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The Ground Water Legal Regime as Instrument of Policy Objectives and Management Requirements

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The Ground Water Legal Regime as Instrument of Policy Objectives and Management Requirements.

INTRODUCTION

Except for the arid regions of the world, man turned his attention to exploration for, and extraction of, ground water only in recent times. Abundant fresh water was available from streams and lakes and springs. Human habitation developed along surface water courses, which had the added attraction of relatively easy transportation. With the industrial revolution and the population explosion, however, man "fouled his own nest," so to speak, and began to take water from subterranean sources for quality reasons.

Meanwhile the desert was made to bloom in arid and semi-arid zones by the application of water for irrigation, chiefly using surface water—often transported for long distances or stored in reservoirs. With further economic growth these surface supplies became insufficient and wells were brought into production to supplement the supply and expand production. The development of deep-well drilling and pumping technology facilitated these developments, both in arid and humid areas, until we now have in many regions begun to "mine" water, that is, extract water from underground aquifers more rapidly than it is being replenished by nature. Cries of alarm have arisen as wells have gone dry, the water brought up from further down has been found to be brackish (or sea water), and vile contaminations have appeared also in the water coming out of the well head.

Suddenly the attention of the world began to be focused on the problems of supply and quality of this precious, baffling resource we call ground water. Naturally, governments and concerned citizens in zones particularly hard-pressed for more water or better water responded to the call sooner than did those in areas with a lack of substantial development, with super-abundant supplies, or with an upstream location that gave access to water in an unpolluted condition. Developments differed from continent to continent and from cultural group to cultural group.

In Africa, for instance, surface water sources are limited, except

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for a few great river systems. Supplies can become especially short during the long dry season. The first developers of ground water on a serious basis were the Arabs, along the Sahara's oases and plains, applying the extensive experience gained in West Asia. They sank wells, constructed galleries, and employed a variety of mechanical means to bring water to the surface. Thus, initial exploitation began in northern Africa: the Maghreb, Egypt, northern Nigeria and, of course, the Sahara, where we now know vast reserves of ground water exist.¹

Most of Africa's population lives in the tropical belts near abundant surface waters. Today, nonetheless, most of Africa's modern cities, including the capital cities, are heavily dependent on underground sources for their water supplies. Ground water is used to supply towns and villages because it is often of higher quality than the surface waters, which even in rural areas have become polluted or have chemical impurities making them unfit for human or animal consumption. This use of ground water has thus far avoided the expensive surface water purification plants needed for big city surface water supplies. Still, the continent is not characterized by systematic development of ground water, partly because of a lack of drilling machines and an adequate knowledge of local hydrogeology. South Africa is in this sense an exception, where development of ground water is already at a high level. Some 300,000 wells are presently producing.

Wells in many African coastal areas have been over-exploited, resulting in, among other things, the incursion of seawater or the tapping of brackish water. Such is the case in the Casablanca area, where poor recharge is also a problem. Ground water is, in the arid and semi-arid zones, being used more and more intensively for food and industrial crop irrigation. Consequently, efforts are now under way to explore for ground water scientifically and to deal with the contamination, threat of contamination and over-pumping already encountered in some places. It should be mentioned in passing that rich potential sources are to be found in the thermo-mineral and hydro-mineral springs that abound in the fractured formations in central and northeastern Africa.²

In Europe, where use of ground water is long-standing, the increased withdrawals for industry and municipal uses, as well as for irrigation and domestic uses, have resulted in greatly expanded exploitation. The availability of advanced technology has led to a very

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rapid rate of new wells (particularly for industrial purposes), threatening the agricultural and domestic users. The deterioration of ground water quality has likewise become, or threatens to become, a problem. In some countries or regions the problems of both supply and quality are already acute. A keen interest in the preservation of their ground water assets has characterized the attitudes of European resource managers in recent years.3

In Latin America, the pattern is not unlike that of other areas, though there is less arid land than in Africa, and more than in Europe. Major cities have resorted to ground water as the cheapest means of obtaining water of acceptable quality without the costly treatments required of their now-polluted surface sources. Perennial shortages, accentuated by recent prolonged droughts, have motivated the cultivators of arid and semi-arid lands (such as in the Cuyo region of Argentina) to use well water as a supplemental measure to save their valuable crops. Continued expansion of the cultivated area into terrain not reliably supplied by surface water, even in "good" times, has brought thousands of wells into production as the virtually sole source of supply. The result is overpumping of aquifers with the impending threat of deterioration of quality. Shallower wells have ceased to produce.

The experience in Canada, the United States, and other areas of the world is not, in essence, unlike the sample situations briefly described above for Africa, Europe and Latin America. The general picture is one of more recent resort to ground water, except in arid zones, without an adequate understanding of the physics of the resource and without regard, generally speaking, for the future. Nearly one hundred percent of Saudi Arabia needs are supplied from ground water. Israel depends on subterranean sources for seventy percent of its water.

The world is now generally "awake" to the disastrous consequences of unrestrained use and abuse, either because the ill effects are already being experienced or the dissemination of technical knowledge has finally reached the policy makers. Lawyers, too, are now listening to the hydrogeologists, biochemists, geographers and preventive medicine specialists and attempting to collaborate in a combined effort to do something to correct the situation.4

THE ESSENTIALS OF TRADITIONAL GROUND WATER LAW

Because law and governments respond (with few exceptions) only to felt needs of a society, it comes as no surprise that traditionally there has been a failure to focus on the regulation and management of ground water use in most legal systems. Demand for regulatory action simply has not been insistent.

In every legal system, however, a certain amount of experience accumulated over the decades (if not the centuries) to give rise to some fragmentary treatment of ground water in the law. Neighbors quarreled over access to water from a well, and the courts or other decision makers were obliged to resolve the difference, giving rise to a local "understanding" of the rights different persons in different legal positions had to the ground water resource. Those called upon to decide conflicts often drew upon analogies from surface water or distinguished ground water from surface water rights by taking rights to surface waters as the point of departure. As men turned in ever-increasing numbers to ground water to satisfy their needs—and as the enlarged agricultural, industrial and urban demands of this century multiplied the disputes and taxed the supply—the rudimentary, often factually misguided provisions of the customs, codes and judicial precedents became more obviously unsatisfactory in the resolution of conflict, not to mention for the rational regulation of the resource for sustained optimum yield.

In rural areas, especially in developing countries, there has often been a preference for ground water as a source of supply. In addition to the generally greater purity and greater reliability of year-round supply, the bringing in of a well is often far less expensive than constructing the works necessary to dam a stream or to bring water considerable distances by gradient ditches or flumes to arable lands (possibly over neighbor's properties). The owner of a well is often less irked by the unfriendly acts of others or the interference of government officials; he has been free from the pollution, which has caused such detriment to the surface water user. He has had, usually, fewer maintenance chores and expenses. A man with one or more good wells has been a proud, independent man, secure in his vital water supply.

Ignorance of the basic behavior of water beneath the land's surface, of the linkages between ground water and surface water, and even of the relationships between aquifers, prolonged man's feeling of contentment until bad practices and ground water contamination affected him personally by decreasing the quantity or quality of the water in his own well, or at least in his own neighborhood.
The law, poorly informed of ground water inter-dependencies and derived from antiquated custom, either gave ownership to the well (and the water it yielded) to the one who had developed it or treated it as an incident of land ownership. In the common law, the lore about ground water has included a distinction between "underground streams" and "percolating water." It was argued that there were underground "rivers," and to these the riparian rights doctrines were applied; such waters were not susceptible of private ownership. Although there was a serious proof problem in litigation, once the court was satisfied that it was dealing with an underground stream, it knew what principles to apply to the instant case. Similarly, if the ground water at issue was not part of an underground stream, that is, if it was oozing, artesian or seeping water, or even if it was found to be an underground lake or pool, unqualified title was in the owner of the super-adjacent land.

Islamic law has prevailed in a number of extremely arid countries and from its beginning has treated ground water in more detail than any other principal legal system. Water sources, including wells, are to be surrounded by a prohibited area (harim), protecting the source against the lowering of the water table by too-close spacing of other wells. Under Muslim customary law the well and its water belong to the one (or ones) who dug the well. Owners may be obliged to share water for domestic use with others, but the owners have the exclusive right to irrigate with the water.

The Spanish law has had not only an important development of its own but has influenced the approach to ground water legislation in Latin America and the Philippines. In these countries ground waters have traditionally belonged to the owner of the superjacent land. If the overlying land is in the public domain, the waters are public; if privately owned, the waters belong to the landowner. However, according to the Spanish Water Law of 1866, if the ground water was developed out of a gallery or from an artesian well, it belonged to the developer whether or not he was the owner of the overlying land. The Philippines expressly received these provisions into their own law. In laws deriving from the Spanish tradition, and where the law mentions the matter, the owner's right to withdraw ground water has

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5. The succeeding paragraphs summarizing traditional ground water law and the following section on recent trends are based primarily on Tecclaff, Abstraction and the Use of Water: A Comparison of Legal Regimes 57-68, 72-3, 128-9, 131, 140, 183-6, U.N. Doc. ST/ECA/154 (1972).

not been limited by any detriment caused to other uses, such as in the Bolivian Water Law of 1906. In the Philippines, ground water may continue to be withdrawn by the owner of the land even though neighbors' supplies are adversely affected; however, the owner is not permitted to draw public waters away from their natural course.7

Similarly, ground water has belonged to the owner of the overlying land in most European countries, following the principle that land ownership includes title to everything in the subsoil.

RECENT TRENDS IN GROUND WATER LEGISLATION

For most countries ground water is still a separate regime, even where a permit system has been established for the right to use surface waters. Although more attention is being paid to regulation of ground water and particularly to restrictions on the incidents of title and provisions for pollution prevention and abatement, the owner of the overlying land still enjoys, in most countries, a preferred position.

Even in the Soviet Union and the Eastern European countries, the exploitation of ground water for domestic and certain agricultural uses without government permission is, generally speaking, still allowed to the individual landholder. Yugoslavia, Israel, Romania, and Turkey are among the European countries that have expressly declared underground water to be in the inalienable public domain. Under the Turkish Act of 1940, a well owner may draw only that amount of water absolutely necessary for his "suitable or beneficial purposes" (as determined by the State General Directorate of Hydraulic Works). However, the same law requires sharing of one's ground water with neighbors who do not find water on their own land, or where their cost of exploitation would be excessive. This duty is in turn limited by the 1961 Regulation to situations of surplus or when the owner is not operating his well to capacity. Although the Polish Water Code provides that waters are the property of the State, title to water withdrawn from wells is in the owner of the land, subject to certain limitations; extraction up to a depth of 30 meters and up to 6 cubic meters per hour require no permit for domestic and agricultural purposes.

The German Federal Republic's Water Management Act of 1957 (in force from 1960) institutes a water-use permit regime in general terms; the implementation Acts of the Länder vary but do diminish

the landowner’s rights in ground water. In Italy, the traditional Civil Code provisions have been modified to impose serious restrictions on the rights of landowners; any waters fit for use in the public interest are now in the public domain. But no permit to withdraw ground water is required in Italy if it is for domestic purposes; new wells must not be placed, however, less than the required minimum distance from other wells. Although the rights of the owners of the overlying land continue to be virtually absolute in principle in several states (Austria, Belgium, France, Ireland and Spain, for example), the legislated restrictions are growing, particularly with respect of drilling and registering wells, use permits, reporting, and water management planning. Control is increasingly exercised over the use to which the water is to be applied and the quantity permitted to be withdrawn (priorities). Withdrawal volume limits (without permit) vary widely, for example, 300 cubic meters per 24 hours in Sweden, 25 in Iran. Depth limitations also exist in some jurisdictions for “general license” (no permit required) wells; the assumption is that recharge of the top saturated zone is more immediate and certain than is the recharge of deeper aquifers. The Austrian Waters Authority may authorize interruption of ground water use by a third party in connection with town planning.

In some portions of the United States the landowner’s traditional title to the ground water under his land remains unchanged; some of the states retaining the riparian rights doctrine fit this description, but others have developed a restriction grounded in a theory of “reasonable use” enunciated as early as 1900 in a landmark New York case and subsequently followed in a number of other jurisdictions.

Where the doctrine of prior appropriation prevails, chiefly in the West, ground water is subject to appropriation in all such States where “underground streams” (that is, flowing in definite channels) are involved, and in most such States percolating waters” are also subject to appropriation. Alaska, on the other hand, has taken the big step to a full permit system. In the U.S. southwest, the prior appropriation doctrine is not applied to “percolating waters” which is to say the owner of the superjacent land has title to the ground water. California has also taken this position except that there the doctrine of “correlative rights” has developed, limiting the landowner’s use to amounts that he can beneficially use on his own land and subject to the corresponding (“correlative”) rights of other landowners sharing the same underground aquifer. But if the water

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is to be applied elsewhere than on the overlying land, the prior appropriation doctrine still applies.

Spain has modified its classical stand in the Canary Islands: To withdraw underground water on private property, an authorization is necessary since 1965. Ground water was given inalienable public domain status by amendment to the Argentine Civil Code in 1968; however, the various provinces have been slow to move to implement the new order and doctrinal discussion on the matter continues.9 With the coming into force of the 1951 Chilean Water Code, ground water exploitation on private property has been subjected to regulation. All waters belong to the State under the Peruvian Land Reform Act of 1964. The Mexican nationalization of waters by the 1917 Constitution did not apply to ground water; although the national government may regulate ground water withdrawal and use (even to the point of establishing prohibitory zones) the withdrawal and appropriation of such waters by the landowner is expressly authorized by Article 27 of the Constitution.

The 1974 Water Utilization Act of the United Republic of Tanzania merits special attention because of its recent enactment. In Tanganyika "all water" is vested by the Act in the United Republic of Tanzania (on the status of water in Zanzibar, the island portion of the United Republic, the Act is silent. The statutorily implied conditions for mining, forestry, industrial or hydropower uses—and including the anti-pollution provisions—seem to contemplate only surface water conditions. Otherwise, the Tanzania Act is an example of the integrated approach to water use regulation and administration. For domestic purposes any person with lawful access may abstract and use water. The owner or occupier of land may sink or enlarge any well or borehole thereon and abstract water up to 22,700 litres per day; however, such perforation is not authorized within 230 metres of any other well or borehole or within 90 metres of any body of surface water. Holders of mining leases or prospecting licenses have those same rights and may abstract and use the water for prospecting and mining purposes, with obligation to pay compensation; any underground water not used in the mining or prospecting activities is to be disposed of in compliance with the directions of the Water Officer. Except for these domestic use and mining allowances, no person may withdraw or use water, or construct or maintain any works, except in accordance with a pre-existing right or under a

water right granted under the 1974 Act. Rights are granted by a regional Water Officer for such quantity, duration and purpose and subject to such terms and conditions as are specified in the grant. When an application for a water right is received, notice must be given by the Water Officer and any interested person may object and has a right to be heard. The Minister responsible for water development may direct a review of the use, diversion, control and appropriation of water in any area deemed by him to have water insufficient to satisfy all of the water rights; the result may be a revision of the quantities allowed and of the terms and conditions of any water right in that area. No right shall be cancelled or reduced, "where beneficial use of the whole right has been maintained," except in proportion with all other rights in the same area. In case of drought, the Water Officer may at any time (by notice) suspend or vary all or any rights to abstract or use water from a source for the period he deems necessary. The Minister may declare any purpose to be a public purpose, and where a Water Officer finds that water is required for such a public purpose he may (by notice) determine or diminish any water right to the extent that such water is required for that public purpose. The holder of any such water right is entitled to receive compensation from the Government for all loss resulting from the determination or diminution. These provisions apply equally to ground water and surface water rights.¹⁰

A reasonable and beneficial use test is imposed by Kenyan law, calculated with respect to other users of the same supply. No one may draw more ground water than he can use in a reasonable and beneficial manner. Moreover, no more than a twenty percent loss between the well and the point of use is permitted.

In 1945 the traditional law of England and Wales was modified to require the licensing of ground water withdrawals in areas determined to require protection. With the creation of the river authorities, the 1963 Water Resources Act made mandatory a permit for water use, including ground water, in the area of such a river authority, except that up to 1,000 gallons may be withdrawn without license; for the domestic purpose of his household, however, a landholder may withdraw all the ground water he wishes. With the enactment of the Ground Water Act of 1969, and the modification of the Land Act of 1958, Victoria province of Australia instituted a permit system for well drilling and ground water use, except for domestic and stockwatering uses. If a conservation area is declared, severe

¹⁰ United Republic of Tanzania, 1974 Water Utilization Act(No. 42—Oct. 30, 1974), Parts III, IV, and V.
restrictions may be imposed. The right to use and control all groundwater is expressly declared to rest in the Crown. In practice, however, the privileged position of the owner of the superjacent land is generally preserved. In India the right of use of ground water is still usually in the owner of the superjacent land. The Burma Underground Water Act of 1930 places the authority to grant ground water use in "water officers." Ground water permits are, on the other hand, issued by local town councils in the Philippines and by the county (hsien) in Taiwan—in both cases a different procedure from that followed for surface water.

There has been widespread enactment of legislation dealing with prevention of pollution and the measures to be taken, including penalties, in the event of actual pollution of ground water resources, are of longstanding. However, a comprehensive approach to the protection from contamination of water resources generally can be found in few countries, such as Switzerland (1955 water pollution statute) and Colombia (1975) Natural Resources and Environmental protection Code). Otherwise, the provisions are widely scattered in health, dangerous substances, mining, parks, water, housing, and other special legislation, as well as in the civil codes.

In summary, then, there is a clear trend to impose some restrictions on the traditional title of the owner of the overlying land (or the developer of the ground water source), reflected in use limitations; quantity of extraction limitations; drilling permits, restrictions and standards; use licences; special zones of conservation or prohibition; and reporting and registering requirements.

Far from treating water resources as an integrated whole, legislation is still fragmented and the tendency to consolidate and present comprehensive treatment of all aspects of water resources development, conservation and use, including interactions with other natural resources and with the environment, is thus far mainly a topic of discussion among specialists. Nonetheless, "Little by little, the modern law is moving away from the concept of unlimited use of ground water as a property right and towards a recognition that the quantity that each user can take must bear a direct relationship to the renewability of the resource."¹¹

CONSEQUENCES OF THE PREVAILING GROUND WATER REGIMES

Even with the increased attention to ground water in modern legislation in many countries, we are still faced, generally speaking,

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¹¹ L. Teclaff, supra note 5, at 186.
with unsatisfactory results. It is more a case of non-management than of mismanagement. The difficulties that have faced us in this field still persist: The problems of supply, of quality, of the impacts on surface waters, and the social, political and economic consequences of the still-deteriorating conditions.

A. The Problems of Supply of Ground Water

The major effects of our mishandling of the underground water resources of the planet can be readily identified. In the problem area of supply, many wells have gone dry, and many more will run dry in the near and intermediate future, because of overall over exploitation of an aquifer. Moreover, individual wells fail to yield because of the effects of local drawdown from other wells too close by. By the construction of housing, factories, office buildings, school and other covering structures, and by making even more of the earth's surface impermeable by highways, roads, runways and sidewalks, we have succeeded in eliminating substantial percentages of the natural ground water recharge areas. This is particularly so, of course, in the developed countries, but is a significant consequence of urbanization and industrialization all over the world. Ironically, where modern sewage treatment plants have been placed into operation for pressing sanitary reasons and at great expense, further significant reduction of the recharge has resulted. Cesspools and septic tanks and industrial waste water, which once made their contributions to the ground water supply, have been shut down, and the domestic and industrial waste waters are now piped to the plant where the effluent is, generally, discharged into the sea or a major surface stream. The lands overlying seriously depleted aquifers have also been known to subside with damage not only to the surface structures—natural and manmade— but also to the aquifer, which is partly destroyed and future recharge probably crippled forever.

In the problem area of water quality, there is a similarly impressive list of consequences from our prevailing relationships with the underground environment. Malfunction of neighboring wells, as well as the breakdown of one's own well, can import contamination into the well water. Of course, infiltration of cesspool and septic tank effluents is a notorious polluter of well water when such installations are not properly designed, installed, and operated. In more recent decades the use of wells for the discharge into the ground of untreated industrial wastes has become a seriously harmful practice. Where overpumping has been practiced with respect to aquifers bordering the sea, the well-known phenomenon of salt water intrusion has gradually occurred with often drastic and lasting
consequences for the fresh water supply. Many water users have only recently learned of the gradual and sometimes critical deterioration of water quality attendant upon extraction from the deep, deeper and deepest reaches of an aquifer. We also now know of the harmful "enrichment" of ground waters from agricultural activities and domestic uses of water. Here the difficulties come, for example, from application of fertilizers, especially overapplication, including on golf courses and lawns, and the dissolving out of natural salt concentrations, for example, in overlying soils. Domestic septic systems also contribute to this problem. When ground water is being "mined," the time can come when surface water sources, which once were fed from aquifers, begin to flow back into that same aquifer, bringing certain contaminants along with the reversed flow. In addition, of course, some underground waters naturally contain in solution unwanted chemicals that may render their use unsuitable or noxious for human and animal consumption or for industrial use without treatment, which in many cases is uneconomic. Note also should be taken of the relatively new concern about thermal pollution of ground water.

Reduced ground water flow can also have substantial impact on surface water supplies. There may be appreciably lessened contribution to lakes, rivers and wetlands, thus lowering the water level and quantity in such surface sources as well as altering the ecology of an area. If infiltration and evapotranspiration from a surface water body exceeds the inflow of water because of decreased supply from underground aquifers, the surface body will in time dry up. It should be remembered, however, that such reductions in subsurface flows ordinarily are compensated for, at least in part, by return flows from irrigation or municipal uses, for example.

In addition to the impact on surface water supply, surface water quality may also be affected by reduced ground water flow. The surface water body will have diminished capacity for dilution. And return flows, particularly from industrial and irrigation uses, are almost always of substantially poorer quality. Among the numerous inter-relationships between surface water and underground water, the deliberate overpumping of an aquifer must be mentioned. That is, because the saturated zone in some areas is entirely too close to the surface for successful farming or other activities, ground water is pumped, particularly during certain times of the year, to lower the water table. Most plants and trees do not thrive in poorly drained soils. The discharges from such pumping must be directed to some place on the surface where recharge of the aquifer is unlikely to result, and may or may not be welcomed.
There are certain discernable socio-political consequences from deteriorating conditions in a country's ground water. Users of these waters will become frustrated in their efforts to defend their declining agricultural or industrial positions and may become alienated from one or more levels of government if they find no, or inadequate, response to their problems. There will be demands for government action. In self defense, users may devise surface storage facilities into which they will pump ground water for use in times of anticipated ground water shortage, usually accelerating drawdown. Some may even resort to lawless behavior to obtain good water or more water. Ultimately, if the problem is not satisfactorily resolved, out-migration will begin with its attendant burdens upon the political and social institutions, as well as the actual demoralization of a sector of the population and the breaking up of families.

Deteriorating ground water conditions also bring economic consequences. Crop yields will decrease; there will be efforts to shift to other crops or activities in the zone, and abandonment of formerly productive economic activity. There will be increased costs to industry to treat water prior to use, or it will be necessary to bring in acceptable water from elsewhere. As the water table is lowered, there is increased consumption of energy for the additional lifting by pumps, and wells will need to be deepened, or new wells sunk, to tap the same aquifer. Out-migration of the affected population and the changes in gainful activities will result in dislocations affecting economic planning and the gross national product. Finally, it is likely that there will be important impacts on the development and conservation of other resources resulting from deteriorated ground water conditions, where dependence on that source for water is significant.

NEW APPROACHES TO ACTIVE MANAGEMENT OF GROUND WATER RESOURCES

The first principle of rational management is to require or induce the formulation and adoption of national water policies tailored to the development situation and water resource potential of the country in question. To achieve this purpose, the institutional arrangements should actively conduce the political levels of government to foster the essential prior studies and bring about the decisions that result in a set of coherent policy statements, coordinated with the overall national or regional development and environmental protection planning. Ground water aspects, as integral parts of the country's water resources potential, should be assured constant consideration during this policy formulation process.
No "model" set of policies encompassing underground water needs can be set forth here, but perhaps fundamental is the determination to develop and apply ground water where it is more readily available and more economical (including with less loss in delivery) than surface water for the same application, and \textit{vice versa}. Policies should be aimed at the preservation of the resource, particularly in view of its high vulnerability to long-lasting contamination or salt-water intrusion, and its very slow recharge and movement in many cases. The ability to declare states of emergency and to take extraordinary action in case of shortage or dangerous pollution should, for example, warrant a policy statement.

Once the national policies have been determined (and although these should be at least periodically reviewed), implementation of these basic values probably calls for a new Water Law. Finally, awareness of the unity of the hydrologic cycle has led lawyers and administrators to recognize the need to treat all water resources in an integrated fashion, and not separately, as has been the case until most recently.\cite{12}

The drafters of new water laws should self-consciously and systematically fashion basic legal tenets, starting with appropriate amendments to the national constitution, if necessary or desirable, so as to establish the proper, lawful base for regulatory provisions and government authority not previously contemplated or authorized. This aspect is especially complex in a federal state. Promotion of, for example, self-reliance, administrative due process, rural community development, energy self-sufficiency, a sectoral emphasis, public health, or industrial investment should receive conscious attention in shaping the regulatory system. Problems of compatibility will arise, undoubtedly, and national priorities will have to be consulted carefully, in order to insure that the ground water regime does not work at cross purposes with more fundamental objectives.

Even after a tentative regime has been elaborated, outside review by non-water resources specialists should be undertaken in order to examine the question whether any cherished values of the community are being undermined by the new approach to ground water management. Finally, as war is too important to be left to the generals, water law is too important to be left to water lawyers (or the engineers or the economists) alone. Initial inputs and along-the-way

\textsuperscript{12} In reality, we are still "talking" hydrologic cycle without really accepting the full consequences of this essentially closed system. The waters of the oceans are also part of the cycle, as are atmospheric waters and polar ice. We are not yet prepared (at national or international level) to deal with all water resources on a fully integrated basis. Nonetheless, legal and administrative integration of surface and ground water resources is a major step forward.
review of the drafts should be elicited from each of the relevant disciplines, to insure the economic, engineering and administrative soundness of the proposals.

Assuming the political and technical acceptability of the new (or reformed) water law, including ground water aspects, adequate administrative machinery will need to be created and oriented in order to carry out the management tasks associated with the resulting regulatory functions. Of course, some type of planning was entailed in bringing the new policies and the new legal regime to the decisional stages. Subsequently, however, there will be a continuous need for a flow of specific information in order to inform the resource managers and planners. The design of this information system should include all data needed with respect to ground water management, something which is commonly still lacking in most countries.

Institutional linkages with other planning bodies should also be expressly provided for, including all natural resources, overall environmental protection and defense and urban planning. Out of the ongoing planning process thus placed in operation, the obligation to make proposals to the decision makers for refinements or changes in the previously determined policies and, thus, in the implementing law and regulations, should be institutionalized.

Within the water resources management machinery there should be created an adequately empowered organ for deciding on water and water-related programs to be carried out, with capability to carry out feasibility studies, final design and financing, including those pertaining to ground waters. An institutional capability to execute (or to supervise the execution of) works and programs should be available, either at the national, regional or local levels. Construction, operation, policing, revenue collection and conflict resolution are important tasks that need careful organization and efficacious execution. Major national and even local resources will often be at stake. An institutional capability is also needed to monitor the results attained, by means of human and economic geography studies as well as by hydrogeological and sanitary engineering or biological studies and tests. Conscious focus on ground water-related activities in a comprehensive fashion will be relatively novel in most cases.

In order to accomplish the above management tasks a high calibre of professional and paraprofessional expertise and experience is required of water resources agency staff members. Many countries do not now have such personnel in adequate numbers. A serious training program in the integrated management of the resource, including
ground water aspects, at the post-graduate level—and inter-disciplinary in conception and in realization—may be one of the most important elements tending to bring national water resources management up to the necessary level of sophistication and efficiency. Outside of the water resources management institutes functioning in the United States, Canada and Europe, there are few such centers available to the developing countries. One such training, research and advisory services program has, however, been formed with assistance from the United Nations in Argentina: The Center for Economics, Law and Administration of Water (CELA) with its seat in Mendoza. An extraordinary library and documentation center has been assembled within CELA and the Center is staffed by a highly trained interdisciplinair staff, with a marked interest in modern ground water development, utilization and environmental protection.

Finally, every country needs a more powerful and well-informed public information program, including perhaps instruction by "extension" at the level of the individual user of ground water or at least working with and through, and promoting, user organizations.

SOME CLASSICAL LEGAL, ADMINISTRATIVE AND SOCIO-ECONOMIC ISSUES

In the specialist deliberations preparatory to the formulation of ground water policies and a legal and administrative regime for achieving the goals thus set, a number of issues tend to surface. Among these perennial questions, which often lead to doctrinal (if not partisan) debate, are those set forth in issue form below. There usually are grounds for supporting, or opposing, each side of the issue, which means that within these topics are serious questions of societal values (often hidden by the "Form" of the discussion, whether that be by lawyers, engineers or political scientists).

One such popular issue deals with the function and utility of setting forth in the law who "owns," or has title to, ground water. Related to this question is the importance and need of the value of certainty given the user by means of a "water right." In practical terms this issue can be expressed as "protection" (via detailed regulation) vs. "flexibility" (via broad discretion in the hands of a government agency). A favorite, related topic is whether ground water rights ought to be appurtenant to the land.

Also requiring careful enquiry is the appropriate jurisdiction to be vested in the national government in a federal country, and the appropriate jurisdiction for political units not at the national level, in-
cluding in unitary States: The role of provinces, municipalities, special districts, basin authorities, regional development authorities, and international water resources arrangements.

Another difficult issue is the amount of “override” to be given the concept of the “common good” or general welfare, at any level of government, versus the value of preserving and encouraging the initiative of the individual user of ground water, in the form usually of a water right. A somewhat related matter is the territorial unit to be used in determining optimum community benefit—the total national approach, or the regional or local area development approach.

Many water resources management systems fail in their impartiality and consistency of observance of the law and regulations promulgated. There is a cost (economic and political) attached to ensuring full compliance and even-handed determinations by officials and decision-making bodies. The costs of due process machinery must be included. Too complex a system invites, or at least makes likely, part-time or ineffective performance records with respect to these important matters, particularly where funds and staff are inadequate in numbers, competence and independence to accomplish the job. The question of water pricing is a particularly sensitive issue.

There is great interest in some sectors for achieving meaningful participation by water users, and by other interest groups, in water policy formulation and in conflict resolution. The viability of this approach is often challenged by those with experience in countries that have thus far not developed such organizations.

A critical issue for the lawyers is always the access to objective determination of charges of abuse by officials and violations by users. The design and operation of such administrative hearing tribunals and the role of the ordinary courts remain disputed matters. In this connection, the question of compensation to holders of valid water rights when these are diminished or taken away altogether involves not only the earlier mentioned issue of property in water, but the method by which liability and the amount of indemnification are determined.

Meetings among water resources specialists seem always to revive these, and other, preoccupations; the time has come to discuss these issues now taking into account the development, use and conservation of ground water.

Those who are charged with the study and selection of new principles and machinery for the affirmative management of ground water resources may be tempted to abandon all prior practices and legislation on the assumption that any other choice of norms and
management devices must be an improvement over the existing regime. Given the all pervading imperfection of human institutions, and of the human beings who operate them, regardless of good intentions, it is important to avoid this temptation under most circumstances, for a variety of reasons. It is not rational, and may not even be practicable, to discard—whatever the historical or ideological base may be—the rules and institutions the people are accustomed to working with unless and until we have some assurances that the new rules and institutions are in fact going to work a substantial improvement, justifying thereby the social and economic "cost" of the transformation. Most countries can not objectively afford change simply for the sake of change, which in the end is a sign of immaturity.

Therefore, in the above, brief elucidation of doctrinal principles or institutional arrangements no suggestion is implied favoring a wholesale abandonment of existing ways of handling ground water problems in any particular country at any particular time. Idealized concepts need to be adjusted carefully to persistent local customs, which may be found to reinforce values important to the community and beyond the scope of water resources management. The human and financial resources effectively to mount an advanced form of legal and administrative structures may, in addition, not be available prior to considerable professional and economic development, which may take many years. Scarce resources should not be squandered on elaborate management structures when adequate results may be obtained from less ambitious and less costly systems. And nothing may be more counterproductive than a poorly administered and enforced system of "over-regulation" of water resources development, use and conservation.

SUMMARY AND CONCLUSIONS

The widespread agreement among specialists that underground water law and administration should now be treated as part of all fresh water resources law and administration has more meaning than simply the placement of the ground water rules in the same law or regulatory document where surface water norms are found. It means to apply the same basic development, use and conservation policies to the resource as a whole. On the other hand, identical treatment in the law and regulations is not intended, at least by most students of the problem. Integrated management is sought in order to achieve the optimum sustained yield of a nation's, or a region's, total water resources.
There are some peculiar physical incidents in the appearance, movement and availability of ground water that require special regulations and a particular administration, in coordination with the management of surface waters. Matters of replenishment, extraction and water table measurement, losses, contamination, distribution, works design and inspection, withdrawal control, and relationship to the sea are among the behavioral and management considerations that continue to distinguish ground water from surface and atmospheric water resources. There is also a formidable task in erasing from the mind of the judge, the lawyer and the administrator the misconceptions that have for so long and in so many places been entertained about underground streams and other supposed ground water characteristics.

The makers of development and environmental protection policy need, nonetheless, to have at their disposal the entire picture of the quality and quantity of the water resources within their jurisdiction, including underground water resources, and to be able to work toward optimum utilization of the whole, without serious sacrifice of other values enshrined in the community they serve.

The problem, then, for water lawyers and administrators, is to fashion a legal regime and a management machinery best calculated to achieve the desired results, that is, the realization of all the policy objectives of the country, and not merely the ground water resources utilization objectives.