Mechanisms of Water Management: Economics Instruments and Voluntary Adherence Mechanisms (Parte 2 de 2)

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ABSTRACT: Modern environmental management, particularly concerning water resources, requires the articulation of four different spheres of action, namely: (i) the traditional instruments of Command and Control, which are appropriate to the centralized operation as a government prerogative; (ii) building social consensuses, to define objectives and establish intervention plans, which requires institutional models for the shared management of responsibilities; (iii) the sphere of the so-called economic management instruments whose nature of induction of environmental behavior in a decentralized manner also implies institutional arrangements for shared responsibilities; and (iv) the field of voluntary adherence mechanisms, generally based on certifications of quality of the processes and the environmentally correct forms of production, more appropriate to the decision space of the private agents. These different spheres of action, with their respective advantages and disadvantages, are not mutually excluding. It is fully desirable that different mechanisms be implemented jointly, in order for the benefits achieved regarding the water management objectives to be maximized. However, it is acknowledged that their joint and articulated implementation is not trivial. In fact, although these mechanisms with their concepts and possible forms of action are widely accepted, good examples of their practice and integrated application are still rare, even in developed countries.

KEY-WORDS: water resources management, command and control, building consensuses, economic instruments, certification.

RESUMO: A moderna gestão ambiental, em particular a dos recursos hídricos, exige a articulação de quatro diferentes esferas de atuação, a saber: (i) os instrumentos tradicionais de Comando e Controle, próprios à operação centralizada no Aparelho de Estado; (ii) a construção de consensos sociais, na definição de objetivos e no estabelecimento de planos de intervenção, o que exige modelos institucionais para a gestão compartilhada de responsabilidades; (iii) a esfera dos chamados instrumentos econômicos de gestão, cuja natureza de indução descentralizada do comportamento ambiental também implica em arranjos institucionais de responsabilidades compartilhadas; e, (iv) o campo dos mecanismos de adesão voluntária, geralmente baseados em certificações da qualidade dos processos e das formas de produção ambientalmente corretas, mais próprio ao espaço decisório dos agentes privados. Essas diferentes esferas de atuação, com suas respectivas vantagens e desvantagens, não são excludentes entre si. É de todo desejável que diversos mecanismos sejam implantados de forma conjunta para que os benefícios alcançados em relação aos objetivos de gestão da água sejam maximizados. Reconhece-se, no entanto, que não é trivial sua implementação conjunta e de modo articulado. De fato, embora estes mecanismos, com seus conceitos e possíveis formas de atuação sejam amplamente aceitos, são ainda isolados os bons exemplos da prática de sua aplicação integrada, mesmo em países desenvolvidos. Nesta primeira parte, são abordados os instrumentos de comando e controle e os mecanismos sociais.

PALAVRAS-CHAVE: gestão de recursos hídricos, comando e controle, construção de consensos, instrumentos econômicos, certificação.

INTRODUCTION

Water management, integrating the – different but complementary – perspectives of environmental management and water resources management, seeks the possible balance between a preservationist view and another one emphasizing utilitarian aspects. There is a continuum between one extreme and the other, and it is up to society to find its point of equilibrium. The water resources management policies should identify which are the values of the local communities, as well as the broad guidelines established for the river basin, reflecting and rendering explicit on the one hand the anthropocentric character of decisions marked by a search for economic growth, and at the other extreme, concerns relating to the restoration and/or preservation of the integrity of ecosystems (Perry and Vanderklein, 1996). In the last few decades, societies have shown that they are prepared to find a way that will partly fulfill both perspectives mentioned, insofar as possible and according to their specific forms of valuation, seeking the levels with a higher net social benefit.

In practical terms, management systems depend on instruments that can be developed and applied so as to fulfill the expectations and wishes of the community, within the limits imposed by the natural aptitude of river basins, be it from the more utilitarian perspective or focusing on environmental protection, ideally in the balanced measure required to ensure sustainability over the medium and long term.

In the last few decades, water resources management became a problem that can no longer be treated exclusively from the technical standpoint, seeking to explain the hydrologic, physical, chemical and biological processes that occur in the medium, to overflow into other fields of knowledge. Whereas it is found that the technical topics have been extremely well developed, it is also found that the considerations of an economic, political, social and institutional order, that are part of more comprehensive approaches, are still treated in an incipient form, with major gaps as regards their practical solution. An exemplary case of barriers of an institutional nature is explicitly shown by the difficulties in undertaking water resources management and territorial management in a joint and articulated form.

Thus, despite the advanced stages of technological development, it is essential to render operational the systems and respective management instruments – and this includes institutional terms – i.e.: the processes should be based on activities and decision mechanisms that are feasible and efficiently applied. In other words, whatever the sophistication of conceptual models or the perspectives ruling the systems (preservationist or utilitarian), the operational feasibility of management will be defined based on a flexible, competent set of instruments.

Currently, modern environmental management, particularly for water resources, requires the articulation of four different types of mechanisms, namely:

(i) the traditional instruments of Command and Control (C&C), specific to centralized operation in the State Apparatus, and which, within the scope of water resources management are disciplinary instruments, usually defined as granting the right to use water resources and as standards established by environmental legislation, through granting permits for activities.

(ii) building social consensuses, used in establishing objectives and defining intervention plans – such as water resources plans, whose objectives are reflected in the framework and classification of water bodies, indicating objectives for water quality – consensuses that require institutional models for the shared management of responsibilities between the State and the other agents of society;

(iii) the sphere of the so-called economic management instruments, whose nature as decentralized induction to environmental behavior also implies institutional arrangements of shared responsibilities; and,

(iv) the field of voluntary adherence mechanisms, in general, based on circumscribing

markets, fields of action and/or sources of resources, by means of certifications of the quality of processes and environmentally correct forms of productions which characterize decision spaces more appropriate to private agents, but that also can be applied to public entities, both in the sphere of water resources management and of environmental management.

This paper presents the last two instruments, namely economic and voluntary adherence mechanisms, with its characteristics, advantages and disadvantages.

ECONOMIC MANAGEMENT INSTRUMENTS

The third type of mechanism are the so-called economic management instruments, meaning the decentralized incentives which guide the agents to value environmental goods and services according to their offer and/or scarcity, according to their social opportunity cost.

In 1972, the Organization for Economic Cooperation and Development recommended the use of the 'polluter pays' principle which, years later, was adopted by the European Union and expresses the notion that the costs derived from pollution (environmental externalities) should be internalized by the very agents that caused them, and they are considered as part of the production systems financing matrix (Bernstein, 1997). This is not a simple compensation for damage. The principle indicates that the polluter should pay for the costs of preventing pollution, and also for programs that include water quality management measures (OECD, 1972).

In order to achieve an environmental objective, the latter includes considerations of an ecological, geographic, social and economic order. Thus the allocation of environmental control costs should considered two aspects: how to achieve a given environmental objective, minimizing costs, and how to distribute those costs socially. The social allocation of the costs derived from environmental externalities should seek efficiency and equity. Thus the principle of 'polluter pays' should combine requirements of efficiency (internalization of the external environmental effects) and social equity (the one who is most responsible for the pollution pays more) (OECD, 1972).

Because of their constitution as market mechanisms, as well as due to the specific estimates of opportunity costs involved – different for different uses and users – and also due to the need to consider third party interests not directly related to the transactions involving environmental resources, the economic instruments (with particular interest in charging for the right to water use) require an institutional model of shared management of responsibilities (Lobato da Costa, 1997).

Concerning relations between institutional arrangements and the application of economic instruments

In the absence of an institutional model that is able to provide public-private sharing of management, the economic instruments tend to have a lower potential, and they are 'perceived' by the users-payers as mere taxes or penalties associated with traditional C&C mechanisms applied by the State, with the limitations inherent to them. The challenge of raising charging to the full level of a management instrument, i.e., as an item that is a component of the users' production costs, largely falls onto the building of institutional arrangements, besides, of course , the appropriate definition of prices.

Currently it must be acknowledged that no country, developed or developing, has exploited particularly well the economic concepts formulated above. Further, there is little practical evidence on the relationship between the incentive (inducing behavior) and income (collecting funds) functions of pollution rates (Banco Mundial, 1998). Even in more developed countries, incipient stages are found – mostly limited to isolated niches – in applying concepts such as full coverage of economic and environmental costs involved in the appropriation of natural resources or the implementation of price mechanisms for the management of demands, as well as the elimination of heavy subsidies to irrigated agriculture, not to mention the long time periods needed for new advances in using economic instruments to be achieved and consolidated.

To a large extent, the difficulties in rendering operational the use of economic management

instruments are the result of weaknesses inherent to the legal-administrative structures of the State apparatuses. In fact it is clearly seen that the concepts involved in modern management of the environment are much more rich, complex and inclusive that the effective possibilities of management conferred by the legal apparatus in force in several countries, which ultimately reduce, when they do not render unfeasible, the use of economic instruments, in extreme cases based on ideological justifications.

In Brazil, few will dare challenge the broadly accepted concepts that were established by means of National Law nº 9,433, of January 8, 1997, which are the integrated management and multiple use of waters, articulation with regional development and land use planning, decentralized and participatory management, and others. There is great unanimity about the institution of river basin committees as a deliberative space that can provide the necessary conditions of *government* (establishing and achieving management goals and objectives) and *governance* (interaction and building of consensuses with the intervening social actors).

However, a large distance remains between the concepts provided by legislation and their effective application in practice, when the limits inherent to the legal and administrative apparatuses enter the picture. Strictly speaking, one could say that the National Water Law – characterized much less as a law of institutional organization and rather more as a charter that covers new concepts and guidelines on policies, breaking with paradigms – is not easily and directly applicable, in the light of the real possibilities presented by the administrative and legal structure in force.

A good example of the above statement is provided when we analyze in greater depth the possibilities of implementing charges for water use as an effective economic instrument for decentralized management, i.e., as a mechanism to induce the users' behavior, by pricing the natural resource water. In the absence of a better alternative, all that remains is to record charging for water use and having the legal nature of "patrimonial revenue of the State", established as a "public price", consequently budgetary revenue and, based on this classification, subject to a number of injunctions and controls that are completely out of conformity with their main conceptual function and their full applicability as a *decentralized* instrument for economic management.

Form does not take into account the wealth of the content, but impoverishes it. The legal foundation is shown to be insufficient to express the concepts and challenges established by the concepts of modern management of water resources. A more detailed analysis may be undertaken based on the figures presented below, which show how easy consistent economic concepts are abandoned, often replaced by tendencies to administrative centralization that are attractive to certain bureaucratic segments within the public machinery.

In Figure 2, it is observed that any entrepreneur is obliged to have a minimum initial value of investment ($V_{initial}$), resulting from the emission standards (Q_{max}) established by C&C mechanisms. Thus, discharges above Q_{max} are illegal and are subject to fines and penalties.

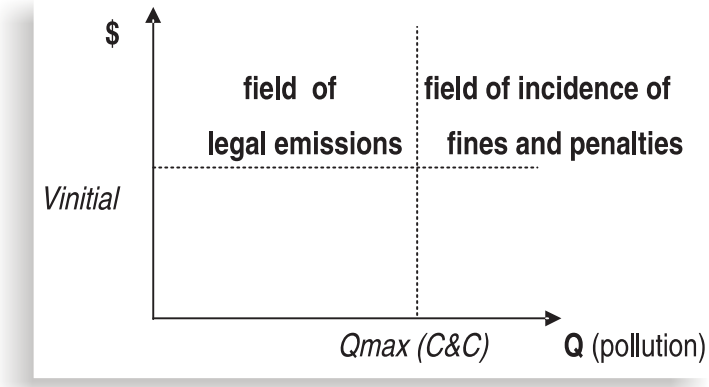


Figure 2. Relationship between Costs and Quantity of Pollution in the C&C strategy

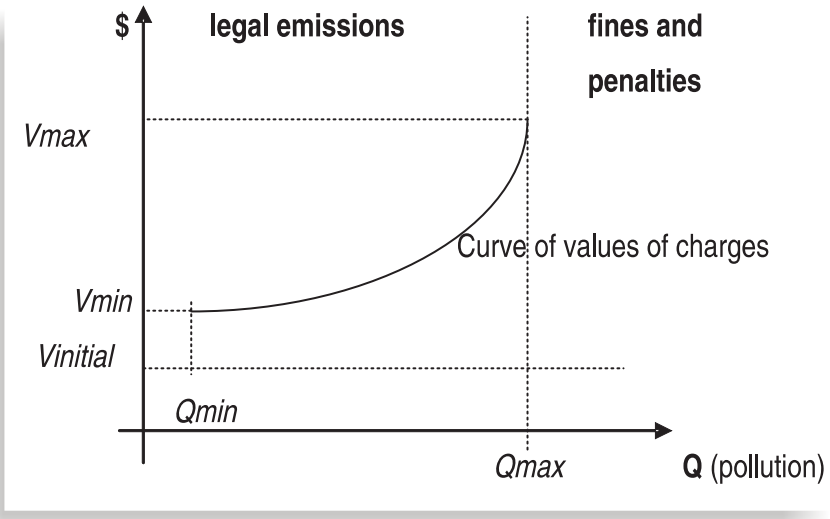


Figure 3 – Incidence of charging on the relationships between costs and quantity of pollution

It is important to recall that the minimum investment is constituted by: (a) a part referring to the inputs of capital directed to the facilities and equipment, localized in time, in terms of the relatively short time period required to build effluent treatment plants; and (b) routine expenditures on operation and maintenance (O&M), including inputs used by the pollutant removal technologies. This second part is distributed throughout the life of the treatment system, and it is proportionally higher, in a direct ratio to the sophistication of the technological processes adopted. Thus, $V_{initial}$ should be calculated as the sum of both parcels mentioned, brought to a current liquid value (CLV), by the incidence of the appropriate rate(s) of monetary cost[1].

On this initial situation, circumscribed by the perspective of C&C, there begins to be a charge for the discharge of loads, as a mechanism of decentralized incentive to the improvement of environmental behavior by the polluting agents. It is observed (Figure 3) that the limits of emission remain, and it is permissible to apply charges only in the field where discharges are legally accepted. Ideally, the charging values should grow exponentially, insofar as the residual loads are higher, inducing the polluters to use more effective load removal practices in their discharges[2].

It appears reasonable to accept that there will always be some residual discharge (Q_{min}). From the perspective of charging, it makes no sense to issue bills whose administrative cost will be higher than the collection (V_{min}), i.e., the charge curve does not begin with zero. On the other hand, the maximum value foreseen by collection (V_{max}) will correspond to the top limit of the legally established limits of emission ($Q_{max} - C\&C$).

If the levels charged are low, the economic agents will tend to inertia, without changing their levels of emission: they simply pay the bill. However, insofar as the unit values of charges rise, the agents begin to consider the hypothesis of undertaking *additional* investments in their facilities, with a view to reducing the bill originated from charging. These additional investments present by means of different options of technologies, whose costs rise exponentially for greater abatement of the pollution loads. Figure 4 adds the curve of own investments in the present analysis.

[1] The monetary cost rates may vary over the period of analysis (variation of the capital costs).

[2] Very restrictive values for the emission limits reduce the field of application of charging as an economic management instrument.

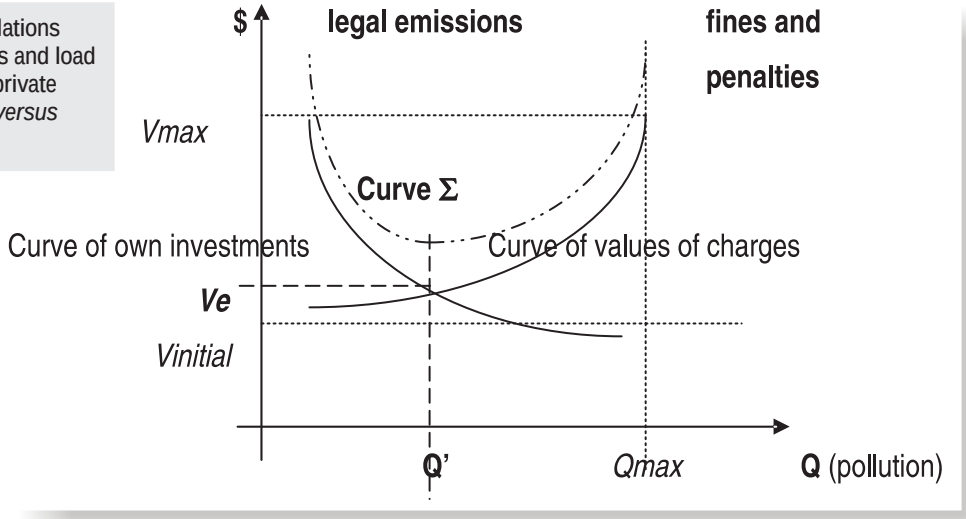


Figure 4 – Relations between costs and load of pollution: private investments *versus* charging.

Again, the private investments are composed of two parcels: (a) the input of capital directed at facilities and equipment, located in the time required implement the upgrade of treatment plants; and (b) the expenditures on operation and maintenance (O&M), distributed over the work life of the treatment system, and they are equally higher for more sophisticated technological processes.

Therefore there are two options for the economic agents: (i) to pay the whole bill of the charge without changing the level of discharges (maintaining $V_{initial}$); or (ii) promoting improvements in the facilities, reducing the sums to be paid via charging. For both options, the total expenditure will be the sum of the parts: own investment + charging for residual load. In fact, even for high upgrades in load removal, there will always be a residual discharge subject to charging. The curve of the sum of costs (curve **Σ**) is seen in Figure 4, the interrupted line above.

The maximum disposition to pay for water use will be defined by comparison of the costs involved tending to the value of equilibrium (**Ve**), corresponding to crossing the curves of charging and own investments[3].

[3] *Ve* incides beginning with *Vinitial*.

This cost comparison is not direct, and in economic terms implies considering the present net value (PNV) of both cash flows that occur throughout the period of comparison (life of the treatment systems). It should be recalled that, on the side of charging, the flow of resources occurs in the periodicity of emission of bills and, on the side of own investments, the inputs of capital are concentrated on the acquisition of new equipments and facilities, the expenses of O&M being distributed and falling upon throughout the period of analysis.

Obviously the economic agents must choose the least sum alternative of the PNV, i.e., if the amounts of pollution are already below the point of equilibrium (Q' = crossing of the curves), it will be cheaper (and less trouble) to maintain their level of emission and pay for the use of water. If there are major margins to reduce the emissions by upgrades in the facilities, it is very likely that the economic agents will undertake investments to improve their effluent treatment systems.

However, there are other variables that should be highlighted in this decision process. Figure 5 identifies two fields, in which the dominances of distinct *administrative and managerial* mechanisms, responsible for the use of

resources - are differentiated:- for values obtained via charging, the collection is public and State, for the own investments the management is private.

In field ***A*** higher bills prevail via charging, and the additional inputs to improve the efficiency of the treatment systems are small. Thus, what predominates is state collection, consequently budgetary and subject to control and to administrative and bureaucratic procedures inherent to the Public Sector (mainly tenders), and from this condition higher costs of transaction *lower yield per monetary unit applied result.* In fact, many agents must consider not only the costs derived from public bureaucracy, but also possible risks of losses and diversions, which recur a lot in the state apparatuses, including for reasons of acknowledged low operational efficiency, when not for reasons of corruption.

In field ***B***, on the contrary, the parts coming from the private sector are higher, because of investments required for upgrades of the treatment systems. The values of charges are lower, since there are small residual loads. What predominates is the private management of investments performed directly by the users. For these resources the transaction and control costs are lower, since it does not appear reasonable to assume that the entrepreneur will steal from himself, but seek to optimize the yield of each monetary unit applied.

The lower yield per monetary unit applied, as a consequence of the incidence of higher transaction costs in the public-state management of the application of resources from charging, is similar to the displacement, *downwards*, of their efficiency in removing loads of pollution. Figure 6 illustrates the fact: for the same amount of investment via charging, there are higher residual loads.

Figure 6 explicitly shows that, considering the higher transaction costs inherent to public democracy, the users are made to choose higher own investments, so as to avoid the loss of yield per monetary unit applied. The value of equilibrium (***Ve1*** < ***Ve***), is displaced reducing the disposition to contribute by charging for the use of water. Field **A** becomes smaller, while field **B** is extended, i.e., an obvious *direct relationship is revealed between the attractiveness of the institutional arrangements and the Water Resources Management System expectation of collection.*

There is nothing against it if the single objective is limited to reducing the load of a given pollutant, since the latter may occur through own investments. However two consequences are important. The first refers to the

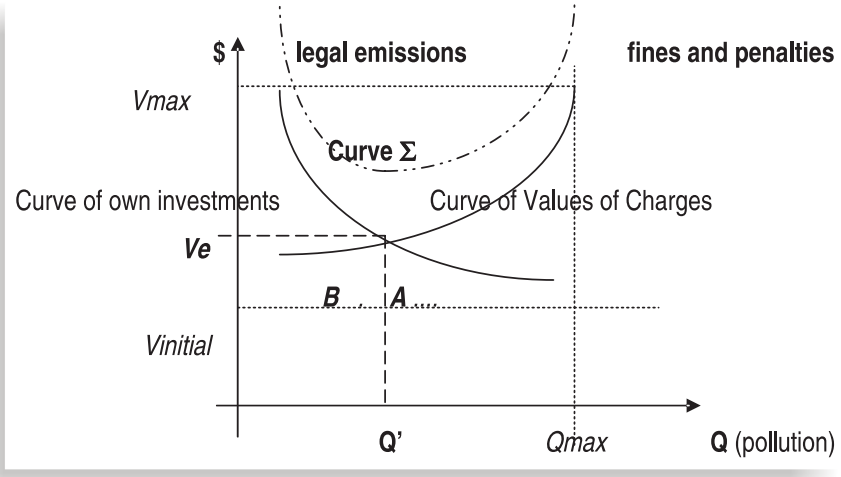
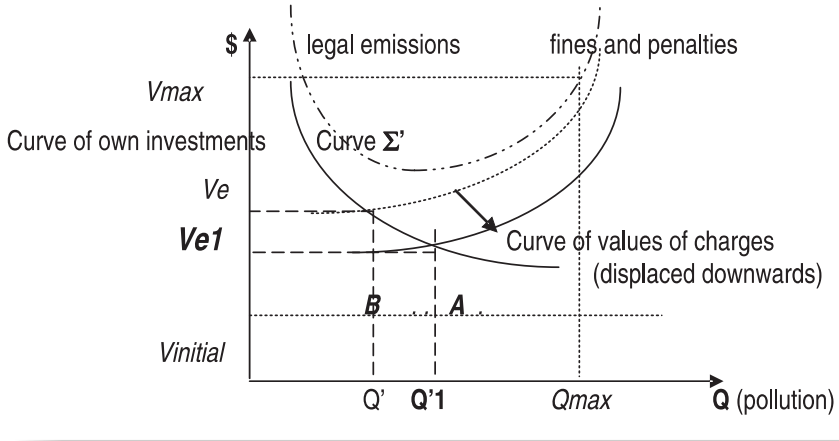


Figure 5 – Fields of dominance of the public collection *versus* private management

Figure 6 – Incidence of Higher Transaction Costs via Public-State Collection



change in the point of equilibrium induced via charging (***Q'1*** > ***Q'***), which loses part of its potential as an economic management instrument.

The second consequence concerns possible objectives of a social nature which may be inserted into the context of basin plans to be financed by resources resulting from charging. When it is intended to establish cross-subsidies between different user sectors, namely in the case of higher payment for the industrial segment, so as to pay the costs of basic sanitation for low income families, or when collective actions are needed to face problems such as non-point pollution, the smaller collection via charging ultimately *weakens the redistributive effect of the System itself*. In fact, own investments will always be circumscribed to the industrial plant of each polluting agent, while charging characterizes a collective (or condominium) source of funding for the river basin plan[4].

Considering what has been presented, the recommendations appear to be directed towards greater flexibility and attractiveness of the institutional arrangements compensated by higher unit prices of charging for water use, instead of choosing more centralized state arrangements, which become palatable to the users due to the lower values charged for the water resources.

Distinct forms of economic management instruments

The principle of 'polluter pays', which can be extended to the concept of 'user pays', can be implemented by means of several different instruments such as, for instance (OECD, 1972; Hanley, 2001; Bernstein, 1997):

(i) direct controls of pollution at the source;

(ii) charging for pollution and use of natural resources (pricing);

(iii) tariff mechanisms;

(iv) subsidy schemes; and,

(v) tradable permits.

As opposed to the instruments of Command & Control, the economic instruments can confer economic advantages on the different organizations and, at the same time reduce the cost of management systems and control programs. This relative advantage is relevant, because no economic mechanism can do without the activities of inspection, besides other

[4] Paradoxically, the excess of bureaucratic control by the state limits and stiffens the potentials for the use of charging as an economic management instrument – the panacea of bureaucratic control has an effect against social objectives.

control actions, such as monitoring and studies that imply reasonable demands for additional investments.

Direct control of Pollution at the Source

Some authors consider that the direct control of sources of pollution, reproducing the aforementioned mechanisms of Command & Control, can also be qualified as the application of the economic principles of 'polluter pays'. When one demands 'the best technology available' for treatment from all polluters in order to attain the best environmental quality possible, this implies that all agents are obliged to internalize the costs of treatment required to fulfill the standards of emission, under threat of suffering sanctions that range from fines to judicial penalties (at the limit, forbidding activities and arresting the people responsible).

Doubtlessly, from the standpoint of reducing emissions this method may be effective, in the direct proportion of the efficiency of the inspection apparatuses and the flexibility of the judiciary power. However, it presents a low economic efficiency, since no mechanism that takes investment demands into account operates in order to achieve the environmental objectives at lower costs. In addition to the difficulties in implementation and operation, there are problems when the cost-benefit relations of this method are taken into account.

Charging for Pollution and for the Use of Natural Resources

Charging for pollution (seen as one of the forms of appropriation and making natural resources unavailable) is the most common mechanism that has been used to implement the principle of 'polluter pays'. It consists of making the polluter pay a value proportional to the quantity of pollutant discharged and/or natural resource extracted.

The most common way of applying this instrument is to implement it attached to a set of Command& Control measures, as in the example of the environmental standards. Charging constitutes an economic incentive for a given quality objective to be attained, sometimes even surpassing the desired standards, whenever economic-financial advantages are identified by the polluting agents The lower the quantity of pollutants discharged, the smaller the unit values charged, reflecting the lower impacts of that discharge on the environmental standards established as a goal. Generally the value charged is calculated to make it advantageous for the polluter to implement their treatment plant (Johnson, 1985). This instrument is used in countries such as France and Germany, and is also foreseen in the National System of Water Resources Management in Brazil.

The main advantages of this instrument are (OECD, 1972):

- the payment obliges the polluter to include in his production costs the expenditures on the treatment of effluents; the price corrects itself and the consumer carries part of the cost, conferring on it a social distributive character;
- the system is flexible and thus gains in efficacy; it allows the polluter to decide how to balance the costs between how much to treat and how much to pay; it is also he who decides on the way the reduction in the amount of pollutants emitted will be reduced.;
- the charging system acts as an incentive to the polluter; the less he discharges the less he pays, which helps equalize, with greater economic efficiency, the levels of treatment adopted, i.e., for those polluters whose treatment is cheap and easy to implement, it is worthwhile to have high levels of load reduction, while for those who try more expensive treatments, the reduction rates will tend to be lower, which however, implies a larger contribution to this collection; thus rationality, efficiency and best cost allocation are combined;
- collection via charging helps finance recovery programs for the whole river basin, without specific connection to the sources of origin, even allowing financing non-point loads and also the management system itself..

The problems related to the implementation of charging mechanisms are several and of diverse origins (Hanley et al., 2001; OECD, 1972):

- the determination of the value to be charged, which usually tends to adjustments by trial and error, going through the following corrections: if very low it is inefficient and if very high causes economic difficulties in the region';[5]
- many critics say that the polluters 'purchase' the right to pollute which is only true if the prices established are very low; for this reason, charging should be accompanied by quality objectives in order fulfill the objective of increasing the overall efficiency of the pollution control system.
- if the price is established based only on the percentage of reduction of pollutants, efficiency will also not be high; a heavy polluter, despite reducing a lot of his pollution, will still cause great impact and pay the same as a small polluter for whom the same percentage of reduction really provides low impact.
- in the vast majority of cases, the polluter will be induced to treat his effluents and, in addition, to pay for the remainder discharged, and for his overall bill it may be less burdensome to submit directly to a pure Command & Control mechanism which will only oblige him to expenses with treatment, although the limits of emission are stricter; the "double billing', in many cases has led industries to attempt to block the implementation of the charging system.

It should be noted that the main difficulty of the desired combination of both instruments – C& C and charging for the remaining discharges – is to establish appropriate limits of emission since, as they are very high, they reduce when they do not suppress the field of action of charging as an induction mechanism, for instance suppressing incentives to locating activities in the regions where the natural support capacity is higher (greater availability of natural resources, especially water; better conditions of load depuration; lower densities of territorial occupation, besides other relative advantages).

There are a few conditions that make it easier to apply the system of charging for pollution (Johnson, 1985):

- charging for a small number of pollutants;
- combining the charging systems with environmental standards;
- establishing a transition period, beginning to charge at low, gradually rising levels;
- the amount to be charged should be the result of negotiation between all interested parties – public administrators, users and civil society;
- creating more simplified systems to measure volumes and concentrations, whenever possible based on declared self-monitoring systems, besides adopted indirect inspection practices operated by selective sampling and statistics connected to the characteristics of production systems;
- establishing guarantees that the funds collected will be reinvested in environmental recovery programs in the river basin itself;
- protecting the industries and municipalities with clauses on exceptionalities; and,
- supporting the implementation of charging with appropriate mechanisms of social communication, clearly explaining to polluters and society the objectives and what is done with the amounts collected.

France began charging for pollution based on only two pollutants: organic matter and suspended solids. Later, when the program was already operating, it was extended to salinity and toxic substances and in some cases also nutrients (Bernstein, 1997). For the toxic substances, in order to avoid charging for a large number of different substances, the simplification adopted was to create a unit called *equitox*, based on effluent toxicity: if one m^3 of effluent kills 50% of the *daphnia* used in the test, then this effluent has 1 *equitox*/m^3; if it is necessary to dilute the effluent

[5] It should be recalled that, theoretically, the price to be paid for the use of natural resources should correspond to its opportunity cost of social use, a value that is not established in a trivial manner. It varies from basin to basin and from region to region, with different uses and users, and also in time, according to availabilities and demands.

50 times to reach the level at which 50% of the *daphnia* die, then this effluent has 50 *equitox*/m^3 (Bower et al., 1981). In order to avoid the charges and costs of measuring all discharge points, charging is done by typology of industry or by municipality population. The volumes and concentrations are only measured in cases especially requested by the polluter or managing agency. Depending on their contribution to environmental recovery in the basin, polluters receive incentives in the form of subsidies.

In the case of Germany, the pollutants considered are settleable solids, COD, cadmium, mercury and fish toxicity. Different pollutants are assigned different values for purposes of charging: mercury is charged at values 2.5 times greater than COD. The instrument used for charging is combined with emission standards by means of a specific license for the limits to be obeyed. Whoever discharges above the standard is charged a much higher amount per unit of pollutant (and this alternative is allowed only twice a year). Whoever discharges below the limit receives incentives in the form of a reduction in value charged per unit (Bernstein, 1997).

Tariff Mechanisms

In a very similar manner, behavior induction can be applied, provided by the price mechanisms of the economic management instruments, by means of sectorial tariffs, especially in the case of the sanitation sector, responsible for providing water supply, sanitary sewage collection and treatment services.

By means of appropriate tariff structures, established according to the levels of consumption and by the consumers' levels of income, it is possible to undertake *management of demands*, reducing consumptions and, consequently, the generation of wastewater. Mechanisms of this kind can force industrial consumers to change technologies of productive processes, in search of closed circuits and/or the adoption of reutilization practices.

Sectorial tariffs are particularly important in countries in which the largest number possible of environmental externalities generated (the case of the United Kingdom, for instance) will be covered by the cost of providing water supply and sewage collection services, without the forecast of pricing and charging for the use of water resources, as a public good appropriated by the utilities as an input. For Brazil, taking France as a reference, the clear option is in favor of acknowledging that many of the positive externalities (benefits) related to the intervening services in the case of water resources, are not picked up only by the specific sector, but are broadly reflected in the regional sphere (Table 1), exemplarily in the case of the treatment of domestic effluents.

TABLE 1
Matrix of Investments and Benefits in Environmental Recovery

Nature of Investments in Environmental and Water Resources Recovery		Magnitude of Investments	Externalities (benefits) and Means of Cost Recovery	Nature of Agents Involved
Initial Input of Capital	Sanitation Systems	HIGH	Service Tariffs, Socioeconomic Development, Lower Production Costs and Real Estate Market.	Systems Operators and/or Other Entrepreneurs
	Other Actions	HIGH	Socioeconomic Development, Lower Production Costs and Real Estate Market	Other Entrepreneurs
Operation and Maintenance		LOW	Tariffs and Service Rates	Systems' Operators

Source:Lobato da Costa, 2003.

In effect, in the Brazilian case the difficulties of the sanitation sector in bearing its own charges (conveyance of water from increasingly distant places, treatment and distribution; collection, transport and also effluent treatment, submitted to increasingly restrictive emission standards) are acknowledged. It does not appear very reasonable, therefore, to deposit expectations that broader actions to improve environmental quality have their costs recovered only by sectorial tariffs. In fact, according to results of contingent evaluations performed in the Country, the disposition to pay is systematically lower for tariff additions over services already rendered, than to finance broad programs for water recovery, with prospects of improvement of the urban and regional environment quality.

The field of application and the efficiency of management instruments based on tariff mechanisms are related to the prices-demands elasticity. Indeed, there are levels where consumption is no longer achieved, insofar as the essential needs are met, and this may mean the retreat of consumers to other forms of supply. In the case of the Metropolitan Region of São Paulo, for instance, today there is a significant trend of the large consumers to migrate to individual supply via wells, since this is cheaper in view of the high tariffs charged by the State Sanitation Utility (SABESP), which is causing serious problems of groundwater aquifer management and control, without the corresponding reduction in effluent generation (CBH-AT/FUSP, 2001).

On the other hand, the tariff structures must be fixed specifically for different categories of consumers – domestic, commercial, industries and agriculture – making their administration rather more complex. Specifically, for the industrial and agricultural sectors, it is observed that more simplified forms of bonus emission may be more effective to induce the practice of reutilization and consequent reduction of discharges.

Subsidy Schemes

Subsidies constitute incentives arranged by reduction of taxes, inputs of non-repayable capital (*a fonds perdu*), loans at lower interest rates, characterizing forms that are very frequently used to control pollution.

High non-repayable investments were great drivers of pollution control in the United States. They are efficient over the short term and a transition measure to initiate the pollution control process, but tend to lose efficiency very fast (OECD, 1972).

The lack of incentive to seek efficiency is the main criticism leveled at using subsidies. Another criticism finds that all of society – through taxes and general revenues of the State – ultimately finances the activities that could leverage own inputs, which goes against the principle of 'polluter pays'.

Considering the observations above, it is deduced that the subsidies should be selective and temporary (Bernstein, 1997). For instance, to finance small establishments, so as to guarantee feasibility and competitiveness conditions on the markets.

From the internal perspective of the sectors, namely for basic sanitation, considering the objectives of universalization of the services, one of the main issues to be faced is establishing adequate subsidy schemes, highlighting two types:

(i) *inter-regional*, based on the acknowledgement that there are more appropriate and feasible scales to provide services, from the viewpoint of the size of the market that purchases the services, and it is clear that small towns have trouble in supporting autonomous systems. However, paradoxically, it must equally be acknowledged that there are weighty margins of gains in terms of economic-financial feasibility, if the costs involved are regionalized in terms of staff and technologies for system operation, always taking into account the maintenance of product (clean drinking water) and services standards of quality. In fact, it makes no sense to render small systems responsible for the amortization of part of the high administrative costs of large utilities; and

(ii) *between levels of consumption* (and consequently of income) *and categories of users*, when it is possible to administer crossed subsidies at the limit of the price-demand elasticity relationships, running the risk that commercial and industrial users will migrate to their own supply systems (generally drilling wells to take

up groundwater), with negative repercussions for the feasibility of the system as a whole.

As to the inter-regional subsidies, despite the possibility of decentralizing the services, which includes operating in small rural communities, it should be recalled that there is still the need for a significant level of responsibilities that remain up to the Governments, concerning technical assistance as well as regulation, with a view to ensuring adequate standards of clean drinking water, given the public health aspects involved.

These subsidies may have their origin justified by variables connected to aspects of public health or environmental externalities, which are expressed differently in each region. Therefore, they must be selective and guided. Thus, it will be acceptable that the sanitation sector asks for the input of resources (subsidies) outside its context, whenever capital investments are justified (basically, operation and maintenance should always be self-supported), the case of sewage treatment, in which it should be recognized that the positive externalities ultimately are broadly picked up on the regional scale and not only by the sanitation sector.

In favor of establishing subsidies among the consumption classes and categories of users (cross subsidies), it is known that the strata not served by water services in general are located in small localities and niches of shantytowns and illegal real estate development agglomerations and metropolitan regions, requiring investments and operational costs that are difficult to cover by tariffs. In these cases, an investigation about the appropriateness of giving subsidies directly to the consumers or to the connections should be performed, and it is essential to have transparent criteria and procedures.

Also as regards the key issue of subsidies, it appears appropriate that establishing them be preceded by some regulatory care, so as to define the real need for them, and prevent unnecessary expenses (for instance regional costs raised over small systems) from being inappropriately supported.

Tradable Permits

In order to apply this instrument, it is determined which is the highest level of pollution the basin can receive without altering the environmental standards, so as to ensure that the quality objective be attained (Hanley et al., 2001).

The pollutant load thus determined is then divided into pollution 'quotas' that can be negotiated. The quotas are put on sale and the respective 'market' is established, duly regulated by a managing agency. Depending on the value of the quota, it may be worthwhile for the polluter to purchase a large number of 'emission licenses', treating its effluents with lower levels of removal. If the quota value is high, possibly it could be less burdensome to treat the discharges and purchase less quotas. With a view to raising the standards of environmental quality, the managing agency can enter the market and purchase quotas, making the price rise and thus inducing higher levels of treatment.

The advantage of this system is to guarantee that the quality objectives desired may be high and be gradually raised (OECD, 1972). The disadvantage may result from fixing a given level for basin recovery, remaining stationary. Furthermore, there is always the risk that large entrepreneurs will hold all the quotas, forcing small and medium-sized businesses to leave the basin. Problems of spatial scale in the allocation of 'quotas' were also identified: the upstream 'quotas' tend to be more expensive than the downstream ones, where there is a higher assimilation capacity.

Today the United States are turning to this economic instrument to be used mainly in already saturated basins, or in those where it is more difficult to approach all pollutants and polluters collectively. In 1995, this was one of the challenges proposed by the then President, Bill Clinton, on the need for new ideas to promote pollution control (http://www.epa.gov/reinvent/pubsinfo.htm).

A study that raised 37 initiatives for tradable permits in the United States (Podar, 1999) shows that the advantage of the system lies in its flexibility, in the redistribution of responsibilities, with benefits to the management system and improvement of economic efficiency. However, these are too recent experiences to provide very definitive responses about its efficiency.

MECHANISMS OF VOLUNTARY ADHERENCE

Recently, environmental management has been shaping alternatives to command-control through the decentralized route of defining spaces of action, access to sources of resources or markets receiving goods and services available to the productive sector – private or state-owned – only if the latter obtains certifications with a view to the quality of environmentally correct production processes and/or technologies, considering mechanisms to reduce their externalities, horizontally and vertically, in the chain of productive processes (among other variants are the norms of series ISO 9,000 and ISO 14,000).

This route has shown a significant capacity to spread the environmental standards required in the main world markets (especially Europe and the United States) to the industries of the other countries, and has the merit of promoting incentives to technological modernization and the reduction of waste, improving production processes[6].

An example of the application of mechanisms of voluntary adherence in water resources management is shown in Box 5.

Box 5
A good example of certification for a water resources management system
Source: CBH-AT/FUSP, 2003.

For the water resources management system it is also useful that, from the medium and long term perspectives to reach the basin plan objectives, an instrument be created that is capable of attracting the polluting agents to fulfill the goals proposed voluntarily. This system can be seen as a gradual adherence to the goals, encouraged by easy access to resources available in the basin and, when appropriate, discount in water use charges.

Hypothetically, to make the system of gradual adherence to the goals prevail, it is accepted that the basin plan will define standards and guidelines on two levels: one with compulsory application under threat of legal action, whenever the observance of the principles that are at the foundation of laws that give rise to the plan itself is at stake; and another, with progressive adherence, in which different levels of classification are accepted according to guidelines that contribute to the more efficient fulfillment of the plan goals.

The implementation of guidelines that allow progressive adhesion will be defined on objects with shared management that will be established within the scope of common competencies between State and Municipalities. Objects with shared management are the components of policies and programs of urban drainage, solid wastes, water supply (including measures for conservation and rational use), sanitary sewerage, preservation of sources, land use and occupation, and others, which, although they may now be strictly associated to a specific sphere of the Public Power, may share responsibilities.

It is typical of the use of natural resources and of the constructed common environment, that sectorial goals present conflicts amongst themselves and that, within a same sectorial plan, the local goals coincide with the supra-local ones. The institutional strategy of a plan should include instruments that make these conflicts clearer, defining instruments to support decision that allow choosing the best alternative for the set. The progressive adherence to the non-compulsory guidelines, by the public agents and groups of basin resources users, assumes that there are also progressive stimuli for more favorable tariffs and greater access to the resources available in the basin. The most elementary level of adherence would correspond to actions of institutional improvement, including the local plans.

The great challenge of the basin plans is to harmonize the conducts of the different agents in the state sphere – administrative organs and utilities and municipal sphere, which have responsibilities in the development of water resources, besides, of course, the private agents. The great instruments available

[6] Refers to the concepts of BATNERC – Best Available Technology Not Entailing Raised Costs.

are the economic penalties on non-conforming conducts – attributing the costs of stream regulation works to the impermeabilizing agents and making water use charges vary as a function of the quality and quantity of effluent, as compared to the goals established for each sub-basin – and the connection of access to resources available in the basin to the conformity of the agent's conduct.

For this purpose, it can be proposed that a certification of conformity be established, along the lines that have been practiced in the different Quality Systems that are being disseminated. The conformity of conduct could be defined at different levels, as for instance:

Level 1 – Adherence to the Basin Committee and Sub-basin committees;

Level 2 – Adherence to the plan goals for the sub-basins where the public agent acts, adaptation of legal texts and service standards concerning water resources and the definition of control procedures for the implementation of new regulations and standards;

Level 3 – Implementation of control mechanisms;

Level 4 – Full implementation of the goals defined in the plan.

These levels would correspond to decreasing economic penalties and increasing degree of access to the resources available in the basin. Certification by independent bodies, with external audits and publicity of the information, would enable diminishing the degree of negative political interference in the process, allowing civil society to follow up and inspect the effective implementation of the Water Resources Policy.

The great water consumers, great polluters and private enterprises with a more significant urban impact could be submitted to similar procedures to those of placing the municipalities in a framework, either directly within the same type of certification, or indirectly, through a classification of their conduct by local or sectorial regulations

Utilities that may have been privatized, according to the present reasoning are equivalent to public agents because they operate public services. Applying similar conduct adjustment mechanisms to municipalities and to large water resources users could create a positive demonstration effect. Insofar as private users were to be included in the classification, this would act also to classify the public agents.

CONCLUSIONS

The concepts and definitions presented in this paper, as well as the present experience of water resources management throughout the world, may allow the following conclusions regarding the use of different types of instruments:

- due to the complexity of water related problems, water management must rely upon several different but complementary management mechanisms; command and control, consensuses building, economic instruments and mechanisms of voluntary adherence as described in this paper, are available for water management but each requires a different institutional arrangement to be applied;
- such mechanisms are not excluding; they are to be applied in different situations and, although their implementation in an integrated manner is quite difficult, the best results, with an expressive gain in their efficacy, will come from the use of several of them together, through the selection of those best suited to solve the problem;
- it is essential to recognize that command and control mechanisms have to be used at all times, no matter what other instruments are also implemented; the water management system always requires discipline and enforcement; it must be applied by the government;
- nevertheless, if the command and control methods aim for very difficult or ambitious targets, they tend to lessen the power and the efficiency of the other mechanism, mainly of the economic instruments;
- both the 'consensuses building' and the 'economic instruments' require a flexible and decentralized decision process;
- if centralized decision processes are used with those two instruments, they tend to reproduce the command and

control process and its efficiency is greatly reduced;

- there is a potential use for the mechanisms of voluntary adherence; creativity is the word: there are a lot more that can be done besides ISO 14000;
- as a final word, although much of what is said in this paper is fully accepted by the water resources community, there are very few examples of good practice related to the integrated use of the instruments here presented, even in developed countries.

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