FOREWORD

Ground water economics is an interdisciplinary subject related to ground water exploration, exploitation, management, planning and protection, taking into account those economic concepts, values and guidelines needed for the efficient use of this resource, as well as the social priorities. Efficient use means consideration of the availability of financial resources, the involved costs and expected benefits, and also the social implications and environmental consequences, in addition to the classical hydrogeological considerations. Efficient use involves the consideration of alternatives using existing surface and groundwater resources, as well as other water resources such as reuse or desalination, when circumstances are appropriate.

Groundwater development and management is often carried out by ground water hydrologists or engineers with a poor training in economics, if any at all. In many instances, they reduce economical aspects to cost evaluation and price studies, in a very simplified form. On the other hand, economists often ignore the basic concepts related to groundwater resources and concentrate mainly on macroeconomic theory or econometrics, which may differ substantially from the real world of water as an economic issue. This divorce is more pronounced in many developing areas and countries, where good use and management of the available scarce water and economic resources is crucial to development, in order to get a net benefit which helps in reducing the gap between them and developed countries.

The lack of sound management and interdisciplinary training may lead to misuse of scarce water and economic resources, which is often aggravated by the generation of foreign debt and a higher dependence on imported technology and manpower. The high risk associated with the development of an inadequate water project - sometimes a major project - involves a very heavy and suffocating economic burden in the case of failure to achieve the intended results.

Water is an important factor in the economic output of many countries. It is dominant in poor, arid, rural areas, and the only way to reduce this dependence is to transfer benefits accruing from an efficient use of water to develop other sectors of the economy in which water is less important from an economic point of view.

There are limited opportunities for groundwater hydrologists, managers and planners from one side, to meet with economists from the other side, in order to exchange points of view and constitute interdisciplinary working teams or, at least, to establish the basis for a more sound understanding of the involved problems. This consideration was the basis of the Symposium and Workshop on on Ground Water Economics, from which most of the material of this book comes.

United Nations, through its Department of Technical Co-operation for Development recognized that, up to the present, little has been done nationally or internationally to promote an interdisciplinary approach to the subject. Thus came up the idea of convening an international meeting, with some emphasis on developing countries. The Government of Spain, through different state, regional and local organizations, took upon itself the task of organizing the meeting in Catalonia (Spain) under the responsibility of the Curso Internacional de Hidrología Subterránea (CIHS, International Course of Groundwater Hydrology) and the Centro de Estudios e Investigación del Agua (CEIA, Centre for Water Studies and Research). The Symposium, combined with a workshop addressing issues related to developing countries, was held in Barcelona, from October 19 through October 23, 1987.

The Symposium considered six main topics:

- Economic aspects of groundwater assessment (including exploration, geophysics, mapping, etc).

- Economic aspects of groundwater exploitation (including well construction and completion, well operation, extraction machinery, etc).

- Economic aspects of groundwater use (including supply, irrigation, distribution, operation and maintenance, etc.)

- Economic aspects of groundwater conservation (including pollution, protection areas, legislation and regulations, sea water intrusion, etc.).

- Economic aspects of the combined use of surface and groundwater (including artificial recharge, water reuse, alternative desalination schemes, rainfall stimulation, etc.).

- Economic assessment of the consequences of groundwater use (including environmental impacts, reserve depletion, quality impairment, subsidience, changes in social behaviour, etc.).

Each of the topics included a key paper from a specialist invited by United Nations and a report from other specialists invited by the Spanish Government. These reports not only reviewed the presented papers, but also provided a synthesis of the personal knowledge and experience of the reporter. Also, some special papers from United Nations organizations were included. A total of about 50 papers were contributed, although due to time limitations, only the more relevant ones were orally presented and discussed at the Symposium.

The meeting, probably the first ever held on this topic, was attended by about 130 specialists, of whom 30 were invited by the United Nations. It fullfilled its main goals, although, as expected, hydrogeological aspects dominated over typically economic ones, once more demonstrating the existing gap between these two subjects, both at university and administration levels, and in practical terms. It became clear that many experts and decision-makers have only a rudimentary knowledge of economics, often reduced to cost calculations comparing a limited number of often not very well-selected alternatives excessively simplified from the economic point of view. On the other hand, formulations by economists were sometimes too general or lacked in many instances a sound knowledge of groundwater behaviour and characteristics. Once more, the lack of enough information and the rash and isolated actuation of experts who have a limited view of the problems precludes attaining an effective use of limited natural and economic resources.

The purpose of this book is broader than merely collecting the papers presented at the meeting. The goal is to produce a publication with useful contributions, containing basic concepts, general formulations, relevant specific studies usable as reference cases and issues of interest for developing areas and countries. Therefore, a Publication Committee, aided by comments from the key speakers and the reporters, has reviewed all the papers, suggesting modifications, additions and deletions. Also, some people who were not able to attend the meeting were invited to contribute on specific aspects not covered in the meeting. Although not all desirable topics have been covered, we hope that we have succeeded in gathering a useful and comprehensive set of topics.

Papers failing to fulfill the scope of the book or the quality requirements have been rejected and thus are not included in the book. Many of the rejected papers were good ones but were not directly relevant to ground-water economics. In particular, some of the regional papers from developing areas contained very useful information relevant to the respective countries (hard to find in other

publications), but they lacked relevant economic information and have therefore not been included. Many of those may be published separately by United Nations.

The book has been organized in sections, covering different aspects

INTRODUCTION: Basic concepts on economy and groundwater economy. It has been prepared for those readers who need an introductory background on economics.

SECTION I.- Economic aspects of groundwater exploration and exploitation. It covers mainly information on costs and cost improvement.

SECTION II.- Economic aspects of groundwater use and conservation. It covers issues related to supply, distribution, irrigation, pollution, protection and groundwater treatment before use.

SECTION III.- Economic aspects of groundwater management. It covers issues such as alternative schemes, conjuntive use of different water resources, environmental and social impacts, and water planning and legislation.

SECTION IV.- Economic aspects of ground water relevant to developing areas and countries. The conclusions and recommendations of the workshop are included as a final paper.

Within each section, except for the introduction,, the order of presentation goes from key papers (not necessarily those considered as such in the symposium) to case studies. General papers dealing with some specific aspects of interest are included in between. This will ease the task of the reader in finding what is most relevant to him.

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