Groundwater and pollution of water resources

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The drafters of water legislation in the developing countries are faced with two major challenges: first, to make the law a suitable instrument for promoting social investment in the development of water resources; and second, to devise machinery which will protect those resources in all their different forms. This paper addresses those challenges. It also discusses the ways in which the law deals with the problems of water and the pollution of water resources. The concept of economic externalities is of basic importance in any consideration of both of these questions. The goal is to handle them with legal instruments designed to prevent individuals from taking action which affects the welfare of other users or which impedes the conservation of water resources for the purposes of their development and long-term utilization.

For the purposes of this paper, we understand the term 'groundwater' to mean water that has been discovered under the ground and used by people. Groundwater has several advantages as a source for irrigation and for drinking water and sanitation. The advantages are *inter alia*: groundwater is naturally protected from losses by evaporation; it is generally of good quality; and it does not require a major piping system because it can usually be extracted at the place where it is to be used. Investments made to extract it can usually be adjusted to effective demand without the over-investment so often associated with surface water projects.

However, the unrestricted use of groundwater gives rise to a number of serious problems. When these problems persist, the viability of related water projects is affected and the loss of such a production base has serious socio-economic repercussions. Sometimes, the unrestricted use of groundwater is adversely affected by the provision of subsidies to individual users for its extraction. Those subsidies are welcomed by the users because they represent an income which they would otherwise not have. They also allow the user to build his own independent, individual water supply system.

If groundwater is over-used, the aquifers are undermined. In areas near the coast, seawater intrudes, the water becomes brackish and the solid parts of the aquifer become compacted and crumble. Groundwater may become polluted, either from general or specific causes, such as the underground piping of various products and residues, the injection of residues from wells and the infiltration of sewage. Overuse and pollution of groundwater is a fairly recent event: they are the result of industrial development and mass-development techniques.

In the past, groundwater was relatively unimportant in economic terms. People did not realize that it was linked to the hydrological cycle. If there were any laws regulating it, they consisted mainly in recognizing the rights of surface ownership. Measures of protection tended to be concerned with individual investment rather than with a common resource. The rights of surface owners were usually unlimited so that any limitation to that right would require proof of malice or intent to damage.

Obviously, this unrestricted use of groundwater could last only on two conditions: that its significance remained unknown and that simple and limited techniques were used in its exploitation. Once these circumstances changed, groundwater became regulated by means of two classic legal devices: public domain and policing power. Under the first, groundwater is transferred to the public sector. Under the second, it is

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The opinions expressed in this report are those of the author and do not necessarily reflect the views of the United Nations.

0165-0203/92/030226-06

regulated in accordance with the requirements of the general desire to protect a common resource.

Groundwater is controlled by three instruments:

- *Legal provisions*: they establish the conditions for water use, such as the need for use and drilling permits; registration and survey of rights, acquifers and wells; obligation to provide information; regulations as to how the water is extracted and used; imposition of penalties; and so on.
- *Technical rules*: they establish districts for the use and exploitation of groundwater and are directly related to supply and demand in specific areas, to the characteristics of the aquifers etc.
- *Financial rules*: they provide for tariffs to be applied to groundwater use as a multi-purpose measure; the purposes may include the recovery of costs of underground water use and the regulation of such use.

Legal origins of groundwater regulation

Under the French system of law based on the Napoleonic Code, groundwater is subject to dual ownership – public or private – depending on the nature of the country where the water was found (eg France, Portugal and Spain).

Legislators basing their regulation on English common law considered that water was by definition a common good. It could not be owned but only used – in a reasonable way – by people living near to it. Groundwater was the property of the person extracting it, the rights of the driller could only be limited by judicial order, ordinance or administration regulation.

However, not all groundwater was subject to the same rules. Underground 'watercourses' could not be privately owned. But all other types of groundwater (lakes, swamps, artesian wells and percolating waters etc) could be. The surface owner had full rights of ownership and use of percolating waters.

The English common law system was transferred to the colonies and areas of English influence. However, the English legal system is undergoing the same changes as its political systems. The role of the state becomes stronger; the rights of individuals become weaker. The curious thing is that the English system is being modified by the use of policing power and not by the transfer of water to the public domain.

The English doctrine has been applied in the USA in a modified form. In some cases, Americans followed the principles of first appropriation; in others, they combined correlative rights with beneficial uses. Judges have supported restrictions on the rights of potential users. They have maintained that a system of licenses is the only way to protect a water source. In their view, there would be little point in giving owners absolute dominion over the land and water sources in question because existing investments could be wiped out by the unlimited addition of new users to a limited source.

Most countries tend to regulate the use of groundwater by imposing a licensing system, setting extraction quotas and controlling the use of wells and pumps. Usually, regulations tend to safeguard existing uses and sometimes domestic and common uses of surface water are exempt from licensing.

Joint use of surface and groundwater

Surface and groundwater belong to the same hydrological cycle. Hence they are normally interrelated. The use of one type of water will therefore affect the other. Nevertheless, only recently have legislators realized that they can and must jointly regulate surface and groundwater. The most common case of interaction between the two types of water is when surface water is reduced by groundwater pumping. Such a reduction of surface stocks by indirect outflow is well known. Some legislation takes this situation into account. For example, in New Mexico water developers cannot obtain permits for the use of groundwater unless they accept an equivalent renunciation of surface water. Under Colorado law, drillers may operate in order to provide an alternative to surface water. The idea is to compensate for reductions in surface water supplies suffered by downstream users and ultimately to increase the amount of water available in a particular area.

In other cases, drillers cannot work within a minimum distance from bodies of surface water (eg Italy, Belgium, Portugal and Spain). It is understood that these prohibitions must be drafted in flexible terms so that they may be applied in all cases in which interference is observed, and not only in those cases in which the drillers infringe on the minimum distances prescribed in the regulations.

Other legislation (for example in Belgium and Florida) carefully regulates the artificial recharge of aquifers. They require special licences for this purpose and insist that the water to be injected into the aquifers is compatible with the original quality of the groundwater. The legislation of France and Spain confers on their respective governments the power to plan and manage jointly both surface water and groundwater. A basic component of this joint use is an integrated policy for surface water and groundwater. Such legislation must also allow developers to exchange surface water and groundwater supplies and

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to modify their entitlements in those cases in which the water is not used or is not used in the most efficient manner.

Control of use and exploitation

Use and exploitation are controlled by permits for exploration, drilling and extraction. In many cases, the granting of an exploration permit does not automatically imply an extraction permit. Some experts have suggested that permits should always be made conditional on changes in circumstances. The permits must normally contain: data about the applicant; the proposed use; the location of the place of use; the volume to be extracted; means to be employed; drilling depths; the type of concession; the period of extraction; the consequences of not using the water for its stated purpose and of not meeting the quality criteria laid down in the permit etc.

Some legislation (France and Belgium) makes the granting or non-granting of permits dependent on the quantities of water extracted or the provision of public or private supplies. Moreover, the Belgians require a permit for artesian wells.

All legislation dealing with groundwater, regardless of country, has requirements for leaving space between wells and for the establishment of protective zones. Those requirements are subject to periodic review because, presumably, the conditions for exploiting an aquifer vary by location. Moreover, because accurate mathematical models are lacking, the value of norms laying down minimum distances is often subjective.

In some countries, especially in Eastern Europe, groundwater is used preferentially for drinking water supplies. It is not clear if this is because groundwater is better or because it is cheaper.

It has been suggested that, as a rule, groundwater should be allocated or reserved for drinking water supplies. All that we can say is that this rule should not be accepted without a critical evaluation of its implications.

Quality control

We have already mentioned that groundwater is subject to a series of harmful environmental influences, including seepage of residues from products which are used intensively and extensively, such as fertilizers, pesticides etc.

Measures for water protection include: permit control; licensing and control of wells; management and control of recharge activities; monitoring and data requirements and the taking of water samples; planning of activities, limits to uses of and products in the recharge area; prohibition and treatment of discharges; establishment of special protection zones etc. In addition, the authorities frequently require a permit for deep injection wells and there are special protection rules for aquifers considered to be a 'single source'. Measures to assure water quality may include the absolute planning of the use of space. In some cases this planning may reveal the need to pay compensation to surface water owners whose activities are restricted beyond what is reasonable policing power.

To deal with pollution, countries need to devise procedural laws and mechanisms for suitable repair of pollution damaged groundwater sources, and also measures to tackle emergency situations and those resulting from sudden and serious accidental pollution.

Implementation of legislation

No legal system is effective unless it has the support of the public and unless the state has the economic, professional and institutional means to ensure its implementation. The implementation of control mechanisms requires at least the coordination of activities between the main government organs which have an interest in, or impact on, such activities. For the management and control of water, these include organs dealing with agriculture, public health, the environment, drinking water supply and sanitation. We must also bear in mind the organs in charge of those aspects of financial policy which have a potential impact on the use of groundwater, such as planning bodies and those which propose machinery for development and for fiscal subsidies. The actual administration of groundwater must be in the hands of water agencies and not of mineral agencies, as has often been the case.

Finally, if the control legislation is to be implemented, it must be justified in terms of necessity and reasonableness. Such justification means that the measures taken must be based on appropriate data and information. In other words, there is a permanent need for on-going programmes of investigation and control of water-use.

Legal measures for pollution control

Water pollution is a negative externality that produces a harmful alteration of water's qualities; it makes water less useful in the discharge of its environmental role or in the performance of its present or future uses.

Pollution may arise from sources which have been identified or which remain diffuse; in either case, it may be controlled by legal provisions or by economic or financial measures. The economic measures may

take the form of subsidies or taxes. Also, economic and legal measures may be combined. Whatever formal machinery is used, the problem of control is ultimately one of proper techniques and financial means.

Water pollution control began with actions based on private law remedies, and developed into actions resulting from legislation specifically designed for pollution control and the accompanying administrative measures. This control increasingly takes the form of activities which are not only aimed at tackling effluents caused by individuals or groups, but also at planning water activities and uses which may give rise to pollution.

The control of water pollution takes shape not only in substantive rules, but is also reflected in profound changes in procedural rules. For example, a litigant may bring a legally acceptable action on the basis of collective rather than individual interests; the burden of proof may be invoked; the control authorities may automatically carry out inspections; and in some cases their decisions may be immediately applicable without resort to a judicial order etc.

The modern tendency is towards integrated pollution control of water bodies. Ideally, such control should be organized on the basis of each individual basin. The most important administrative mechanisms include: effluent permits, registration, information collection systems and monitoring.

Permit and effluent regulations

In many systems the authorities have used effluent permits and regulations in order to control pollution. In fact, this approach is obsolete to some extent unless it is combined with systems which impose technologies for achieving the desired results in the treatment of effluents. The regulation of effluents determines the substances which may or may not be discharged, their concentration and the technologies to be used in their treatment.

Technologies. It is common to combine the permit system with the use of specific technologies for the control of water pollution. Three types of technology have been identified: the best practical technology (BPT), the best available technology (BAT) and the best conventional technology (BCT).

The best practical technology (BPT) represents a reasonable standard of engineering and a reasonable cost in the light of the objectives sought. It is not the best available but it is reasonably viable, effective and economic. It is adopted for an industry (activity) in general and a certain period of time is allowed for adjustment to it. Adoption follows a series of viability studies. If an individual firm cannot pay its costs, this is no excuse for non-compliance. A delinquent firm can be made to go out of business.

The best available technology (BAT) is an advanced technology based on the performance averages of the best control technologies used in a determined industry. It is applied when serious public interests are at stake and when the cost-analysis and the ratio between this and the financial capacity of the industry do not have the same weight as the cost-analysis of the industry in general, using the best practical technology available.

The best conventional technology (BCT) is an answer to the problems encountered in the implementation of programmes requiring the use of the best available technologies. In some respects it is a way of avoiding the technical and financial stringencies of BAT.

Standards of performance for new sources of pollution. New pollution sources may arise after discussions on the implementation of new standards for certain industries have been finalized. In those cases, the new sources become subject to the new standards and must achieve levels of pollution reduction attainable by BAT. In exchange, firms receive the assurance that no new standards will be applied for a period of ten years.

Treatment plants under government control. Treatment plants run by government are subject to the same controls as private treatment plants. In the developing countries the control of public corporations and state-owned enterprises is crucial for the implementation of a pollution control programme, because the public sector plays a major role in those countries.

We must therefore develop legal machinery which is applicable specifically to pollution control by the public sector, for the public sector. We must also encourage the interest of the general public.

Toxic pollutants. Toxic pollutants are identified in special lists and are subject to very stringent regulations. In some cases, they must be eliminated completely. There is a strict system of permits for those that can be modified in the light of possible changes in our knowledge of their toxic effects and in the light of the changes which they produce in the environment. No acquired rights can be claimed in the case of toxic pollutants.

This is a logical approach; otherwise, an administrative permit could result in damage to public or private interests. If there is any doubt, the criteria to be applied for the control of toxic pollutants must allow for the broadest possible margins of security.

Toxic pollutants must be subject to expeditious administrative measures for their elimination and for the mitigation of their harmful effects.

Standards of pre-treatment. Discharges to government-owned treatment plants may be subject to prior requirements to be carried out by the polluters in order to make them compatible with non-polluting plants.

In particular, government-owned plants or the organizations operating them must be enabled to deny or establish conditions for discharge permits; to require compliance with such conditions; to control discharges; to insist on a programme for compliance with, and monitoring of, discharges; to demand the provision of information and the upkeep of registers; and to take remedial action in cases of non-compliance, including the immediate and effective cessation of discharges which affect the public interest.

Standards of water quality

The system of permits based on effluent qualities is not enough in itself to ensure that water in a given reservoir has the characteristics desired by water policy-makers. Modern legislation is based on effluent control as a function of a desired water quality. This quality is normally established in the light of environmental objectives or of future water use.

For practical purposes, the authorities lay down a maximum daily load for the reservoir in question which is then divided up among the effluents to be discharged. On occasions, they prescribe special handling methods for specific areas. The performance of the system as a whole is evaluated by standardized monitors, inspections, up-to-date registers, compulsory submission of reports etc.

Economic considerations

It has been argued that financial charges based on the quality and quantity of the effluents produced are the best way of controlling pollution. Three kinds of financial charges have been established: those based on water quality objectives; those designed to finance pollution control programmes; and those combined with regulations.

It has been pointed out that at times the economic advantages of controlling pollution are not clear. But this should not impede the implementation of control programmes. If the economic benefit is nil or negative, the future advantages should be applied.

Planning

Pollution control in metropolitan areas or in the case of diffuse sources gives rise to special problems. These can only be solved by integrated water-use planning. Planning involves the control of space use, the regulation of activities and possibly the regulation of products which threaten water supplies.

Effective planning also requires the determination of the governmental bodies responsible and sufficient legal power to deal with them; the establishment of integrated and combined projects; the identification of uses and activities to be restricted and controlled, and so on.

Implementation of pollution control

Water pollution can be controlled by legal or administrative remedies. Legal actions may be public or private. Administrative remedies include inspections, the right to demand reports and take samples; the implementation of registration systems; and the possibility of issuing administrative orders to cease and desist without having recourse to the judicial authority to publish and enforce such orders.

Judicial remedies may be based on private law or public law actions. There is a tendency to allow private actions on the grounds of common rights or interests of a non-economic nature. The system has been further advanced by reversals in the burden of proof; objective responsibility for pollution; responsibility of the community; accumulative fines; personal responsibility for the directives issued by individuals or corporate bodies; granting of emergency state powers etc.

Institutional arrangements for pollution control

The modern tendency is to concentrate pollution control within a single organization. It defines the basic national standards and allows them to be implemented at the local level or by specialist bodies. It is generally agreed that such control is better when it is carried out at the level of each water basin.

Conclusions

Groundwater

Increased public control over groundwater resources will assure their long-term sustainable development. However, control of groundwater resources should be done on a systematic basis, including land use controls, and conjunctive management of surface and groundwater resources.

Pollution control

Evolution. Pollution control has evolved from case based, *ex post*, reparative remedies of common and civil law, to comprehensive legal systems for pollution prevention and control. They are based on statutory legislation expressly aimed at protecting and improving water quality.

The modern approach is systemic, including source and non-source pollution. A variety of legal, economic, planning and institutional measures are used to protect surface and groundwater resources.

Key legal tools. The key legal tools are standards, permits, and procedural rules expediting administrative control, monitoring, inspection, decision-making and enforcement.

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