

# Mechanisms of Water Management: Command & Control and Social Mechanisms (Parte 1 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 resource

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 brings the first part of the discussion, presenting the two of the above cited mechanisms, namely the traditional command-and control procedures and the action of building consensus around planning purposes.*

### COMMAND AND CONTROL MECHANISMS (C&C)

The mechanism called Command-Control refers to attributions that cannot be delegated and are exclusive to the State system, and are traditionally applied by the Public Power, by legal disciplining and exercising police power. They are the more traditional instruments and use a compulsory application approach: - it is decided directly (sometimes unilaterally), what situation is desired for the water body, and then the police power of the State is used to achieve it.

From the perspective of an omnipresent State, this appears to be enough to achieve the intended objectives. It is a perspective of management that is attractive to certain public administrators, but its effective implementation presents deficiencies that result from the fact that the quality of the environment in general and of the water resources in particular, is the result of the action of multiple social agents. This makes it rather complex to 'command' all the factors involved to achieve the desired objectives, including those to impose law-enforcement mechanisms which require structures to inspect and apply fines and penalties, with increasing difficulties because of the magnitude of the problem. This is particularly true when one is operating in critical situations of pollution and environmental stress (multiple sources of point pollution and dispersed loads).

Management procedures via C&C usually reproduce the conventional approach applied by environmental agencies, based on the point identification of sources of pollution, followed

by the corresponding limitation of the emission standards, by means of activities in issuing permits.

Due to the predatory nature of productive activities, which tend to this behavior when they are not submitted to environmental regulation mechanisms, it is impossible to get away from the mandatory application of such instruments, whose main burden are the demands for powerful systems to inspect and enforce and also to perform environmental monitoring, both for point inspection of potential sources of pollution and to pick up isolated episodes (irregular discharges and other critical events), besides drawing scenarios with the tendencies of the evolution of water availabilities, as to quantity and quality, over the medium and long term.

Imposing emission standards forces the economic agents to minimum levels of pollutant emission, besides ensuring conditions of competitive equality as to the costs of implementing systems to treat the effluents generated by production.

However, due to their regulatory nature, the law enforcement (C&C) instruments do not take into account the differences in control costs among the polluting agents or those who exploit the natural resources. The norms and standards are generically imposed, and do not confer incentives on those who hold advantages in reducing their externalities to levels lower than the others. In economic terms, more efficient alternatives to allocate natural resources or to attend to the environmental quality objectives, always desired at lower costs, are discarded, and no incentives are produced to generate more efficient technologies to use environmental goods and services. Furthermore, critical pictures of pollution commonly occur, in which the sum of the waste loads is higher than the depuration conditions of the watercourse, although the discharges into the contributing river basin obey the emission standards imposed by environmental permits.

Moreover the heavy burden imposed by maintaining the monitoring and inspection structure is borne by the State, and this is one more externality derived from the need to control productive activities.

In Brazil, the classical Command-Control instruments adopted for water management are:

- those established by the National Policy of the Environment (Appendix II), there classified into four categories: environmental standards (for quality and emission); land use control (environmental zoning, ecological-economic zoning and zoning of protection areas); issuance of environmental permits (including studies on environmental impact and the respective reports – EIA-RIMA (Environmental Impact Report)); and the penalties (fines, compensation, and other similar ones) (Leal, 1998).
- those defined by the National Policy of Water Resources, with particular interest in granting the right to use water resources

and penalties corresponding to violations of conditions imposed through them.

### Command & Control Instruments applied to Water Quality Management

It may be said that the need for water quality management comes from acknowledging that human activities produce waste. This is a universal and unequivocal finding. It is impossible for humankind to live in urban agglomerations, producing food and consumer goods, expanding their technological development, without increasing the production of wastes, and especially without having a large part of these wastes reach the water bodies. The task of natural resources management, as well as the task of waste management is to get such processes to occur within sustainable environmental limits.

#### Box 1 – Limits and Possibilities in Applying Restrictive Zonings for Land Use and Occupation: Learning in Source Areas in the Metropolitan Region of São Paulo

(Source: Araújo, 2003)

The watershed areas used as a source of drinking water supply for Metropolitan Region of São Paulo (with a population of 18 millions) cover a significant part of the metropolitan territory and are the object of legal protection since 1975/76, when a law was enacted to discipline and mitigate the advance of the urban network on the sub-basins that are meant for public supply. Although rather restrictive, the legal standards were not sufficient to attenuate this advance, and there are reasons enough to diagnose negative traits of its influence on the current predominant scenario of urban poverty, above all in the sub-basins of Billings and Guarapiranga reservoirs.

The disjunction between this scenario of neighborhoods that began in a clandestine manner and shantytowns (*favelas*), growing almost out of control, and the requirements to preserve the sources, led to the Guarapiranga Program developed in 1993/2000 and to the initiation of a substantive change in public policies for these regions, whose basic guideline became the simultaneous and integrated treatment of the bi-

nomial of urban development /environmental protection: acknowledging the irreversibility of occupation, extension of public infrastructure, improvement of housing conditions, mitigation of poverty conditions, reserving areas for preservation and leisure.

Besides the measures derived from these guidelines, there was a still ongoing effort to investigate aspects directly related to the quality of water in the reservoirs and its tributaries – which provided subsidies to technical decisions and relevant executive actions already during the Program implementation – and the establishment of institutions and mechanisms to manage the sub-basin, which has not yet been concluded. In particular, this institutional face of the Program encouraged the beginning of change in the law dated from the 1970s, already mentioned, towards a new legal statute (State Law n.º 9.866/97, which establishes guidelines and procedures to protect sources that are of regional interest) more adequate to the complexity of a situation that involves the need to cooperate among the different spheres

of public administration and dealing with intricate relations between the environment and land use and occupation, with the typical characteristics of the areas involved.

Currently, the preparation of a new project for physical and institutional interventions, the *Programa Mananciais* (Water Supply Sources Program), whose complexity is even greater, which similarly to the conditions faced by its predecessor – Guarapiranga Program – led to planning for a very broad range of interventions, according to a distribution framework of also much broader executive responsibilities.

It should be mentioned that the most important institutional incentive to *Programa Mananciais* comes from the Water Resources Management System of the State of São Paulo, legally constituted by State Law n.º 7,663, of 1991. Since that time, the state government, several municipal administrations and non-governmental organizations have made an effort to structure the System, creating committees in the twenty-two main river basins in the state and developing studies and law bills to

charge for water use. In the case of the Upper Tietê basin, with its geographical boundaries that almost coincide with the administrative contours of the Metropolitan Region of São Paulo, besides the committee of the basin itself, five sub-committees were established intending to extend the representativeness and efficiency of the decision processes related to the management of each portion of this territory. More recently, the Basin Agency of the Upper Tietê was implemented, which is now beginning to operate.

As already mentioned, prior to the *Programa Mananciais*, the State Government, with the financial support of the World Bank, coordinated the implementation of the Environmental Sanitation Program of the Guarapiranga Basin, the second most important source of the São Paulo metropolis. This prior program was a pioneer with multi-institutional features, agreeing with its environmental and urban development objectives. To a large extent, the concept of *Programa Mananciais* benefits from the experience acquired during the implementation of its predecessor.

The purpose of water quality management in the bodies of water is, at the same time, to allow the occupation of river basins and the use of this natural resource, and therefore it requires an appropriate level of control of the wastes resulting from human activities in the basin. It is known that some level of damage will occur, but the system must try to keep the degradation of the aquatic environment at acceptable conditions of risk. The great motivation to implement a water quality management system is precisely the possibility to choose forms of harmonious companionship between occupation of the river basin and water uses, with a socially acceptable expectation of the risk of degradation.

These are the reasons that make it necessary to define water quality standards. Quality standards are the legal form of regulating pollution control. They are the essential core of the Command & Control type systems. It is by

checking on their implementation that one also evaluates ‘progress’ achieved. The objectives are expressed by always well-defined numerical or narrative values, so as to provide subsidies for the inspection and monitoring processes.

The numerical values assigned to the standards are established based on water quality criteria, so as to have a scientific foundation and ensure appropriate levels of safety for the designated uses.

Two types of qualitative standards are commonly used as water quality management instruments. The environmental standard refers to the water body and defines the limit-values of the different indicator variables, specific to each use. It characterizes attention to the quality objective defined for that water body, i.e., it defines the quality that a water body should have to support a given use or set of uses. The other type of standard used is for discharge,



also called emission standard, referring specifically to the polluting loads produced by a given enterprise. This is the end-of-pipe control that aims at limiting the amount of pollutants that can be discharged by a given activity.

The water quality management systems should use both types of quality standards mentioned: environmental and emission. The greatest control efficiency is achieved by combining the two types of standards. The environmental standards cannot be used alone for water quality management, without having any control over emissions. If the environmental standards are not being fulfilled, there is a clear need to identify the source of this violation. In fact, inspecting and controlling pollution in a river basin, based only on environmental standards is an impossible task. There is no technical domain that can establish the causes precisely through the effects

The environmental standard is also important insofar as it enables a view of the river basin as a whole. It is therefore essential, for instance, to allow some control on the non-point pollution loads. Based on the assumption that the environmental standard of a river basin has been violated, despite the fact that all point polluters are in conformity with their emission limits, two reasons may justify this fact: either the assimilation capacity has been surpassed and all emission limits granted must be reviewed, or the pollution that exceeds the standards are of non-point origin, and it is up to the managing system to act to control and improve the management of these loads. Thus, the main function of the environmental standard is characterized: to serve as a reference for river basin management, as to the overall control of water quality.

On the other hand, the definition of the environmental standards should obey the natural conditions of water bodies, whose quality changes according to the lithology, climate and type of vegetation. It is essential that environmental standards be established in a flexible and decentralized form, precisely to be able to serve local specificities. A typical example is that of Negro river, in the Amazon basin, which has a pH below the one commonly found in nature, and the rivers of the Pantanal-Mato-

grossense which have organic matter quantities higher than those commonly found in basins that have not undergone any anthropic changes.

Depending on the intended objectives, especially in the cases of public supply and protection of aquatic life, the difficulties of establishing scientific criteria become greater as a result of the growing number of toxic products found in the water, which makes it complex to define environmental standards. This type of difficulty accounts for the growing trend to establish environmental standards based on biological monitoring.

As to the emission standards, these are essentially technological in nature. The polluters are obliged to discharge their effluents in accordance with a set of standards for the different substances contained in their discharges, whenever they are potentially polluting.

It is interesting to note that the management mechanisms to control pollution present a markedly local character, insofar as the demands to inspect and control are concerned and the proportion of difficulties in identifying improper discharges on broader scales, including the self-purification of the receiving water bodies themselves. However, it will be the convergence between (a) the sum of local emissions, joined together within the scope of a given river basin, and (b) the environmental standards designated to fulfill the intended uses in the basin, that will define the water quality management requirements, characterizing mutual interaction between the limits of emission of the sources of pollution and the objectives set for the river basin as a whole.

However, this interaction is not trivial, and it presents known difficulties, varying from one basin to another and requiring substantive efforts to understand the hydrologic behavior and quality of the bodies of water which are in themselves very complex. This understanding requires effective, continuous monitoring systems, besides the application of water quality simulation models, through which different situations that may occur in the basin that is being analyzed are tested. This, however is an alternative to detail the management decisions 'to measure', favoring the optimization of the

resources available (including investments), and respecting the expectations of the local communities to reduce undesired states of pollution.

*In the absence of data, information and simulation models that will allow one to establish specific environmental standards for each basin, the alternative becomes the generic determination of uniform limits of emission for all polluters. The debate on both these perspectives (uniform standards of emission and/or the capacity to support it in the territory) is still intense throughout the world. It is the dilemma between equity of costs of load removal, in search of the best possible control, and the alternative of adapting the limits of emission to fulfill specific environmental standards for each territorial unit of analysis. There was a heated debate on this subject during the process of establishing the Clean Water Act in the United States, and the US Congress finally adopted uniform emission limits, enabling the environmental standard to be used as a determining factor only in the densely occupied basins, by adopting the Total Maximum Daily Load. This system may even result in even more restrictive limits of emission for point loads, since currently the Total Maximum Daily Load is ultimately restricted by the control applied to non-point pollution.*

The definition of standards of emission generally uses three different technological categories (Johnson, 1985; <http://www.epa.gov/docs/epacfr40>):

- (i) the so-called *best available technology*, in which the polluter is required to treat his effluents with the best technology available at the time; a cost-benefit evaluation can be performed, but emphasis is laid on the greatest possible removal of pollutants.
- (ii) the *best conventional pollutant control technology*, in which the polluter is asked to deal according to the most usual form of pollutant removal used in the sector, emphasizing more the uses and customs of the sector than the quality of the effluent to be discharged; it is a form that may increase the polluter's adherence to the pollution control process; and,
- (iii) the *best practical technology*, which emphasizes the cost, and allows the polluter to use the best technology permitted by

his production costs; it is based on the mean performance of the technologies used in the sector.

Normally these technological standards are used for the purpose of making the requirements uniform within a given productive sector. This procedure makes management and inspection easier, besides avoiding possible legal challenges that may occur, based on demands for competitive equity of production costs. These three types of standards, with different levels of technological demands, may guide successive stages of a pollution control program. The load reduction program is started with the 'best practical technology'. After some time the polluters are obliged to promote improvements in their treatment plants, until they start using the 'best conventional technology'. Finally one reaches the level of requirement of the 'best available technology'.

In this latter stage, emphasis is indeed on the maximum reduction of pollutant loads, and this goal prevails over the economic aspects of the process.

There are significant advantages in requiring the same standard of treatment from all polluters, since this allows a certain economic equity as related to the expenditures on the removal of the loads of pollution (Perry & Vanderklein, 1996; Chave, P.A, 1997). In fact, if all paper industries are to treat their effluents to the same standard of emission, this means that the incidence of the cost of treatment on the price of the final product will be the same no matter where the industry is installed. Another advantage is that no extensive set of data on the river basin is needed, which may reduce the costs of monitoring and studies on which the management system is based.

However, there are disadvantages associated with this requirement. To begin with, excessive resources that could be better invested in other programs are spent. Furthermore, the different support capacities are not used to organize the activities in the territory, and lower investment cost alternatives, and even environmental result, following from combinations between different limits of emission are discarded. Another disadvantage is the definition of emission standards by industrial categories,

and the processes, products and rules of operation of the industries are very variable. In fact, there are still questions in the United States because EPA, in 1993, had 'best available technology' standards for only 51 industrial categories (Adler et al. 1993). Now there are 54 types of industries whose emission standards are defined by EPA (<http://www.epa.gov/docs/epacfr40>), which establishes these standards based on broad public consultation to the whole industrial sector, which also increases the time necessary to define them.

In the United States, 'the best conventional pollutant control technology' is required for the simpler pollutants to be treated (BOD, Total Suspended Solids, pH, fecal coliforms, oils and greases) and the 'best available technology' for the toxic pollutants. Where economically feasible, or where the basin is very saturated, the 'best available technology' is required for all pollutants. USEPA also allows the standard to be based on the '*best professional judgment*' for special cases. In 1993, only one in each three permits in the United States fulfilled the requirement of 'best available technology' (Adler et al. 1993). Today all new permits are given as the "best available technology", since it is considered that a new business will find it easier to implement improvements in their treatment plants (<http://www.epa.gov/docs/epacfr40>).

In a survey performed by the Organization for Economic Cooperation and Development in 1994 (OECD, 1994, *apud* Chave, 1997), cases from 18 countries were studied, that adopted the 'best available technology' to establish emission standards. In 14 of these countries, this standard could not be lowered, even if the environmental conditions allowed it, since the better the environment, the better the sustainability conditions. The European directive indicated in the document IPPC-Integrated Pollution Prevention and Control firmly endorses the policy for the adoption of the 'best available technology' and allows this condition to be relaxed only when the environmental standards are not surpassed.

In any case, it is important that both for the environmental standards and for the discharge limits there be a good dose of realism to determine them. Excessively restrictive standards

raise the costs of treatment and burden society. If there is no investment capacity, often control is simply neglected. The demands must be fitted to the investment capacity, even if the environmental objectives are fixed progressively, allowed the best levels of pollution control to be gradually achieved.

The perspective assumed is that when permits are issued, analysis is performed cases by case and this gradual adjustment can be made. When comparing the environmental standards to the discharge limits, the decision taken could be the one that best adjusts to the effective local conditions, converging in time, control goals and feasibility to perform the necessary investments. It occurs that, as the instruments of Command & Control are based on the imposition (including the legal imposition) of levels of pollution control, usually little power of decision and margin for maneuver is given to the technicians and agencies responsible for the process, subject in many cases to judicial questioning, even if their action was marked by common sense. Thus, decisions tend to become more uniform and bureaucratic, justifying this by saying that, with this, the Public Power treats all agents evenly. As a result of this rigidity, in some cases the economic losses are substantive and even the feasibility of implementing the pollution control processes is ultimately highly damaged. The environmental objectives concerning the integrated vision of the river basin are lost, and the regional differences are not taken into account.





This tendency is found at all places where the Command & Control process is dominant. In the United States, despite the Clean Water Act indicating the possibility of management by basin, this alternative was abandoned still in the 1980s (Adler et al., 1993), in favor of applying the isonomic principles of treatment via the 'best available technology'. The same occurs in Brazil, where the situation of the river basin is rarely examined when the permit is granted. The permits are issued in a point form, evaluating only the emission limits of the pollutants themselves (see Box 2).

However, it should be acknowledged that issuing environmental permits, as well as granting the rights to use water resources, is an in-



strument with a high potential to discipline the situation if it is applied, exploiting its potential to implement what was planned for the basin. The difficulty of using it thus results from institutional limitations. For purposes of planning it becomes necessary to integrate it with other regional planning instruments, such as basin plans, urban master plans, or even guidelines for land use and occupation. This integration, when it actually exists, is weak and runs into difficulties of multi-institutional coordination and the incipency of forms of shared management. For this to occur, the one-dimensional approach to the problem must be surpassed, with a view to dealing with it in a multidimensional manner (Perry e Vanderklein, 1996).

From this broader perspective, integrated management of water quality takes on special importance due to several factors:

-  the multiplicity of technical disciplines involved;
-  the need to integrate scales, ranging from the macroscopic view that sees the basin and its vocations as a whole, to the micro-scale view that tries to act on the polluter and to control his impacts.
-  the need to integrate management mechanisms which are usually found in different institutions, such as the field of the environment and of water resources and those of urban and regional development;
-  the involvement of various levels of government, since the norms tend to be defined within the scope of central power, but the effective solution of problems makes it essential to involve local instances, and this includes the fact that the participation of the community involved constitutes the best mechanism to follow up on the evolution of the expected results to reduce the impacts of pollution.

#### Command & Control Instruments adopted by the National Policy of Water Resources

Among the management instruments foreseen by the National Law of Water Resources of Brazil (Law nº 9.433, of January 8, 1997), one of the classical mechanisms of C&C is outstand-

ing, the granting water use rights. In Brazil after the 1988 Constitution was enacted, the waters were taken over as goods in the public domain, under the responsibility (a) of the federated states (including underground sources) whenever a watercourse develops, from the headwaters to the mouth, within the territorial limits of that federative unit, or (b) in the Union domain when the water bodies drain more than one state, delimit boundaries between them and/or with neighboring countries or else are stored in structures (dams and similar ones), built by the Federal Government. Thus, there are no waters in the private domain.

This constitutional determination implies the impossibility of 'privatizing' the waters, limiting the possibility of action of private agents in the *operation* of infrastructure *systems* which use water (via grant contracts), like power generation or drinking water supply. Another consequence of the current constitutional provisions is that any use of water resources is subject to obtaining grants of rights to use, in the form of a *conditional permit to use*, issued by the Union or by the states, depending on the domain of the water body to be exploited. The exception foreseen in the law itself should be noted, of uses considered insignificant, exempt from the obligation to obtain grants, and thus being characterized in each river basin by the respective committees, as a function of availabilities and demands.

With such legal dispositions, it should be pointed out that grants are a non-transferable right of the Public Power, giving the simple users a formal authorization to use water resources for pre-established lengths of time, and the waters are unalienable because they are destined for the common use of the collectivity. Despite being in the public domain, it is possible to establish mechanisms to negotiate the grants given, if the original conditions and the possibilities of control and management by the State are maintained.

It is by knowing the water availabilities (hydrologic monitoring networks) and registering the demands in a cadastre (uses and users who have received grants) that the Public Power has the conditions to control and manage water, to be performed in two directions: (i) control

of use as regards the user; and, (ii) the control of management objectives oriented towards the water body (Leal, 1998).

*Control of use* establishes conditioning factors (restrictions and standards for intakes and discharges, of the physical characteristics of facilities, location, seasonal frequency and others), and it is point and specific for each users. The non-observance of the conditioning factors established in the permits to use may imply suspension of the grant. In its turn, the *control of objectives*, aims at concerns about the management of the body of water, mainly the balance between availabilities and demands, a guarantee of ecological flows, projections of future scenarios of the basin and achieving water quality goals foreseen by the framework, besides ensuring the priority uses designated for the waters, particularly those of human supply and watering animals, as established by law.

In order to practice these controls the public organs responsible should be well organized and equipped, both as regards the data base and information needed, whenever possible with the help of decision support systems (studies on flow regionalization, cadastres, simulation models and others), and in terms of inspection and monitoring structure, so as to ensure that the conditioning factors established during the concession procedure are obeyed.

One of the relevant issues in granting a concession refers to the way the authorizations to use are expressed. Generally the grants are expressed in absolute values of flow or volume, which could be questioned at places subject to periodic droughts, that are not reliable as to the right granted. An alternative would be to express the grant in terms of percentages of total availability distributing the water deficits proportionally. Another possibility is to establish the scale of priority uses, beginning with human supply and watering the cattle ranging to uses that may be temporarily suppressed in scenarios of extreme scarcity.

For the process of granting concessions, it is also very important to consider the criterion adopted in establishing the so-called “available flow for permitting”. In Brazil, in general this “available flow” is fixed based on Q<sub>7,10</sub> (mini-

mum flow observed for 7 days, with 10-year recurrence periods). Several specialists in the field advocate greater flexibility, suggesting other values corresponding to the flow permanence curve, with higher degrees of risk (Q<sub>95%</sub> or even Q<sub>90%</sub>), as long as the user who received the grant be warned about the probability that his demand may not be fulfilled, because of the absence of water availabilities.

### The Integration of the Command & Control Instruments adopted by the Environmental and Water Resources Policies.

In Brazil, the ensemble of environmental C&C instruments recently received the addition of water resources legislation, by granting water use rights, whose concept, broadened for purposes of effluent emission results in mandatory consideration of the capacity of receiving bodies to support them, introducing concerns about the spatial unit of analysis. Currently, although Brazilian law introduced this concept in 1997, few river basins have information and decision support systems available which will allow the emission of grants for water use rights, for purposes of effluent dilution.

In addition to the limitations that are inherent to the C&C mechanisms, it should be observed that the potential benefit of the other complementary management mechanisms, particularly the use of economic instruments (see further item), may be larger in developing countries, where the general levels of control are lower, in direct proportion to the institutional weaknesses of the State Apparatus, notably of the agencies responsible for environmental management, mostly with serious deficiencies of staff and operational resources, not counting the weaknesses and long legal procedures of the penalties system and the lack of coordination between the institutions responsible, even greater when one considers the different levels of government (Banco Mundial, 1998).

However, it is important to observe that even considering the precarious situations mentioned, no situation (or country) can be seen in which the C&C instruments are simply discarded. In fact, the recent publication (2002) of the European Union Framework Directive




## Box 2

### Integration of Environmental Licenses and Grants of Water Use Rights

Source: Margulis, 2002.

In Brazil, the two national policies that deal specifically with environmental and water resources management are the National Environmental Policy (Federal Law n.º 6.938/81) and the National Water Resources Policy (Federal Law n.º 9.433/97). The time lag between the two probably accounts for the great conceptual differences they adopt. Managerially, the first is characterized by an approach via C&C, based on normative instruments, while the second institutionalizes participatory management, also including economic instruments and more flexible management mechanisms.

Given the superimpositions that exist between the environmental policies and water resources, it is desirable that some form of articulation should exist to overcome the difficulties presented by the Brazilian institutional framework. Three managerial instruments that emphasize the binding of responsibilities should be mentioned.

-  establishing water quality goals to be achieved and maintained in the water bodies, related to the classification of water bodies according to their main uses;
-  establishing restrictions to the use of the environment with a view to protecting the waters, including grants for their use; and
-  charging for water use.

In this context, the first challenge concerns the integration of the procedures between environmental permits and the granting of the right to use the water resources.

Granting the right to use water resources is the administrative act through which the granting public power defined to guarantee the conditions of use of a specific water resource (intake or effluent discharge) according to technical criteria that will ensure resource sustainability. When the water body is in the Union domain, the grant is authorized by the National Water Agency (Agência Nacional de Água –ANA), while for water bodies that are fully inserted in the territory of the State, the authorization is up to the state agency that has jurisdiction. On the other hand, environmental permits are mandatory for ef-

fectively and potentially polluting and/or environment degrading activities, according to Federal and State laws.

The pressing need to integrate the permit procedures with a greater exchange of information between the bodies granting the permit is a consensus, with a view to improving the mechanisms for the relationship between the public powers and the client/users of the systems. It is important, also, that the permit-granting process be seen as a procedure with multiple interrelations and interactions, involving technical and administrative aspects of environmental management, land use and water resources, in order to avoid situations where conflicts may occur between the public powers in charge of analysis and deliberations on the requests received.

Actually, the integrated system requires a broader degree of knowledge that goes beyond the limits of individual and specific attributions of each department. Within an integration proposal, it can be inferred that the instrument of preventive grants, as foreseen in the National Water Resources Plan, tends to function as a conditioning factor for other procedures of authorizations and permits, especially the Prior Permit (LP\_Licença Prévia), an administrative act of granting environmental permits. The preventive grant does not confer the right to use water resources, and its objective is to reserve the flow that can be granted, making it possible for investors to plan undertakings that require these resources, ANA has been tentatively conditioning the presentation of the Operation Permit (LO –Licença de Operação) of the Federal or State environmental agency, to the release of the definitive grant.

One of the most polemical aspects of the water resources policy should also be pointed out: the introduction of the grant to discharge effluents, i.e., the use relating to return of volumes and loads of effluents to the water bodies. From the conceptual standpoint, environmental permits can be considered grants, since they include the permission to discharge effluents into the water bodies, seeking to adjust the discharge to the use of the water resource, after dilution and cleaning. This use must be confronted with

the classification of the water body, so as to avoid letting the quality of water be compromised as regards the designated use, promoting a connection between the management of water quantity and quality (Lanna, 2000).

One of the flaws in applying these instruments results precisely from the fact that often there is no systemic conception of planning, negotiated with society and water resources users, to provide additional information to the concept. This leads to the permit process being analyzed and granted considering only legal demands that establish minimum standards to discharge effluents, even if a weighty capacity of the environment to perform cleaning is identified.

Thus, the assimilation capacity of the water bodies is usually ignored, determining permits guided

by the quality of the effluent and not by the environmental quality. Naturally, minimum standards for effluent discharge should always be applied to toxic and conservative pollutants, which tend to accumulate in the sediments, causing potential damages to the flora and fauna of the water bodies and, consequently, to man.

In the context of this debate, it is the objective of the National Water Agency (ANA) to consider, jointly, the aspects of quantity and quality, using the capacity of dilution and assimilation of the water bodies, especially for the BOD – Biochemical Oxygen Demand parameter. This procedure should be negotiated with the state environmental and water resources management organs, so as to avoid conflicts with environmental permits.

takes on the perspective of complementariness between standards of emission and use of economic management instruments, despite an implementation problem that occurs whenever very restrictive levels of emission end up by restricting the margin of action of the economic instruments, at the limit rendering them innocuous.

In different countries the ensemble of instruments to achieve better pollution evolved through different paths, accordingly to social, economic and cultural aspects (see Boxes 2 and 3).

#### **BUILDING CONSENSUSES: A SOCIAL MECHANISM FOR WATER MANAGEMENT**

A second sphere of mechanisms advances ahead of command and control without abandoning it but, instead, broadening the possibilities of traditional planning. The means are the participatory consensus building processes, which open up spaces to insert the civil society and economic agents with particular interests (public and private) into such negotiation processes.

The perspective is to build a pact defining objectives and establishing consensuses about the desired scenarios, both in terms of environmental quality and the corresponding pro-

rating of social costs. The water resources plans, defined within the scope of river basin committees, constitute good examples of the social negotiation processes mentioned above.

In practical terms, the definition of water quality objectives for water bodies should be treated together (and not singly) with the other instruments, establishing the classification as objectives to be attained by implementing the river basin plans. Water quality objectives together with basin plans must guide investments in physical interventions, as well as the process of issuing water use permits. The articulated treatment of these management instruments (water quality objectives, basin plans and grants) should occur by means of decision processes to be undertaken within the scope of the basin committees (institutional space for management by shared responsibilities). The basin committee characterizes a sphere of consensus building, objectively supporting the decision process. Figure 1 illustrates the interdependences of the process.

The use of water body classification schemes allows a more explicit description of the relationship between water uses and the intended quality objectives. It is very usual for water quality objectives to be expressed or grouped in *Classes of Use*. Thus, they allow the definition of common strategies for uses with similar qual-

### Box 3

#### Evolution of the management mechanisms: the case of the United States

(Source: Porto, 2002)

It can be said that, in the field of water quality management, the *Clean Water Act* is the most ambitious program, based almost exclusively on the Command & Control methodology. The American law for pollution control, enacted in 1972, established the bases of the pollutant discharge reduction program and the recovery of water bodies, constituting one of the most successful examples in applying C&C mechanisms. It created a centralized program in the state governments, under the strong command of the Environmental Agency Program (USEPA), connected to the federal government, with extremely ambitious and restrictive goals. It foresaw the elimination of all sources of pollution and fulfilling two very strict water quality objectives: fishing and primary contact recreation, to be fulfilled in all surface water bodies on American territory.

The good results achieved are undeniable: 80% of the population is covered by secondary sewage treatment plants; the mean removal efficiency of the sewage treatment plants in 1996, was 85%; the levels of dissolved oxygen rose significantly; and, in 1990, 93% of the industries discharged their effluents within the established standards of emission. Between 1970 and 1999, the federal government invested, non-repayable (*à fonds perdu*), US\$ 112.6 billions of dollars to build sewage treatment plants. The state governments invested over US\$ 72 billions. The most pessimistic estimates indicate that, between 1972 and 1993, US\$540 billions of dollars were spent, if the public investments are added to the investments by private industries.

However, even today, 35% of the rivers monitored still do not fulfill the water quality objectives required by law. With such large investments, some consider the results discouraging. The failure seems related to two points: the first, there is a low efficiency in the control of pollution only by the ways of inspection; the second concerns difficulties in controlling non-point sources.

These points clearly indicate the limits of instruments centered on Command&Control. First of all these instruments present a top limit of efficiency which is difficult to surpass, since it originates in difficulties to perform inspection. It is an expensive system, and it is estimated that it costs the American coffers around US\$64 billions a year. Secondly, since the non-point loads do not have a known 'violateur', they simply do not respond to the Command & Control mechanisms.

As a way of improving the system efficiency, recent changes are rather illustrative when seen from the viewpoint of management. The first change was the re-introduction of the concept of river basin in management, with a mandatory evaluation of the Total Maximum Daily Load (TMDL), calculated by river basin, to allow a better-planned and more efficient process of allocating polluting loads. The second change was the introduction of economic mechanism, with market rules to exchange water pollution 'quotas', the so-called negotiable permits.

The Command & Control model adopted in the United States, especially with such restrictive water quality objectives, only persisted practically intact for three decades, due to the huge capacity for financial investment in that country. Besides having financial resources to invest, it also has trained people and equipped institutions available. Therefore, it is not a model that could be replicated in other places. However, first of all we should acknowledge the technological evolution that it provided, in terms of treatment technology, definition of criteria and standards of quality, simulation models and monitoring techniques, with very rich material from which everyone benefits today. Secondly, to be able to observe the behavior of systems and failures generated by the model, in order not to repeat the same mistakes, constitutes an extremely important contribution to countries such as Brazil that still need to develop, almost completely, its water quality management systems.



## Box 4

## Evolution of the management mechanisms: the case of France

(Source: Porto, 2002)

The French experience is interesting due to the fact that the country was one of the first to manage its water availabilities using a decentralized system, taking the river basin as a unit, and also to use economic management instruments. In 1964, the French Water Law provided a great reform in the water resources management system, covering the aspects of intake, water distribution and uses, and also pollution control, creating the charging system. For purposes of management, the country was divided into six river basins. The institutional model was established by means of a division of attributions, and the central government took over establishing norms and regulations, and the basin agencies the executive activities. In each basin there is a Committee, with the participation of the users, representatives of local communities and government bodies.

The Law was reformulated in 1992, for the purpose of promoting greater integration, intensifying the control of water pollution and encouraging further dialogue in planning actions. The following were then introduced: SDAGE (Schémas Directeurs d'Aménagement et de Gestion des Eaux), with general guidelines for the six large river basins, and the SAGE (*Schémas d'Aménagement et de Gestion des Eaux*), which institute the management guidelines in each of the basins (<http://www.eaufrance.tm.fr/>).

The quality objectives foreseen in the 1964 law were very broad. The goal was to attain, in a given horizon, objectives that would represent 'possible' uses, and that would be used to plan the investment and authorize the discharge permits. In 1978 this picture was changed, and the objectives began to be discussed with the community, rendering explicit the costs involved as to the goals to be attained. The objectives thus decided became decrees. The definition of standards is always local in character, and the discharge permits are given based on the environmental stan-

dard desired for the water body, on its hydrologic characteristics and on the volume and concentration of the discharge.

The system of charging provided a great differential factor in the success of the French management of water quality, insofar as it helped provide investment funds that supported the necessary works to be implemented. The system has been in operation since 1969, but its regulation only became ready in 1975, when it began to operate regularly. Charging for discharges, although an important source to finance water quality recovery and conservation, does not cover the capital, operation and system maintenance expenses. In 1997, when the programming of the agencies for the 1997-2001 five-year period was decided, it was estimated that the charges collected would total less than US\$ 8 billions for a need of capital investments on the order of US\$ 16 billions (<http://www.environnement.gouv.fr/ministere>).

Currently, the need to adapt to the European Community Guidelines is leading to renewed discussion about the water law, with a view to a new adaptation. Part of this adaptation comes from the difficulty in controlling agricultural non-point loads. A decision has already been taken to adapt the law to the European Rules, which includes payment of rural loads, besides a general change in charging for pollution.

France appears to be an example of the synergistic result of the use of multiple instruments. What has been learned indicates that the management task appears easier to implement when regulatory mechanisms are attached to economic instruments, since the users tend to fulfill certain rules and be induced to given behaviors (Bower et al., 1981). However, in all the systems presented, it is large investments that prevail together with well-designed institutional structures, always supported by a powerful and compatible legal framework.

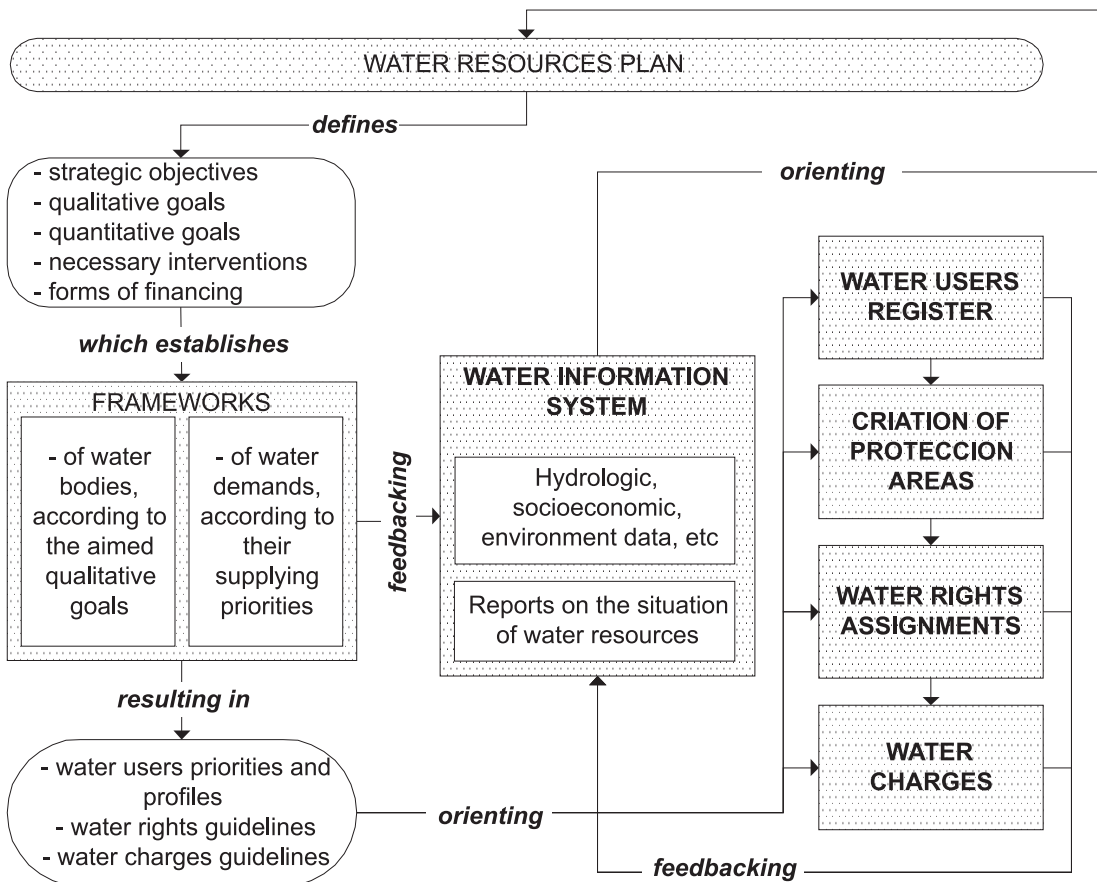
ity objectives. The classification of water bodies is the combination of the instruments *quality objectives* and *environmental standards*, or water quality criteria. In this case, when water body classification schemes are applied, the environmental standards or quality criteria are defined for each class of use.

The definition of water quality objectives, whether it is by class of use or by uses directly, introduces an important instrument, of a general character, which is the classification of water bodies. Classification is the overall process that includes the following stages:

- (i) definition of water uses;
- (ii) definition of quality objectives;
- (iii) establishing the environmental standards or criteria to be served.

The classification should be considered one of the stages of strategic planning in the basin. It is a sign of good strategy, planning to face few adversaries (or resistances) at a time, beginning with the most important. Thus, the classification of water bodies should be a simple process of a clear definition of uses and few water quality objectives to be faced. This means that:

Figure 1.  
The Water Management Puzzle.  
(Source: Lanna, 2001)



- ☞ it is no use to detail many water uses; the most significant for the community in social and economic terms are indicated;
- ☞ it is useless to employ very detailed objectives; it is sufficient to establish what must be supported; in the case of several uses, if they are similar, there is a single objective, and if they are not, it is the more restrictive one that defines the goals to be achieved; and
- ☞ it is useless to work with many variables to define the environmental standard or criterion that will ensure achieving the quality objective.

On the other hand, the classification must have a strong economic foundation. Since it represents the strategy for water quality control in the basin, if there are no sources to finance the necessary actions to achieve it, the quality objectives will never be fulfilled.

Classification is the water quality management instrument foreseen in the 1986 Resolution nº 20 of the National Council for the Environment (Conselho Nacional de Meio Ambiente-CONAMA). Although such an instrument has existed for many years already, it was not often applied to river basin planning in Brazil. There are several reasons for this, one of them being the lack of guidelines that could orient this procedure (Leeuwestein and Cordeiro, 2002).

Another reason, pointed out in this same reference, is the large number of variables that make up the environmental standard related to the quality objectives of the water bodies. While in England eight variables are used, in Japan five for rivers (pH, BOD, Dissolved Oxygen, Suspended Solids and Fecal Coliforms) and seven for lakes (the same as for rivers, plus phosphorus and total nitro-

gen)., and in Canada 20 indicators are applied, in Brazil CONAMA Resolution nº 20 uses 76 variables, which makes it practically impossible to plan a fight on so many simultaneous 'fronts'. From the perspective of review and update of this resolution, it is important that these rules be reviewed in the light of more efficient and effective management techniques.

## 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 the two types of instruments presented in this paper:

- ☞ 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 'consensus building' and the 'economic instruments', which will be presented in Part 2 of this paper, 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.

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