to banks to finance loans to companies investing in pollution control equipment or hiring environmental consultants.

Poland
The national environmental fund finances most environmental investments. Sources of revenue

for the fund include air and water pollution charges, water-use charges and waste charges. The funds are allocated through grants and interest-free (and other soft) loans to support air and water pollution control as well as for other environmental management purposes (soil protection, monitoring, education).

Russia

According to a regulation issued in June 1992, environmental funds should apply their revenues from pollution charges to a wide variety of environmental activities. Among other uses, they can be applied to implement regional and inter-regional projects for: improving environmental and human health, conducting research and designing projects in the areas of pollution control, clean-up and treatment; to support enterprises, research and development organisations and individuals that introduce environmental-friendly equipment; to the design of computer systems for environmental monitoring; and to construct or share in the construction of treatment and other protective facilities. A World Bank loan to the Russian Federation is supporting the establishment of a National Pollution Abatement Facility (NPAF) which will fund economically and financially viable pollution abatement projects.

Source: Lovei, 1994; O'Connor, 1994; Kaosa-ard and Kositrat, 1994

6.3.3 User charges

User charges may be variable (i.e. linked to water consumption or property values), fixed or some combination of the two and they are assessed on both municipal and industrial discharges into public sewerage (Box 6.4). Experience in numerous countries suggests that the effectiveness of these charges in controlling pollution requires the setting of appropriate charges and ensuring the existence of necessary institutional capacity for monitoring discharges and enforcing regulations.

In Izmir and Istanbul, Turkey, for example, sewerage charges (wastewater charges) are assessed on industrial discharges into the sewer systems. These charges are significant because they motivate factories to treat industrial effluents. Enterprises face two costs: treatment costs and disposal costs (sewer charges). Generally, high sewerage charges encourage full treatment of industrial wastewaters such that they are suitable for discharge to surface waters, thereby eliminating sewerage charges. Low sewerage charges, by contrast, encourage only sufficient pre-treatment of wastewaters to make them suitable for discharge to the municipal sewer system. In this way, the enterprises minimise their treatment costs. When seeking to minimise their costs, therefore, the decision of an organisation to apply pre-treatment or full treatment will be a direct response to the level of the sewer charge. Nonetheless, the problem of illegal discharges complicates the application of an optimal tariff in Izmir and Istanbul. If the sewer charge is too high, firms may seek to avoid it by illegally discharging wastewater. Thus, the ability to monitor industrial polluters and to enforce pollution standards is critical (Kosmo, 1989).

Experience in the eastern part (Suzano) of São Paulo, Brazil, also demonstrates the importance of establishing sewerage charges at the appropriate level before public investment in sewage treatment. It also demonstrates the need for contracts that commit industrial users to the scheme, as well as demonstrating that the building of a treatment plan for, basically, one industry by the public sector is inadvisable. In this case, a sewage treatment plant was being constructed largely to treat the wastes of a local

paper mill. About 90 per cent of the capacity of the plant was expected to be used by this company. Due to an unacceptably high tariff level set by the State sanitation company SABESP (Basic Sanitation Company of the State of São Paulo), the paper company chose not to connect to the new sewage treatment plant and constructed its own treatment facility at a lower cost. Consequently, the Suzano treatment plant operated at only 10 per cent of its full capacity for several years because it was necessary to phase investments in residential sewer networks.

Box 6.4 Examples of user charges

Canada

The sewage charge levied on domestic users may be based on residential property values or calculated according to a formula that includes consumption (in m^3). A flat rate residential sewage tax is also used.

Colombia

In Cali, sewerage tariffs are set at 60 per cent of the water tariff, in Cartegena 50 per cent and in Bogota 30 per cent.

Sweden

Municipalities levy a charge for treatment of sewage water. The charge consists of two elements: a fixed charge and a variable charge related to consumption. The charge appears to be effective because the numbers of households and smaller industries attached to the sewer system and extended water treatment facilities are growing. The charge has some incentive effect, in that industries try to reduce water use when extending or renewing their plants, although this could give rise to higher pollution concentrations. In some municipalities, a redistribution occurs because enterprises pay a relatively high charge, implying a subsidy to households.

Thailand

To control pollution, industrial enterprises discharging effluent are required to pay service fees to a central wastewater treatment facility or to set up their own treatment facilities. The revenues from the fees are used to cover the operating costs of the treatment facility.

USA

Towns receiving federal grants for the construction of sewer systems are required by the Water Pollution Control Act to recover their operating costs and part of the capital costs from their users, through municipal sewage treatment user charges. A number of States charge flat permit fees that entitle the permit recipient to discharge wastewater. For example, California levies a wastewater discharge permit fee, based on type and volume of discharged pollutants.

Source: OECD, 1989, 1994

A groundwater charge (or abstraction fee) can be used to discourage excessive pumping of aquifers which can result in salinisation and other types of groundwater contamination (as well as land subsidence). In the Netherlands, the provinces can levy a

groundwater charge from those who extract groundwater, based on the amount of the resource extracted. The revenues can be used for research, necessary groundwater management and for compensation payments when damage caused by a drop in the groundwater level cannot be attributed to a specific individual abstractor (OECD, 1994a). In common with many effluent charge systems, this charge is too low to have any significant incentive or economic effect.

6.3.4 Product charges

Product charges can be applied to products that will pollute surface water or groundwaters before, during, or after consumption. They are best applied to products that are consumed or used in large quantities and in diffuse patterns (e.g. fertilisers, pesticides, lubricant oils). A special type of product charge is tax differentiation. Product price differentials can be applied in order to discourage the use of polluting products and to encourage consumption of cleaner alternatives. When a product is highly toxic, and when its use should be drastically or completely reduced, a partial or total ban is preferable to product charges.

Product charges can act as a substitute for emission charges whenever it is not feasible to apply direct charges to pollution. The rates of product charges should reflect the environmental costs associated with each step of the product life-cycle. The rates are fixed but can be re-calculated if the charge lacks incentive power. The effectiveness of a charge on polluting products or product inputs will generally depend on the elasticity of the demand for that product. For example, where input costs are a small fraction of total costs, doubling or tripling the price through an input tax is unlikely to have a significant effect on consumption, unless there are suitably priced substitutes. If less polluting substitutes are available, small increases in input prices may induce substitution and innovation over the longer term (Moore *et al.,* 1989). Revenues from product charges can be used to treat pollution from the product directly, to provide for recycling of the used product or for other budgetary purposes.

6.3.5 Marketable permits

Setting up effective marketable permit programmes involves establishing rules and procedures for defining the trading area or zone, for distributing the initial set of permits (e.g. direct allocation by a regulatory agency, grand-fathering, various types of auctions), for defining, managing and facilitating permissible trading after the initial allocation, and for carrying out monitoring and enforcement activities. Tradable permit systems work best where (OECD, 1991):

- The number of pollution sources is large enough to establish a well functioning market.
- The sources of pollution are well defined.
- The amount of pollution generated by each source is easily computed.
- There are differences in the marginal costs of pollution control among the various sources.
- There is potential for technical innovation.
- The environmental impact is not dependent on the location of the source and time of year.

Marketable permits are not as effective for controlling water pollution as other instruments because water pollution is directly tied to location and time of year. Where they have been applied to this purpose, they have not produced impressive results.

In the USA, for example, the state of Wisconsin implemented a programme to control biochemical oxygen demand (BOD) in the Fox River. The flexibility of the programme allowed limited trading of marketable discharge permits. Organisations were issued five-year permits that defined their waste load allocation, which in turn defined the initial distribution of permits for each organisation. Although early studies indicated several potentially profitable trades involving large cost savings (in the order of US$ 7 million), there has been only one trade and actual cost savings have been minimal since the programme began in 1981 (Hahn, 1989). Stringent restrictions have significantly inhibited trading under this programme (Oates, 1988). Numerous administrative requirements also add to the cost of trading and lower the incentive for facilities to participate. Some costs can be attributed to the small number of organisations involved and others to the absence of brokering or banking functions (Anderson *et al.,* 1989). In many developing countries, the absence of well-functioning markets would place further constraints on effective trading.

6.3.6 Subsidies

Numerous countries make available tax reductions, grants or low interest loans to mitigate those water pollution abatement or prevention costs that must be borne by polluters (Box 6.5). Policy makers tend to favour these instruments because they ease the transition to a more stringent regulatory environment (especially for established polluting enterprises) and because there may be an economic justification for applying them where there are clear positive externalities associated with private investment in pollution control. Nonetheless, there are some disadvantages to using them. First, subsidies can result in inefficiencies by encouraging over-investment in pollution control or over-expansion of the polluting activity. For example, large subsidy shares in the investment costs of pollution control, as implemented in the United States Construction Grants Program, can induce plant operators to design capital intensive facilities with excessive capacity. They also are not consistent with the polluter-pays-principle because the general taxpayer subsidises the control costs of specific polluters. Moreover, subsidies pose a drain on government resources (O'Connor, 1994).

Box 6.5 Examples of subsidies for water pollution control

France
River basin agencies may provide financial assistance in the form of grants or loans in addition to any other assistance that may be obtained from, for example, the government, region or department. The total amount of assistance must not exceed 80 per cent. Grants are the most common form of financial assistance. Where loans are involved, they are generally for a period of 10-125 years and the interest rate is lower than the market rate. In the Seine-Normandie river basin, for example, the interest rate is equal to half the rate of the Credit Local de France.

Indonesia
The Environmental Impact Management Agency (BAPEDAL), with support from Japan, has established a five-year US$ 103 million soft loan programme for industrial organisations investing in waste treatment. Loans are made available on a first-come, first-served basis and are for a period of between 2 and 30 years with a grace period of 1-5 years and an average interest rate of

14 per cent per year (well below market lending rates). The loan programme should facilitate the implementation of the Government's PROKASH, or clean rivers programme.

Korea

Two provisions under the Tax Exemption and Reduction Control law provide direct and indirect incentives for pollution control. First, there is a direct investment tax credit of 3 percent (or 10 per cent for equipment made in Korea) of the value of the investment which is restricted to facilities for increasing productivity, energy-saving facilities, anti-pollution facilities, facilities for preventing industrial hazards and other specified facilities. More indirectly, for persons starting a business using technology, there is a choice between accelerated depreciation of 30 per cent (50 per cent in the case of machinery manufactured in Korea) of the asset's acquisition price in the fiscal year of acquisition or an investment credit at the rate of 3 per cent (or 10 per cent in the case of machinery made in Korea) of the value of the investment for new assets.

Philippines

The Environmental Code enacted in 1977 allowed half of the tariff and compensating tax on imported pollution control equipment to be waived for a period of years from the date of enactment. The code also made available rebates for domestically produced equipment and a deduction for certain pollution control research.

Taiwan

The government offers a range of subsidies. Among activities eligible for subsidy are acquisition of land for waste treatment facilities and the installation of pollution control equipment. A real estate tax concession is also offered for the relocation of a polluting facility and a number of other tax concessions are offered for pollution control investments, including duty free importation of pollution control equipment, corporate income tax reduction for purchasing such equipment, two-year accelerated depreciation for pollution control facilities, and a 20 per cent profit tax reduction for research and development on pollution control.

Thailand

Partial grants and low interest loans are made available from the Environment Fund to local administrations and private businesses required to set up treatment facilities. Other subsidies include the reduction of import duties to no greater than 10 per cent for equipment used for any treatment facilities. During 1984-89, however, only 130.9 million baht (US$ 5.14 million) worth of waste-water treatment equipment had been imported under this incentive.

Turkey

The Government has provided subsidised credit for relocating polluting industries to alternative industrial zones. For example, leather tanneries relocating to the Maltepe Industrial Zone north of Izmir would be entitled to subsidised interest rates of 35 per cent for general loans and 22 per cent for construction and infrastructure investment, implying negative real interest rates at an 80 per cent annual rate of inflation. This is a clear incentive because interest costs in 1988 and 1989 accounted for 20 per cent of total investment expenditures. The Government also has offered a 40 per cent tax deduction on investment for tanneries relocating to another industrial zone during the first two years of estate construction and a 7 per cent reimbursement on investment for small and medium-scale tanneries.

Sources: Kosmo, 1990; Cadiou and Duc, 1994; Kaosa-ard and Kositrat, 1994; O'Connor, 1994

Subsidies, in general, should be selective and should be provided on a temporary basis. In many cases governments subsidise small and medium size enterprises because they suffer a competitive disadvantage when they adopt environmental control technologies where there are economies of scale. The problems of small enterprises may be especially acute in the case of process changes aimed at reducing waste rather than end-of-pipe treatment technologies. While the latter can be added on without disrupting the production process, the former may require the temporary shutdown of the production process during conversion or retrofitting. When introducing process changes, an organisation also may encounter costly start-up problems. While a large enterprise, with several processes running in parallel, may be able to make changes incrementally, small enterprises must face all-or-nothing decisions and face considerably higher financial risks than the larger enterprises. Therefore, even where such subsidies are not justified on the basis of efficiency, they may address equity concerns (O'Connor, 1994).

The removal of water or other types of subsidies can also have a positive effect on water quality. For example, the removal of a water subsidy can lead enterprises and residential users to conserve water and thereby reduce the amount of pollutants they discharge into the effluent stream. Ensuring marginal cost pricing for water can even help to ensure the sustainability of a water treatment programme. Similarly, the removal of subsidies on pesticides and chemical fertilisers can reduce water pollution, particularly groundwater contamination, and the poisoning of aquatic life through run-off into water systems. For residential polluters, however, water subsidies may have to be maintained in order to support the economically weaker segments of the population, particularly the urban poor. Nonetheless, a free-ride situation of a totally free resource is not sustainable. The poor should be required to pay a small charge for water (which should be increased incrementally) not only to cover the costs of water treatment, but also to promote water conservation.

6.3.7 Deposit-refund system

Although not a principal instrument for controlling water pollution, deposit-refund systems can be applied to this purpose if potentially polluting products which are not consumed or dissipated during consumption, such as pesticide containers, can be returned to an approved centre for proper disposal or recycling. Establishing successful deposit-refund systems requires products that are easy to identify and handle and users and consumers that are able and willing to take part in the scheme. It often also requires new organisational arrangements for handling the collection and recycling of products and substances as well as for managing the financial arrangements, and a national or state authority to establish the system. The advantages of deposit-refund systems are that most of the management responsibility remains with the private sector and incentives are in place for third parties to establish return services when users do not participate. A major disadvantage of this approach is that the costs of managing deposit-refund programmes, i.e. administrative, collection, recycling, and disposal expenditures, fall to the private sector.

6.3.8 Enforcement incentives

Penalties for failing to meet environmental standards are commonly-used instruments to encourage dischargers to comply with environmental standards and regulations. In

Mexico, fines are set according to the severity of pollution and adjusted for inflation; repeated offences lead to plant closure. Combined with public pressure, these measures have been effective in controlling surface water pollution. In Argentina, by contrast, fines for discharging into water bodies without treatment are set too low to achieve the environmental objectives (Box 6.6).

6.4 Choosing between instruments

As illustrated in several of the examples above, economic instruments are rarely used alone to manage water pollution. The focus of any policy debate should not be weighing the relative advantages and disadvantages of economic and regulatory instruments, but instead the most important issue is to find the appropriate mix of instruments that would best respond to the special characteristics of each problem and locality, together with specific operators whose behaviour needs changing, and the desired behavioural response.

For effective water pollution control, pollution charges and standards have to be combined carefully with water prices which should be high enough to cover all costs and provide an incentive for water conservation and recycling. In this way, the incentive to achieve standards by dilution is reduced, resulting in less liquid effluent being discharged into rivers and streams.

In selecting instruments, policy makers need to take into account the nature of the environmental problem and its causes, as well as practical, economic, and political realities. In determining the most appropriate instruments, each country needs to establish clear and transparent criteria upon which to base its selection. In developing countries, where there are extremely limited financial resources and weak institutional capacity, the two most important criteria are cost-effectiveness and administrative feasibility. Other criteria include equity, consistency with other objectives, flexibility and transparency.

Box 6.6 Enforcement incentives in Buenos Aires Provincial

The Law Protecting Water Bodies that Supply and Receive Effluents in the Buenos Aires Provincial prohibits any discharges into water bodies (or to the air) without treatment. In practice, this means that industries must obtain a license to operate. In 1986 the law was modified to enable the application of fines to industries that do not comply with the legislation, according to the extent of the violation. The municipality would be responsible for imposing fines that would then be set aside for its own operations. The municipality also had the right to close production plants temporarily or permanently. The process of imposing these fines, however, is very slow. The fines are extremely low and can be applied "as many times as necessary" and, as a result, industries find it cheaper to pay the monthly fine rather than to adopt pollution control measures. Although this has financial benefits for the municipality, it undermines the main objective of the fine, which is environmental protection.

Source: Margulis, 1994

6.4.1 Cost-effectiveness

In selecting instruments, it is important to select those that achieve the desired outcome at the least possible cost and with a total cost that does not exceed the expected benefits. In theory, market-based policies offer the "least-cost" solution to environmental problems, but there is relatively little experience in using them, particularly for pollution charges on industry. Overall, the optimal instrument is one that leads to the so called "win-win" solutions, i.e. improvements in the environment and other sectors of the economy occur simultaneously and therefore do not involve difficult development-environment trade-offs. Although there will be winners and losers in almost all environmental decisions, some actions can bring about substantial social benefits with a minimum of cost, such as accelerating provision of clean water and sanitation.

6.4.2 Administrative and financial feasibility

An instrument should be selected only if the responsible agencies are prepared to deal with the often complex procedures required for implementing them properly, such as billing and collecting taxes and charges, measuring emissions, determining environmental effects, and taking the necessary enforcement action for non-compliance. All of these require good co-ordination between government agencies. Instruments that require strong enforcement capacity or a high rate of voluntary compliance are difficult to implement.

6.4.3 Consistency with other objectives

The chosen instrument should be consistent with other policies and instruments within or external to the sector. For example, the application of the instrument should not lead to cross-media pollution or conflict with relevant national laws, international agreements, treaties or principles. Moreover, no system of pollution charges or other economic instruments can change the underlying political climate. If a government gives priority to maintaining production and employment, then environmental policies that threaten these goals will be ignored. In addition, adopting policies that are not enforced will merely undermine the credibility of the environmental authorities and the government in general.

6.4.4 Equity

Equity considerations should be carefully balanced with environmental factors when selecting instruments. A major policy question when considering any tax system is who, ultimately, will bear the burden of the tax? Or, does the tax fall proportionately more on the rich or the poor? Most proposals for environmental taxes involve either taxes on environmentally harmful consumption or taxes paid by industrial polluters that may be passed on to consumers through higher prices. Poor people spend a larger percentage of their income on consumption of goods than do the wealthy and, therefore, consumption-based taxes affect the poor disproportionately. To avoid this situation, policy makers should ensure appropriate sharing of the costs and benefits of environmental protection, paying particular attention to the poor. For example, requiring private organisations to absorb the full costs of pollution abatement shifts the burden from those who normally suffer from environmental degradation (usually the poor) to those responsible for causing it (i.e. industry) and, eventually, the consumer of polluting goods.

6.4.5 Transparency

The process of adopting and implementing standards must be transparent so that enterprises can adapt to changing regulatory conditions. Enterprises and other stakeholders are more likely to comply with instruments when they understand how they were derived. In the case of an environmental charge, the polluter knows both the costs of investing in pollution abatement and the tax that would need to be paid if current levels of pollution continue. By contrast, in a tradable permit system, the polluter does not have advance knowledge of the price that the market might assign to permits in the future.

6.4.6 Flexibility

The flexibility of the instrument in adapting to a changing environment can be an important consideration where there are changing local conditions. For example, depending on local political conditions, changing a charge rate may be more easily accomplished than changing legislation, except of course if the rates are set within the legislation. Environmental taxes also confer, on producers and consumers, the flexibility needed to minimise the costs of achieving a given goal. Faced with an emission tax, for example, each enterprise can compare various ways of reducing emissions and choose the solutions that match its own circumstances. The various measures include changing the product mix, modifying production technologies and installing equipment that can filter or clean end-of-pipe discharges. To the extent that different organisations can have different costs for pollution abatement, a charge can encourage those facing lower abatement costs to go further in cleaning up their operations.

6.5 Application in developing countries

Despite growing evidence that environmental degradation is an important socio-economic problem, governments in developing countries have been unsuccessful in stopping it. A common argument is that environmental control is too costly and that countries should concentrate on other development priorities. Underlying such thinking may be a lack of information and insufficient awareness of the true costs involved, together with inertia, lobbying by powerful interest groups, and limited public support and participation. Even where there is strong political will, governments may not be able to act effectively because of institutional deficiencies. Under these unfavourable circumstances, therefore, opportunities for the effective application of economic instruments in developing countries can be very limited. Where they are contemplated, however, policy makers should take into account the following factors:

- *Weak institutional capacity.* Economic instruments cannot be implemented successfully without pre-existing appropriate standards and effective administrative, monitoring, and enforcement capacities. Moreover, there is little difference, if any, in the monitoring and enforcement capability required of government for regulatory and economic instruments. If there is uncertain monitoring and weak enforcement, there is little or no reason for an organisation to report its discharges and pay a fee. Similarly, if discharges are normally made without a permit, organisations will not be motivated to purchase permits or to engage in emission trading. Without existing regulations that establish baseline treatment standards for different kinds of discharges, it will be difficult to determine initial allocations of marketable permits. Moreover, subsidies for less than the total cost of

pollution abatement activities will not influence organisations that have no other reason to change their practices. In addition the use of charges for industrial wastewater discharges into municipal sewer systems will be limited.

• *Inadequate co-ordination.* Institutional co-ordination is an important prerequisite for the effective application of most economic instruments. In the case of water management, however, there is often a traditional rivalry between the environmental and water and sanitation agencies. This may be due to a number of reasons such as political power and differing goals and perspectives. Nonetheless, the structure of an effluent charge system involves parameters and information that are more in the domain of the environmental agencies, while the implementation of the system is largely the responsibility of the water and sanitation companies. Unless the relevant agencies are well co-ordinated, the application of effluent charges will be undermined (Margulis, 1994).

• *Economic instability.* Economic stability is critical for the effectiveness of economic instruments. Although regulatory instruments probably depend less on the level of economic stability in a country, charges and taxes are highly dependent on it. For example, Brazil has not been using economic instruments as often as the institutional and legal frameworks would allow, largely because of its unstable economic situation. The fiscal system in the country is very complex and the collection of duties very deficient, and therefore the creation of an environmental tax would only complicate and weaken the system further (Margulis 1994).

• *Government resistance or inertia.* In some countries, there is a general perception by environmental agencies that the use of economic instruments will not only weaken their control over polluters, but that they will have to share their control with economic ministries, who are usually responsible for creating new taxes or charges. The application of economic instruments, therefore, is likely to make environmental agencies even weaker than they already are in most countries. Moreover, the results in terms of pollution levels would be less certain. In other countries, where regulators have relied on standards, inspections and penalties for managing pollution, there is a reluctance to try a new approach unless it is clearly demonstrated to be better than the existing regulatory system.

• *Resistance by polluters.* In developed countries, as in industrial ones, industrial polluters often have resisted economic instruments because they believe that they have greater negotiating power over the design and implementation of regulations than they do over economic instruments. Moreover, local industries rightly assume that it is easier to avoid compliance with a standard where there is poor monitoring and enforcement capacity, than to avoid fiscal and incentive mechanisms where there is less flexibility.

6.6 Conclusions

Finding the right mix of policy instruments can help to ensure effective water pollution control. In developing countries, cost-effectiveness and administrative capacity are the two most important criteria for selecting them. In every country, however, water pricing policies that may be encouraging over-use and water degradation should be considered first. Although the experience in applying other economic instruments remains limited, particularly in developing countries, there is evidence that effluent and user charges have the most potential for effective application by helping to pay for environmental

improvement. Nonetheless, they are not sufficient for achieving water quality objectives. They should be accompanied by investment in wastewater treatment facilities and, locally, by appropriate regulatory instruments as well as programmes to persuade water users to change their polluting behaviour.

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