

## CONCLUSIONS

### GROUNDWATER ECONOMICS WORKSHOP

#### 1 INTRODUCTION

After the main sessions of the Groundwater Economics Symposium (Barcelona, October 1987) a one-day workshop on groundwater economics with special regard to developing countries was held and attended by a large number of participants in the Symposium, under the leadership of the United Nations experts and with the special help of Manuel Varela and Amable Sánchez González, members of the Meeting Organization Board.

The different issues arose live discussions, especially when administrative, political and social aspects were involved.

Two parallel workshops were held, one predominantly focussing on groundwater exploration, exploitation and use issues, and the other concentrating on administrative, managerial, and socio-political issues. The conclusion of these two workshops are given below in two separate sections.

The conclusions presented are not an official document but a guide to what was the more widely accepted ideas and thinkings of a group of experts and representatives of developing countries. They do not necessarily coincide with those of the organizers of the meeting and the editors of this book.

Further to United Nations and Spain, the following countries had at least an expert attending the meeting: Angola, Australia, Bangladesh, Botswana, China, Costa Rica, Cuba, Czechoslovakia, Indonesia, Ecuador, Egypt, France, Germany

(BR), Honduras, Hungary, India, Israel, Italy, Jamaica, Japan, Jordan, Korea, Malta, Mexico, Morocco, Mozambique, Netherland, Perú, Philippines, Portugal, Saudi Arabia, Senegal, Sweden, Soviet Union, United Kingdom, Tanzania, Thailand, United States of America and Vietnam.

## 2 ECONOMIC ISSUES OF GROUND WATER EXPLORATION, EXPLOITATION AND USE

- 1.- The development of groundwater follows an evolutionary process which can be divided conveniently into three phases, (a) exploration, (b) expansion and (c) management.
- 2.- The principal objective during the exploration phase is the drilling of successful boreholes. In the expansion phase more and more wells are brought into production and hydrogeological considerations such as the spacing of wells, the ultimate limitation of the resource, and possible side effects become important.
- 3.- In the management phase the exploitation of ground water normally reaches, and in arid regions often surpasses, the safe yield, and thus needs to be planned and controlled.
- 4.- The investigator, planner, operator and external decision maker need to take into account, in each phase, the economic considerations.
- 5.- A basic level of hydrogeological information is initially required, whose acquisition cannot be readily justified by economic returns. Investment in the initial stages of groundwater investigation is very much risk capital.
- 6.- Moreover, initial groundwater investigation should be regarded as a public good, whose benefits extend beyond the interested party, and should accordingly be subsidised. Once some boreholes have been drilled, and hydrogeological conditions evaluated, it will be easier to site subsequent production boreholes more successfully. Tax on later developers could be levied to recover subsidies paid to those initiating groundwater development.
- 7.- Beyond the initial exploration stage, investigation needs to be justified

by the value of information likely to be gained, in terms of the economic benefits from the improvements in development efficiency which will follow the application of a given method of investigation in a given environment.

- 8.- In the absence of adequate information to apply a more objective method, it is common practice to allocate for investigation expenses an arbitrary minor proportion of the economically-justified sum for water provision. This proportion is normally higher than that invested in site investigation for surface water development, but appears to vary widely in the range of five to twenty five percent.
- 9.- Investment on investigation can generally be reduced and phased if an integrated, flexible approach to groundwater development is adopted. High cost activities within an investigation programme need to be critically examined to see whether they can be reduced or deferred, without compromising on data requirements.
- 10.- Particular attention should be given to increasing investigation cost effectiveness. Close hydrogeological supervision of production borehole drilling and better integration of groundwater evaluation and development are judged to be most beneficial in this respect.
- 11.- Every effort should be made to store and to make accessible all the costly data collected by investigation. Data banks are especially important in developing countries where much of the groundwater information may have been collected by numerous parties.
- 12.- A full and expert utilization and interpretation of preexisting information including hydrogeologic maps can result in great reductions in the cost of exploratory drilling. Thus the expenditure on skilled manpower inevitably comprises a high portion of total investigation cost. Therefore, there is an urgent need to upgrade national professional skills in developing countries by training and by international cooperation.
- 13.- Groundwater resources lend themselves to step by step development.

This enables development to be closely synchronised with rising demand, which is highly desirable.

- 14.- It is relatively easy to quantify the benefits derived from the exploitation of groundwater resources, when they are used for a production process, be it agricultural or industrial. Difficulties arise in the case of community water supply especially in rural areas due to uncertainties about the quantification of social benefits. However, economic assessment is still possible through evaluation of opportunity costs such as the time saved in water provision and the expected decrease of public health expenditure.
- 15.- The cost of groundwater production is greatly affected by choice of the appropriate drilling and pumping technology and by the efficiency of well design and construction. Improvements in this respect can lead to major financial savings.
- 16.- The design of major groundwater abstraction works should be preceded by a financial analysis of possible alternatives, including development of surface water resources.
- 17.- In addition to the expected benefits the strategy of ground water exploitation should take into consideration and economically assess the following: aquifer depletion, deterioration of water quality, possible salt water intrusion, depletion of surface water supplies, subsidence and other undesirable side effects.
- 18.- Any aquifer overexploitation, conceived of as a rapid heavy abstraction of groundwater resources in order to generate economic benefits in a short time period, is a policy that always requires careful planning. The intensity and duration of overexploitation have to be carefully considered, bearing in mind both quantitative and qualitative aspects, and also any externalities that are likely to be generated. Occasional periods of overexploitation are valuable to postpone the introduction of other more expensive alternative supplies, such as those derived from surface water.

- 19.- One way in which surface and groundwater may be used conjunctively is by using surface water resources in wet periods and ground water resources in dry periods. In this way ground water can fulfill a buffer role as well as providing an emergency back-up system.
- 20.- In areas where ground water is just beginning to be developed at widely separated localities, there is no immediate need for resource conservation, but protection against pollution in the immediate vicinity of the source is essential and should be incorporated in project design. Attention should also be given to the disposal of waste so as to avoid pollution.
- 21.- The cost associated with observation well networks and other conservation measures usually represents a small portion of the cost of a groundwater development scheme. This cost can be allocated as a percentage of the total capital cost of the scheme.
- 22.- The general public will only be concerned about groundwater when a serious problem exists such as when a pollution incident directly affects a water supply. That is when protection has failed. The public is not generally willing to pay higher charges for conservation and protection measures unless the benefit is obvious and hence implementation requires a legal basis, enabling costs to be transferred to the water user or to the individual or organisation causing pollution.
- 23.- Externalities stemming from physical interdependence amongst different individual users, lead to inefficient allocations of water. The related costs perceived by the individual user are different from the social cost involved in the development and distribution of regional groundwater resources. Therefore user associations should be encouraged to increase the efficient management of groundwater.

### 3 POLICY AND INSTITUTIONAL ISSUES RELATING TO GROUND WATER ECONOMICS

- 1.- The workshop concluded that ground water development has expanded

rapidly over the last 20 years given the possibility of expanding systems with relatively small investments and the ubiquitous nature of the resource and its proximity to the points of use. This notwithstanding there are still two billion people in the world who do not have access to a safe source of potable water; this must therefore be a priority issue for many countries.

- 2.- The initial stage in the conservation and protection of groundwater resources is the creation of a government organization responsible for the establishment and implementation of a strategy and policy leading to progressive legislation that regulates and controls groundwater development based on sound scientific principles.
- 3.- In ground water development the role of governments should be viewed as that of promoting the development of the resource and regulating the pattern and rates of exploitation with a view to conserving and safeguarding the resource.
- 4.- In order to carry out its promotional function, governments should in the first instance acquire the basic technical skills in data gathering and organization and establish a data base to incorporate the basic practical knowledge on the availability of groundwater resources, with priority attention given to areas where water supply needs and development potential are greatest. In order to minimise the cost of this information gathering and storage function, government agencies should make maximum use of cooperative programmes with scientific and technical institutions from other countries with a view to focusing the attention of the latter on the priority areas selected for data gathering. Maximum use should also be made of data made available by ongoing ground water development projects so as to minimise data collection costs for governments.
- 5.- As another aspect of the promotional function governments should clarify their water resources development policies with a view to separating activities related strictly to humanitarian, social and

emergency functions where no cost recovery may be expected (refugee camps, drought emergency, etc...) from rural water supply activities where some cost recovery policy may be expected so as to cover at least operation and maintenance charges; urban water supplies where cost recovery may be expected in full; and finally water use for economic activities (including, industry, irrigation and mines) where an economic cash crop return may be expected over and above cost recovery.

- 6.- In countries which are largely agricultural without major incomes from mineral, raw material or industrial exports, governments should consider whether and to what extent water for agricultural use should be subsidised. In this respect agencies should encourage small scale development of ground water resources through private initiative and provide assistance in this regard through loans, tax abatement, or other incentives.
- 7.- In order to ensure that water resources maintain their economic value, it is necessary to ensure their protection through conservation and quality control. Monitoring networks, which generally represent a small fraction of the cost of ground water development, should be established to measure the fluctuation of water levels and of water quality and of groundwater abstraction. There are economic limits to pumping wells for different types of uses of ground water in different regions, and the levels of exploitation should recognise these in establishing well spacing. This should provide guidelines for optimal designs of well fields, especially as regards irrigated agriculture.
- 8.- National water legislation should incorporate aspects which directly relate to the economic value of water as a factor in the production process. This implies that such legislation should regulate quantitative and qualitative aspects of development so as to prevent a waste both of financial and natural resources. Government agencies may set conditions for efficient use and standards for quality

control.

- 9.- Due to the high cost of aquifer rehabilitation from pollution, aquifer protection policies are necessary and should be based on the degree of vulnerability of individual aquifers to different pollutants and their relative importance taking into account delayed effects.
- 10.- In the plans to develop ground water for specific large scale projects, it is essential to make long term forecasts of the evolution of ground water resource use and of its probable future cost. Moreover, such developments should include restitution for any detriment to existing water users.
- 11.- In order to ensure maximum economic efficiency in ground water development programmes and to avoid duplication, waste and policy contradictions, it is essential to secure close cooperation between national, regional and local groups on the one hand, and between sectoral interests on the other, so as to achieve an integrated approach in programme implementation.
- 12.- At the local level, especially in rural and peri-urban areas, cost recovery should be secured at a level which takes into account both economic and social factors. It is essential that local communities participate actively in the efficient operation and maintenance of the water supply systems (in particular handpumps and motorised pumping stations for the watering of cattle where applicable). However symbolic it may be, the financial participation of the population should be assured, for spare parts, fuel, services of a mechanic, etc.
- 13.- In many developing countries women are the traditional water carriers and also represent the bulk of the working population in the countryside in view of the emigration of much of the male working population to the cities. Under these conditions, it is important to minimise the time spent by women in conveying water from the wells to the house through the introduction of appropriate technologies, which allow the transportation of relatively large quantities of water with minimum

effort.

14.- External assistance in terms of technical cooperation should be geared primarily to delivering services, training, and technology which are directly applicable to ground water resources development activities, within the context of development plans and which a country has the capacity to absorb and use over the long term. With respect to project-related decisions equal weight should be given to the development of surface water, groundwater or conjunctive use options even if this includes the need for conducting hydrogeological surveys to expand the existing data base, as far as is practical.

15.- External assistance in terms of investment should generally be preceded by preparatory pre-appraisal investigations which will require the disbursement of funds to ensure the long term availability of ground water resources, alone or in conjunction with surface water.

It may be expected that assistance through loans in the foreseeable future will focus largely on the expansion of projects for urban-rural water supply on the one hand and of irrigation on the other. The relatively low risk involved in ground water-based projects - as a result of the gradual investments required to meet increased demand - may in many cases provide the most economic option for newly developed projects.