Network for Cooperation in Integrated Water Resource Management for Sustainable Development in Latin America and the Caribbean

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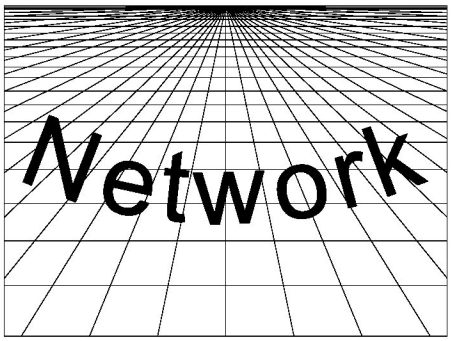
Water resources management must be guided by long-term State policies rather than short-term government policies. The results of good water management can be appreciated when extreme situations occur and, despite those circumstances, economic activities and peoples' lives are not severely affected.



One aspect that reflects the culture of a society is its way of relating to the environment, and this should serve as a model and a demonstration of how to live in harmony with the hydrological cycle. Unfortunately, this requirement is constantly ignored or violated, the most frequent justification being that water policies are subordinate to social, economic or environmental policies. It is essential, however, to be aware that in all circumstances these three objectives have to be balanced and reconciled, as water plays a role in the three areas mentioned.

Water resources management does not always take a prominent position on the agendas of governments or international organizations. Water itself, however, never "disappears" from peoples' daily lives, as an element of the environment, or as a basic need for production and survival. What does disappear for varying periods of time is government concern in this respect, until something happens to remind us that water is not an element that can be controlled by the policies of the moment.

In recent times, as never before, national, provincial and local governments have been assuming increasingly greater responsibilities for management of the environment, and of water in particular, as well as for the regulation of water-related public services and the control of extreme natural events. Such governments need support in many areas, from the reformulation of water policies and staff training in the most isolated municipalities, to support in areas of institutional organization, formulation of plans, financial proposals, academic training, support for legislators who propose changes in water laws, and many other aspects that have been and continue to be the reason for which ECLAC continues its involvement in this area. ECLAC therefore has a commitment to the countries that it intends to maintain.

In 1980 a Water Resources Unit was established at ECLAC with the aim of helping the governments of the countries of the region to formulate water policies that are in line with their social, economic and environmental objectives. The Unit worked on evaluation, analysis, systematization, consultancy services and dissemination of the experiences of the region and other parts of the world in the area of water resources management and the regulation of water-related public services. Today the staff members from that Unit are working in the Natural Resources and Energy Unit of the Natural Resources and Infrastructure Division.

The editorial of our Circular provides an opportunity for disseminating opinions on issues relating to water management. It is based on material collected and observations made during many technical assistance missions to the countries of the region, case studies and studies of related events. In recent issues it has been written by Mr. Axel Dourojeanni with the collaboration of Andrei Jouravlev.

This is the last edition of the Circular to be published under the direction of Mr. Axel Dourojeanni, who retired from ECLAC at the end of November 2002. He will continue working in activities related to water management and we hope that he will continue to contribute to achieving the goals of ECLAC and the region's governments. Mr. Axel Dourojeanni joined ECLAC in 1980 as Head of the former Water Resources Unit, which was created as a result of the recommendations contained in the Mar del Plata Action Plan. Mr. Dourojeanni takes this opportunity to extend greetings to all of his friends and to thank those who have been his colleagues in the area of water for the past 22 years, especially Michael Nelson, Terence Lee, Andrei Jouravlev, Miguel Solanes and Valerie Cunliffe, for their unfailing support, commitment and team spirit. At ECLAC, water issues will now be the responsibility of Miguel Solanes and Andrei Jouravlev.

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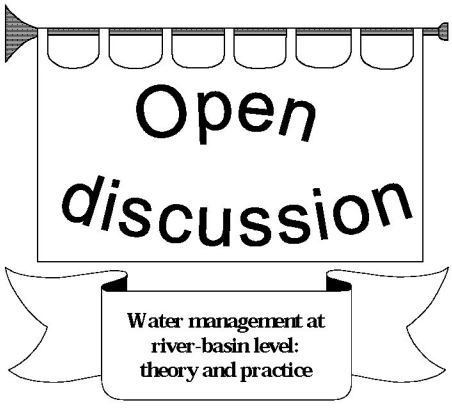


The river basin, whether independent or interconnected with others, is the most widely accepted territorial unit for integrated water resources management. Different approaches

have been taken in the countries of the region, and have been developed to varying degrees, in policies that take the area of a river basin as the basis for water management. Since the end of the 1930s, attempts have been made in many of the countries to adopt models of water management at river-basin level, but there has been, and still is, a series of difficulties. Despite such obstacles, there is widespread interest in establishing and operating river basin agencies in order to improve integrated water management. The issue has become more topical again in recent years, as the region's countries try to achieve goals relating to integrated water management and sustainable development. As a result of that interest, both in recently approved water laws, and in many new legislative proposals and in the modification of existing laws, for the first time there is explicit reference to the intention of strengthening and complementing the management capacity of the national or central water authorities, by creating participatory and multisectoral structures for coordination and collaboration at river-basin level.

The Natural Resources and Infrastructure Division recently published a paper entitled "***Gestión del agua a nivel de cuencas: teoría y práctica***" (*Water management at river-basin level, theory and practice*) (LC/L.1777-P, August 2002), written by Axel Dourojeanni, Andrei Jouravlev and Guillermo Chávez Zárate (see "***Publications***"). This paper is the Division's third publication on river basin management. The first two were called "***Políticas públicas para el desarrollo sustentable: la gestión integrada de cuencas***" (*Public policies for sustainable development: integrated river basin management*) (LC/R.1399, 21 June 1994; see Circulars N° 6 and 7) and "***Gestión de cuencas y ríos vinculados con centros urbanos***" (*Management of rivers and river basins linked to urban areas*) (LC/R.1948, 16 December 1999; see Circulars N° 12 and 13).

The main objectives of this document are: (i) to order, describe and analyze recent experiences of Latin American and Caribbean countries with the creation of water management entities at river basin level, with emphasis on the strategy used by Mexico's National Water Commission (*Comisión Nacional del Agua* – CNA) of establishing and operating River Basin Councils with their auxiliary bodies; and (ii) to collect and summarize inputs from the Division that may be useful for the countries interested in creating participatory and multisectoral water management structures at river basin level.

In this issue we introduce this document. The discussion focuses on the importance of river basins as territorial units in integrated water management. In the following issue we shall have a more in-depth discussion of other aspects of river basin management covered by the document.

All the key international conferences on water resources have emphasized and recommended the area formed by a river basin, or interconnected river basins, as the most appropriate base unit for integrated water management. Accordingly, at the United Nations Water Conference (Mar del Plata, Argentina, 14 to 25 March 1977), it was recommended that the countries consider "as a matter of urgency and importance the establishment and strengthening of river basin authorities, with a view to achieving a more efficient, integrated planning and development of the river basins concerned for all water uses". At the International Conference on Water and the Environment "Development Issues for the 21st Century" (Dublin, Ireland, 26-31 January 1992), it was emphasized that "effective management links land and water uses across the whole of a catchment area or groundwater aquifer" and that "the most appropriate geographical entity for the planning and management of water resources is the river basin".

In chapter 18 "Protection of the quality and supply of freshwater resources: application of integrated approaches to the development, management and use of water resources" of Agenda 21, approved at the United Nations Conference on Environment and Development (Rio de Janeiro, 3-14 June 1992), it was emphasized that "integrated water resources management, including the integration of land- and water-related aspects, should be carried out at the level of the catchment basin or sub-basin" and that the "complex interconnectedness of freshwater systems demands that freshwater management be holistic (taking a catchment management approach)". At the International Conference on Water and Sustainable Development (Paris, France, 19-21 March 1998), it was recommended that bilateral and multilateral assistance agencies concentrate their activities on the "implementation of institutional, administrative and economic reforms to establish river basin organisations and national or regional regulatory authorities".

More recently, at the International Conference on Freshwater "Water: a Key to Sustainable Development" (Bonn, Germany, 3-7 December 2001), it was noted that the "key to long-term harmony with nature and neighbour is cooperative arrangements at the water basin level" and that "watersheds are the appropriate frame of reference for water resources management" and it was emphasized that "watersheds, river basins, lakes and aquifers must be the primary frame of reference for water resources management", and that "institutional and participatory mechanisms need to be developed at this level". Lastly, the Plan of Implementation of the World Summit on Sustainable Development (Johannesburg, South Africa, 26 August-4 September 2002) contains the recommendation to develop and "implement national/regional strategies, plans and programmes with regard to integrated river basin, watershed and groundwater management" and "adopt an integrated water basin approach". Furthermore, the European Parliament and the Council of the European Union, in its Directive 2000/60/EC of 23 October 2000 "establishing a framework for Community action in the field of water policy" recognizes the river basin as one of the fundamental elements of its water policy.

Why are river basins considered the appropriate territorial unit for integrated water management? First of all, it is simply because, in the hydrological cycle, they are the main land forms that collect and concentrate the water supply from precipitation. Apart from this basic physical factor, there are at least three other reasons.

The main reason is that the physical characteristics of water generate an extremely high, and in many cases unpredictable, degree of interrelationship and interdependence (externalities or external effects) between uses and users of water in a river basin. Surface water and groundwater, especially rivers, lakes and aquifers, as well as catchments, recharge areas, water extraction sites, hydraulic infrastructure, and also coastal margins, form an integrated and interconnected system in relation to a river basin.

In the overwhelming majority of "consumptive" uses (such as irrigation and drinking water supply), only a small part of the water initially extracted from a stream is actually consumed. The water that is not consumed —that is, that does not evaporate or evapotranspire or is not transferred to another river basin— returns to the stream at some other point downstream, either directly, through a surface flow, or indirectly, through groundwater, and can then be used again. As a result, the uses and users situated downstream depend to a critical extent on the quantity, quality and timing of the overflows, return flows, or losses from uses and users situated upstream.

There are also uses which take place in the stream itself, and are "non-consumptive" (such as hydroelectric generation, recreation and aquaculture). Although there is not usually any competition between users for the quantity of water used, there is also a high degree of interrelationship, interdependence and reciprocal effects among different instream uses and between consumptive uses and instream uses. The various uses referred to as non-consumptive have different, but interdependent, requirements with regard to

the physical, biological and chemical attributes of the water flow that vary in time and space. All of these attributes are affected by water and land uses taking place upstream.

These interrelationships and interdependencies, in the case of both consumptive and instream uses, take place within the river basin (or group of interconnected river basins). This makes the river basin the appropriate territorial unit of analysis for water management decision-making, especially with regard to multiple use, allocation, and pollution control.

One aspect to emphasize is the one-way and asymmetric nature of the interrelationships and interdependencies between the uses and users of water in a river basin. The external effects, both positive and negative, caused by the interrelationships and interdependencies among multiple water uses and users, are always propagated —by means of overflows, return flows or losses— from the uses and users situated upstream to the uses and users located downstream. In other words, what happens upstream almost always has an effect on uses and users located downstream, whereas what happens downstream is very unlikely to have any influence on users located upstream.

Therefore, as a general rule, the users located upstream are not very interested in the effects of their actions and decisions on the uses and users situated downstream, and hence they tend to take advantage of their privileged position. The users located downstream have no means of controlling them unless there is external regulatory intervention. This fact severely restricts the possibilities of negotiations or transactions among individual users or their collective action alone being insufficient to achieve a resource use that is economically optimal, socially just and environmentally sound, and this is why State intervention is justified.

The second reason is that river basins are an area where water is interdependent and interacts with the physical (natural resources) and biotic (flora and fauna) systems, in a continuous and dynamic process. Changes in the use of natural resources upstream, especially land, alter the hydrological cycle within the river basin downstream in terms of quantity, quality and time. This is why it is best to work in the area of a river basin to achieve integration between water management and use, on the one hand, and management, use and control activities for other natural resources that have repercussions on the water system, on the other hand.

These considerations help explain the importance attached to watershed management activities within water resources management. The purpose of such, as originally conceived, is to manage the surface and subsurface of the river basin that collects the water in order to regulate the flow in terms of quantity, quality and time.

Third, a basic characteristic of river basins is that they form the territory within which the interrelationship and interdependence arises between the physical and biotic systems on the one hand, and the socio-economic system, consisting of the users of river basins, whether as inhabitants or external actors, on the other hand. In mountainous areas, river basins form natural axes for communication and trade integration, along the rivers or the ridges that separate them. In river basins with heavy flows of water and extensive and relatively flat valleys, the axis of the rivers also provides a zone of connection for the inhabitants, especially for use in navigation, transport and communication.

The territory of the river basins, and especially the channels, facilitates interaction among the individuals living there, although they are grouped within the basins in territories defined for political and administrative reasons (municipalities, provinces, regions, states, etc.). Their dependence on a shared water system and on access roads and routes, and the fact that they have to face similar risks, give the inhabitants of a river basin common socio-economic and cultural characteristics.

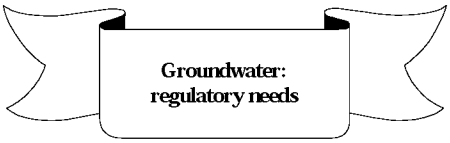
Although the river basin is generally recognized as the most appropriate territorial unit for integrated water management, this is not the only desirable or possible arrangement for the management of natural resources or of the environment in general:

- ***Hydrologically***: the natural surface boundaries of a river basin do not necessarily coincide with groundwater boundaries; obviously, they do not include the marine areas where a large part of the hydrological cycle is generated; and generally do not include coastal margins and deltas where the water drained by a river basin has a determining influence. At the same time, the boundaries of river basins are, in general, less important in relatively flat or extremely arid areas, and should be extended if, owing to proximity or the configuration of the hydrological systems that form them, two or more river basins are interconnected, and produce hydrological regions or subregions which generally have the same productive and ecological characteristics.

- ***Politically***: the boundaries of river basins create complex administration systems for the different levels of government (national, central or federal, state, provincial, regional, municipal, indigenous communities, etc.), which, on the one hand, are responsible for directing, administering or facilitating management processes relating to natural resources and the provision of water-related public services and, on the other hand, must interact with other levels of government in order to resolve shared problems. The political and administrative boundaries are superimposed on the boundaries defined by nature.

- ***Institutionally***: in many cases the territorial areas of action of public and private organizations do not coincide with the natural boundaries of the river basins, which makes coordinated water management difficult. In fact, whereas the river basin is the unit that determines the supply of water, many of the decisions that determine the demand for water and the related public services and that affect water availability, are not taken in the river basin concerned, but by actors external to the river basin.

The adoption of the territory defined by one or more river basins as a unit for the purposes of managing water and the associated natural resources is, therefore, an option that is more or less appropriate depending on the political, economic, environmental and geographical characteristics of the surroundings and the management objectives concerned.



We introduce the document entitled "***Aguas subterráneas: necesidades regulatorias***" (*Groundwaters: regulatory needs*) produced for the Annual Chilean Water Law Conference organized by the Catholic University of Chile by Miguel Solanes, Regional Adviser on Water Law and Public Service Regulation of ECLAC and member of the Technical Advisory Committee of the Global Water Partnership (GWP).

The groundwater issue

There are complex technical problems in the use, conservation and optimization of groundwater. Groundwater is water situated beneath the earth's surface which is potentially usable. It should be distinguished from underflow waters, which are connected to a surface channel and flow beneath the bed of the river that they belong to.

The fact that a specific type of water is considered as groundwater does not imply that it is separate from the hydrological cycle, and it may even be connected in such a way

that the use of water considered as groundwater has a negative impact on surface flows. There are situations, however, where bodies of water stored below the earth's surface have become separated from the hydrological cycle and have no way of re-entering it. These are known as fossil or connate waters.

Groundwater does not take on the forms of surface water resources, as it appears as deposits with defined but inexact boundaries, consisting of liquid and solid parts. In view of the associated technical difficulties, hydrological knowledge is a growing component in the legislative processes and judicial decisions concerning water.

Water management and soil management are intimately related, as there is inevitably a connection between the management of groundwater and surface water. This is why regulations for groundwater are based on the aquifer as a whole, taking into account the well fields, the recharge area, and the interconnection with surface water, that is, the whole extent of the aquifer, rather than on legal abstractions taken out of context, which would be the case if considering solely whether one particular borehole gives water or not.

Consequently, the legacy of earlier legislation in which groundwater is managed as an separate entity is an unfortunate reminder of times of great ignorance about aquifers. The economic aspects of groundwater management should also be taken into account, as the pollution or depletion of such water may affect the economic activities in the extraction areas. There is also a similar impact from the application of subsidies that may encourage water use beyond the effective demand for products, or beyond the sustainability of the aquifers. This is why economic criteria have been applied in some jurisdictions to deny permission on the grounds of adverse effects in local areas, or in administrative statements of unreasonable pumping levels, when an economically more powerful user imposes an impossible level of costs on poorer users.

Groundwater may or may not be a renewable natural resource, depending on whether or not it is integrated into the hydrological cycle. The techniques for its regulation and use vary from one case to another. Aquifers connected to the hydrological cycle, or aquifers that are recharged, must be managed in such a way as to ensure a yield that is indefinite over time. Such aquifers must be maintained. Aquifers that are not recharged cannot be exploited indefinitely, although there are ways of ensuring that they are used for a limited period with the maximum economic and social benefits.

A related problem is the issue of the economic implications of groundwater. The latter has traditionally been known as a "common property resource", meaning that individuals have the right to use the resource free of charge, sharing it with others. As there is no price attached, there is no incentive for users to reduce present use for the sake of the future. On the contrary, anyone who does not make use of the resource with a view to preserving it runs the risk of his share being taken by someone else, so that his final share would be less. This gives rise to a situation where each individual wishes to maximize his or her use, resulting in excessive exploitation and leading to depletion or exhaustion of the aquifer, which in some cases is unnecessary and in others premature. There is no individual private incentive for rational use.

The social consequences are serious: the resource is used at a higher rate than is desirable and the economic activities based on it are terminated prematurely. This also leads to the disappearance of ecological systems that depend on the groundwater.

Situations such as these require State intervention to regulate the resource and establish legal and economic measures to encourage its rational use and maximum exploitation. With regard to the economic arguments, the conclusion is that the most efficient incentive for conservation is to establish charges or fees for extraction.

The regulatory schemes should take into account the fact that groundwater has special characteristics that are very advantageous. These include the fact that the water is naturally stored, is usually of good quality, is not lost through evaporation and can be obtained relatively easily by drilling.

Joint use

Groundwater and surface water use has to be integrated due to the connection between all components of the hydrological cycle. Many sources of surface water, such as springs, rivers, lakes and lagoons, depend, partially or totally, on groundwater. The latter, in turn, is fed from surface streams, from which the water filters through to aquifers.

For this reason, water laws have to recognize and take into account the relationship that exists between surface water and groundwater. The rights to both types of water sources should be integrated and their use should be organized and managed jointly. There should not be any separate legislation for groundwater and surface water. The laws should be unitary bodies that cover all the different sources of supply.

In places where the water sources are connected in this way, water use should be managed in order to maximize the benefits to be derived from both, authorizing or requiring users to substitute one form of supply for another. A closely related issue is the need for the sources of surface water and groundwater to be managed by public bodies, even when they are made up of users.

The integration of groundwater and surface water extraction is still at a primitive stage. This means that, in some places, traditional uses of and rights to surface water, such as ponds, wetlands, springs and brooks, are affected by groundwater use. Part of the problem is due to the ignorance and inertia on the part of uninformed users and non-proactive administrations. In some places, however, integration of surface water and groundwater extraction has been achieved.

Achieving a balance between water recharge and extraction

The balance of an aquifer, or its prudent use in the case of aquifers without recharge, can be maintained by means of economic incentives or legal measures.

Economic measures mainly consist of charges for pumping, which mean that for each usable aquifer, with well defined boundaries, there is a management district whose administrators aim to maximize the net benefits over time. The district may adopt a pricing system for water extraction, imposing a charge for the volume of water extracted. The pumping charge would play a regulatory role, but should vary according to the volumes consumed. The charges would be increased for larger volumes, in order to help keep extraction within established acceptable limits.

The funds collected could be used for improvements or to finance research. Such funds should not be returned to the groundwater users in the form of a subsidy, as this would remove the incentive inherent in a unit consumption price that ensures more efficient water use.

This is where the law of diminishing returns has one of its most useful applications. If additional water units have a cost, they produce fewer returns than the preceding units. Accordingly, the existence of a price, in the form of a charge, will encourage more prudent use of the resource. The absence of such charges may lead to the waste or premature depletion of the resource.

An alternative means of regulating groundwater use is to establish fixed and stable quotas for use. The quota may be based on previous consumption. When this system is adopted, each user may consume a fixed volume determined by the magnitude of the initial pumping levels.

The total volume to be extracted is determined by what is considered technically acceptable. This system, although it protects the aquifer, does not encourage more efficient water use, because each person will use his or her allowance —if the units included in it do not have a price— in the most convenient way from their point of view, even if the use is not the most economically valuable. One way of correcting this situation is to combine a quota system with an overall total limit on aquifer exploitation that does not compromise it, and a pricing system that encourages rational use.

Furthermore, from a purely economic point of view, it has been recommended that groundwater rights be freely transferable between properties. If this is causing groundwater depletion, the State, as well as establishing regulations for use, complemented by measures that encourage joint and more efficient use, may announce a closed season or a prohibition of use for a specific period of time. The objective, in any case, should be to move towards a prudent use and conservation of the resource. Not only physical factors, but also economic, social and ecological factors should be taken into account. Studies of the impact of groundwater use should be carried out prior to authorization of such use.

Groundwater quality

The effects of groundwater pollution may be very serious, as they take a long time to manifest themselves and are then long-lasting, and very often with characteristics that compromise the entire future use of the aquifer. The possible causes include contamination by cesspools, filtration of oil, salt water intrusion, fertilizer and pesticide residues, waste water and industrial residues. The research plan should therefore determine not only the volume of groundwater but also its quality and the factors that affect it.

The regulatory standards should cover drilling, operation and closure of wells in order to protect groundwater quality. Companies that drill wells should be controlled, with permits required prior to drilling, as well as reports on operation and maintenance tasks and on the quality of water obtained.

For groundwater preservation it is not sufficient to merely regulate the activities that have a direct impact, but there should also be control of those that might have indirect effects. Such activities include oil and mining operations, and in general, all activities involving extensive areas of land.

Information needs

The State should conduct research in order to establish: how much water there is, where and when it is found, water quality, the useful life of the aquifer and what would be the effects of developing and using the resource. As many aquifers depend on surface water for recharge, the difficulties in predicting their occurrence will be the same as for surface water, plus the particular problems involved in predicting the movement of water situated below the earth's surface.

Groundwater data are generally difficult to obtain, expensive and less accurate than comparable data for surface water. This means that extra care is needed in research. The results should be managed and distributed in such a way that individuals who use groundwater can easily understand them without requiring any technical knowledge.

Aspects to be covered by the research should include the following:

- the boundaries of the aquifer, its depth, saturation and transmissivity;
- the potential for artificial recharge;
- the depth, quality and temperature of the water;
- the storage capacity, at various levels;
- the sources of contaminants found in the aquifer;
- the natural discharge of the aquifer, main withdrawal points, recharge sources and volumes, the potential yields and the effects of pumping on surface water flows;
- the scale of the problem of aquifer depletion and the economic useful life according to present or future rates of exploitation; and
- the potential for managing the aquifers to obtain a continuous yield.

Groundwater use should be regulated on the basis of this information.

Comparative legislation: background and modern trends

Traditionally and since Roman times, groundwater has been considered part of the land, so that the owner of the surface property has had an absolute and exclusive right to its use. This Roman principle is commonly encountered in all legislations of the nineteenth century and the beginning of the twentieth century. Gradually, as the interdependence of surface water and groundwater is confirmed, together with the possibility of groundwater depletion, protective measures are being included in legislation.

Modern legal frameworks tend to regulate the use of this resource, either through the public domain or by exercising State police powers. State regulation is a necessary consequence of modern exploitation techniques. Earlier techniques did not involve large-scale incursions on the resource. With exploitation on a limited scale, the impact was marginal, and as a consequence, legal regulation was not essential. Modern techniques allow large-scale exploitation, practically on an industrial scale. The impact of this as well as the impact of the resulting pollution, can be serious. The need for regulation is therefore generally accepted.

The United States of America offers us an example of a clear and sequential development of public-interest, pragmatic and preservationist legislation, that works towards the sustainable use of groundwater.

Absolute dominion

At first, English Law was applied, which fully accepted the Roman principle of the extension of dominion above and below the surface. The unrestricted dominion of the overlying land was accepted, and the owner could make free and individual use of the water if able to extract it. According to this rule, even malicious or destructive use of water was protected by law. The excesses arising from this rule of absolute dominion resulted in significant changes towards more equitable perspectives, as it did not prevent aquifer depletion, and thus came to be seen as a form of ecological and economic suicide.

Reasonable use

The above rule was subsequently moderated by the reasonable use and correlative rights principles. According to the reasonable use principle, water may not be wasted, or removed from the area overlying the aquifer. As water is used, the equal rights of those owning the land above the aquifer must be taken into account. This principle is applied according to the maxim *sic utere tuo alienum non laedas*, according to a criterion of reasonableness.

Equality of rights can only be fully enjoyed with the understanding of the correlation of obligations and rights, in that the rights of ownership are always limited and never absolute. "Reasonable" in this context is a factual issue. But this principle should not be interpreted as implying an element of shared uses and rights. "Reasonable" only means that the use is appropriate, but within such limits, a reasonable user may take all the water available, provided that such use is not malicious or wasteful, and does not involve exporting the water out of the area.

Correlative rights

According to the principle of correlative rights, owners of the overlying lands of an aquifer have a preferential right to make use of it, in proportion to the extent of their properties. This principle is in fact just one

aspect of reasonable use. The distinction between the two is that even when applying the reasonable use principle, the flow of neighbouring wells may be reduced, whereas in the case of correlative use, such rights are proportional to the area overlying the aquifer, and the principle of proportionality must constantly be respected. When there is insufficient water it is allocated on a pro-rata basis. There is thus an element of obligation to share among all the landowners.

According to the principle of correlative rights, it has been resolved that the installation of wells and pumps with sufficient power to extract water from an entire region and to prevent its return by means of commerce, is unreasonable with regard to those whose lands are being clandestinely deprived and which are thus losing value. In this case, the objective of exporting the water was considered a less natural use than keeping it within the basin.

First appropriation

Other western states of the United States apply another rule: first or prior appropriation. There is a physical limit beyond which no new drilling is tolerated. These states have included groundwater in the public domain, with limits on exploitation. This limit, as in the case of surface water, is determined by water availability.

In these states there is a sustained trend towards integrating the use of surface water and groundwater. In view of the economic disaster that could result from poor management of groundwater, there has been an increase in the administrative control of such water with regard to the reciprocal impact of surface water and groundwater. In parallel, these states have increased controls on water and the requirement for permits for its use, with regulation of drilling activities and drillers, and the recognition of pre-existing rights.

The granting of permits is entirely dependent on the informed judgement of the administration. The administrative judgement may not be reversed, unless there is clear proof of abuse of power or arbitrariness. The judiciary is strongly inclined to defer to the technical conclusions of the administration.

In the process of granting or denying a permit, importance is attached to effective notification of potentially affected parties and to not causing damage to pre-existing rights. There are no rights without use, and non-use results in the loss of rights. Rights depend on use and are of indefinite duration. Reasonable pumping levels must be defined and respected, and the extraction methods must be reasonable.

The transfer of rights is permitted, but actual historical use, aquifer boundaries, well levels and hydrostatic pressure must be taken into account, as determining elements and externalities inherent to the transfers. In this way, transfers may not be denied unless they affect the public interest or the interests of third parties. There may be limitations regarding a change in the timing of use, when rights are transferred among seasonal uses and other uses that are continuous over the year, such as from irrigation to industry or mining, when there is substantial damage to third parties.

In all cases the regulatory schemes are evolving into permit systems, regardless of whether in the past they applied the English rule, reasonable or correlative use, or first appropriation. Permits are recorded and administrators decide on the location and construction of wells, the volumes of water to be pumped, allocation in times of scarcity, and the penalties and loss of rights upon violation of the permit conditions.

Regulatory schemes for groundwaters

The minimum contents for legislation in this area are as follows:

- A clear, precise and comprehensive definition of waters considered as groundwaters.
- Identification of the qualities and elements of aquifers that are to be protected and establishment of guidelines to limit exploitation.
- Requirements for a balance between extraction and recharge, in the case of aquifers with recharge.
- Authorization for the State to decide on the period of use and exploitation methods for aquifers without recharge.
- Definition of customary uses and their exploitation methods.
- Definition of requirements for access to private use of public waters.
- Definition of the legal nature and extent of the title by virtue of which private uses are permitted.
- Exact definition of rules for exploration and exploitation.
- Identification of data and information that groundwater users must supply to the State.
- Definition of the basic rules for organizing a system of registration and cadastre.
- Establishment of ownership limits according to the use of groundwater.
- Establishment of water protection and conservation measures.
- Establishment of a basis for creating exploitation districts.
- Establishment of a basis for a system of charges, especially in relation to groundwater.

ECLAC, acting through the Natural Resources and Infrastructure Division, and with the support of the German Agency for Technical Cooperation (GTZ), is implementing the project "***Prevention and reduction of the danger posed by natural disasters***" (see Circular N° 16). The project activities include the following case studies:

- ***Argentina***: Arroyo del Medio sub-basin, municipalities of Pergamino, Colón and San Nicolás, Buenos Aires Province.
- ***Chile***: "*Prevención de desastres naturales: visiones de los actores institucionales*" (*Prevention of natural disasters: views of the institutional actors*) and "*Prevención y mitigación de desastres debidos a eventos hidrometeorológicos en la cuenca del Río Limarí, IV Región*" (*Prevention and mitigation of disasters caused by hydrometeorological events in the Limarí river basin, Fourth Region*).
- ***Colombia***: Tunjuelo river basin, Bogotá Municipality.
- ***Peru***: Sisa river basin, Department of San Martín.

These studies are expected to be completed by mid 2003, and local and regional seminars and workshops will then be held.

Additional information is available from:

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ToolBox is a tool designed by the Global Water Partnership (GWP) to support the development of integrated water resources management. GWP recognizes that a huge amount of knowledge and experience exists around the world in the field of integrated water resources management. Professionals

from a variety of backgrounds have participated in creating this tool, including Judith Rees from the London School of Economics, Peter Rogers from the University of Harvard and Miguel Solanes from ECLAC.

The collection of all these experiences provides a powerful tool for the development and implementation of sustainable water resources management. The key for taking advantage of this capacity lies in sharing this know-how with policy-makers, practitioners, academics, experts and water users, wherever they are situated around the world. ToolBox draws on the wealth of global experience of practitioners in the water sector, specialists and decision-makers. It includes a range of different approaches and policy options, and key lessons learned, illustrated by actual cases from all over the world. Each set of tools includes references, organizations, resource persons and the relevant Internet addresses.

ToolBox is structured around three basic elements of integrated water resources management:

- The appropriate environment, or "rules of the game", defined by legislation, and policy and financial structures.
- The institutional role of resource administrators, service providers, irrigation agencies, public services, basin authorities, regulators and other stakeholders in the water sector. Capacity-building supports the functions needed for these roles.
- Management tools — for assessment of water resources, demand management, public education, conflict resolution, regulatory mechanisms, economic measures and information and communication.

Readers are advised to consult ToolBox at the following address: *http://www.gwpforum.org*.

SAMTAC

The ***South American Technical Advisory Committee*** (SAMTAC) was formally constituted in 1998, as part of the activities of GWP, an organization established in 1996, which is an international network open to all the agencies involved in water resources management. At present, the SAMTAC secretariat is carrying out its functions in the Natural Resources and Infrastructure Division of ECLAC.

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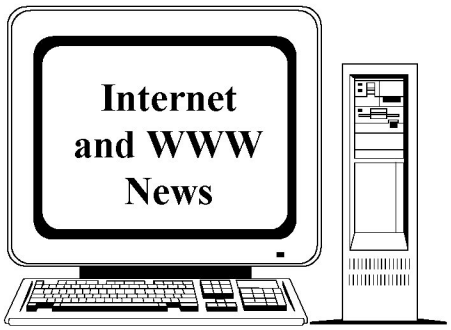


We highlight the following websites worth visiting for information on water resources management and use:

- The ***Second Meeting of the Association of Water and Sanitation Regulatory Entities of the Americas*** (ADERASA) took place from 25 to 28 September 2002 in Santa Cruz de la Sierra, Bolivia (see Circular N° 15). Further information is available from *http://www.cra.gov.co/htm/publicaciones/boletin/Aderasa4i.htm*.

- The goal of the ***Dams and Development Project*** (*http://www.unep-dams.org/*) is to promote a dialogue on improving decision-making, planning and management of dams and their alternatives based on the World Commission on Dams (WCD) core values and strategic priorities. Building on the dialogue of the WCD and the core values and strategic priorities expressed in its report, the objectives of the Dams and Development Project (DDP) are to: (i) support country-level, regional and global dialogues on the WCD report and the issues it addresses with the aim of engaging all stakeholders with emphasis on those not currently involved; (ii) strengthen interaction and networking among participants in the dams debate; and (iii) support the widespread dissemination of the WCD report and the report of the Third WCD Forum, and make available other stakeholders' responses; and facilitate the flow of information and advice concerning initiatives relevant to dams and development.

- The ***Environmental Management Secretariat for Latin America and the Caribbean*** (EMS) (*http://www.ems-sema.org/*) is an international secretariat managed by the International Development Research Centre (IDRC). EMS started activities in August 1996, from the Latin America and Caribbean Regional Office of IDRC in Montevideo, Uruguay. The Secretariat provides the coordination of donors to promote the use of best practices in environmental management in the countries of the region. EMS focuses its activities on the field of managing urban environmental problems through the promotion of applied research with emphasis on strongly holistic and participatory approaches. To subscribe to the ***INFO-EMS*** list, an electronic bulletin on its activities, go to *http://www.ems-sema.org/english/noticias/news.htm*.

- The overall objective of the recently created ***Latin America Water Education and Training Network*** (LA-WETnet) is to promote the formation of human resources for integrated water resources management and service provision in the countries of the region (*http://www.cap-net.org/ShowNetworkDetail.php?NetworkID=43*). Its specific objectives are: (i) to improve access and exchange of education materials and training in water resources management and service provision in collaboration with water subsectors; (ii) to encourage joint research; (iii) to facilitate information exchange across the region on water resources management and training; and (iv) to foster public awareness regarding use and management of water resources.

- The electronic version of the journal "***Ingeniería Hidráulica en México***" (*Hydraulic Engineering in Mexico*) is available at *http://www.imta.mx/otros/RIHM/rihm.htm*.

- The ***Latin American Groundwater for Development Association*** (*Asociación Latinoamericana de Hidrología Subterránea para el Desarrollo* – ALHSUD) – ***Chilean Division*** is a non-governmental organization founded in 1989, whose objective is to encourage education, research and human resources training and to promote the exchange of information and knowledge relating to groundwater practices in Chile. Many interesting documents are available from its website (*http://www.alhsudchile.cl*), such as "*Desafíos para una gestión sustentable de las aguas subterráneas en Chile*" (*Challenges in sustainable groundwater management in Chile*) and "*Legislación comparada – sistema legal de regulación de aguas subterráneas en España, Estados Unidos, Francia y México*" (*Comparative legislation – the legal systems for groundwater regulation in Spain, the United States, France and Mexico*).

- The ***General Department of Irrigation*** (*Departamento General de Irrigación* – DGI) of Mendoza province in Argentina is responsible for general water administration and also for considering and resolving all issues relating to water within the province. This institution has an extremely interesting institutional design. The DGI is a decentralized and autonomous organization that approves its own expense budget and resource calculation. It has dual autonomy:

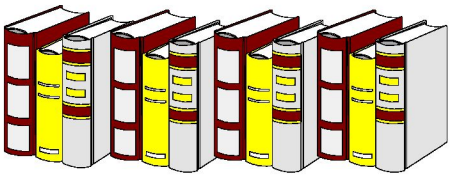
institutional and functional, so that it is not hierarchically subordinate to any other power of the central government; it also has financial and budgetary autonomy, as, under the supervision of the accounts office of the province, it controls its own resources. More information about its activities is available on the DGI website at: *http://www.irrigacion.mendoza.gov.ar/*.

- The ***Water for the Americas in the Twenty-First Century Forum*** was held in Mexico City, Mexico, from 8 to 11 October 2002. The objectives were: (i) to analyze the status of water resources and their administration in the Americas; (ii) to share experiences, strategies and case studies relating to the sustainable use of water in the Americas; (iii) to contribute to the formulation of a hemispheric perspective for the Americas for the Third World Water Forum, to be held in Kyoto, Japan, in 2003; (iv) to boost regional cooperation on water-related issues; and (v) to explore the possibility of reaching a consensus on a document to be presented to the Ministerial Conference of the Third Water Forum. All of the materials of the Forum (background documents, statements, conclusions, presentations, lectures, etc.) are available from: *http://financiamiento.sgp.cna.gob.mx/evento_2002/index_aa.htm*.

- The ***National Water Resources Institute*** (*Instituto Nacional de Recursos Hidráulicos* – INDRHI) of the Dominican Republic was established by Law N° 6 of 8 September 1965 in order to manage and protect surface water and groundwater throughout the country. Its main objective is to ensure a high-quality, sufficient and timely supply of water and hydroenergy in the present and future, at the lowest possible cost and at an acceptable price, through the management, planning, development, production and regulatory control of the water sector. Its website (*http://www.indrhi.gov.do/*) contains a wealth of information about its activities.

- Many interesting documents are available from the web site of the ***Third World Centre for Water Management*** in Mexico (*http://www.thirdworldcentre.org/*) such as: "*Environmental sustainability of water management in Mexico*", "*Contribution of women to the planning and management of water resources in Latin America*", "*Análisis y perspectiva de los recursos hídricos en la República Argentina*" (*Analysis and prospects for water resources in the Argentine Republic*), "*Análisis y perspectiva del recurso hídrico en México*" (*Analysis and prospects for water resources in Mexico*), "*Los Consejos de Cuenca en México*" (*River Basin Councils in Mexico*), "*La participación de la sociedad civil y los gobiernos locales en el manejo de los recursos hídricos en México: la experiencia del Estado de Guanajuato*" (*The participation of civil society and local governments in water resources management in Mexico: the experience of Guanajuato State*).

Publications



Recent publications from the Natural Resources and Infrastructure Division on water-related issues:

- "***Gestión del agua a nivel de cuencas: teoría y práctica***" by Axel Dourojeanni, Andrei Jouravlev and Guillermo Chávez Zárate (*Serie Recursos Naturales e Infraestructura* N° 47, LC/L.1777-P, August 2002) (available in Spanish only) (see "***Open discussion***").

- "***La contaminación de los ríos y sus efectos en las áreas costeras y el mar***" (*River pollution and its impacts on coastal areas and the sea*) by Jairo Escobar (*Serie Recursos Naturales e Infraestructura* N° 50, LC/L.1799-P, October 2002) (available in Spanish only). Around 70% of marine pollution is the result of human activities that take place on the earth's surface. About 90% of contaminants are transported by rivers to the sea. At the same time, about 75% of the world's population is situated at the coast or close to it, especially in urban areas, where a significant part of the waste produced is deposited directly into the ocean. As a result, many critical ecosystems, such as mangrove forests, coral reefs, coastal lagoons and other interface zones between land and sea have been altered beyond their capacity to recover. Modification of the course of rivers that drain into the sea and alteration of their water flow, owing to dam construction, sand and gravel extraction or irrigation, have also affected marine ecosystems and associated environments. The objective of this document is to present a regional overview regarding pollution originating in river basins and transported by rivers, as well as the environmental impact that this has on the sea and on coastal areas. There is a discussion of policies and tools that can be applied in order to control the pollution of seawater and how they are used by the countries of the region.

The publications of the Natural Resources and Infrastructure Division are available free of charge in two formats: (i) printed documents, single copies of which are sent by airmail (while supplies last); and (ii) electronic files (Microsoft Word or PDF formats) which are sent as e-mail attachments, or may be downloaded directly from *http://www.eclac.org/drni*. Requests should be sent to ***ajouravlev@eclacl.cl*** or ***Natural Resources and Infrastructure Division, ECLAC, Casilla 179-D, Santiago, Chile***.

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