
Preface

Groundwater—from development to management

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Economic and population growth worldwide are moving groundwater—the once so “invisible resource”—into the headlines. More than 2 billion people worldwide depend on groundwater for their daily supply. A large amount of the world’s agriculture and irrigation is dependent on groundwater, as are large numbers of industries. In developing countries, groundwater scarcity and pollution disproportionately affect the poor because they are often not able to keep up with sinking groundwater levels or to find alternative sources when their groundwater resource becomes polluted. But also in industrialized countries, the economic livelihood of entire regions depends on groundwater.

Thus, from the southwestern United States, to Mexico, India, and northern China, local groundwater users and governments at all levels are realizing that the once so abundant and cheap groundwater resource is getting scarcer, increasingly polluted and thereby affecting options for social and economic growth and development.

It is consequently important to think about the underlying issues that prevent effective groundwater management and how to tackle them. Addressing groundwater issues from a technical perspective alone—as has been tried unsuccessfully in a number of cases—is clearly not sufficient, and the role for improved groundwater management in addressing this situation is becoming increasingly obvious. Consequently, many countries are actively moving from *laissez-faire* approaches where each individual could abstract from his or her source, at will, to managed approaches, involving groundwater users and developing a variety of instruments to improve groundwater and aquifer management. This is a clear shift in groundwater management approach, stepping away from *laissez-faire* and towards active aquifer management.

This issue of *Hydrogeology Journal* brings together contributions illustrating the groundwater situation across a number of continents, and discussing the management approaches being developed to cope with the changing groundwater management situation. It is hoped that readers will appreciate the panorama of challenges and options to improve groundwater management.

This issue also follows on the Third World Water Forum held in Japan in 2003. This was the first major international conference to strongly feature groundwater within an overall water context. Two days of sessions in Osaka on 18–19 March were devoted specifically to moving “Groundwater—from development to management”. This Special Issue re-emphasizes this important theme, to which the IAH, jointly with a number of other institutions, significantly contributed. Dozens of speakers from around the globe and an international audience discussed groundwater from a variety of perspectives, including hydrogeological, social, economic, and development approaches.

The *Thematic Statement* on groundwater, which was subsequently presented at and submitted to the Interministerial Conference in Kyoto, follows this message. It strongly highlights the need for urgency and for factoring institutional and management dimensions into a country’s view of its groundwater-resource needs. It does so by advocating a pragmatic, incremental approach to improved groundwater management, especially in developing countries, where small steps in the right direction will ultimately lead to long-term benefits. Equally, the importance of stakeholder involvement at all levels is emphasized.

The articles in this issue highlight these messages. *Ricardo Sandoval’s* article, about the Mexican state of Guanajuato’s attempts to move towards participatory groundwater management as a way to tackle the state’s unsustainable groundwater overexploitation, is complemented by *Mohamed Chebaane et al.’s* article illustrating a participatory approach to developing management options for more sustainable groundwater use in an equally water-scarce situation. The options analysis perspective is also taken in *Acharya’s* article, specifically focusing on the role that economic analysis can play as a tool for groundwater management in semi-arid countries such as Nigeria. The results, in this case, illustrate how an analysis of the costs and benefits across different uses in a

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river basin can yield different management scenarios, permitting more sustainable use of both ground- and surface-water resources.

Concrete experience with conjunctive ground- and surface-water management is also addressed in the paper by *DuMars and Minier*. They take a legal perspective and maintain the need for proactive administration of groundwater use, including the need for capacity building. This is illustrated by focusing on the state of New Mexico in the United States. *Jacobs and Holway*, who analyze the history of groundwater management in Arizona, provide a further dynamic US example. Here, the state has been playing an active role since the 1980s, and a number of administrative tools have been developed to manage both ground- and surface-water resources. The paper by *Sakiyan and Yazicigil*, in turn, focuses on the modeling of development options in situations of groundwater overdraft and availability of surface water resources.

In the case of the North China Plain, tools for groundwater management in a scarcity situation are currently under development, as highlighted in the paper by *Foster et al.* The article shows how technical and institutional/administrative knowledge can be combined to tackle groundwater depletion in an urban and densely populated, yet agriculturally vital area of China.

Shifting from quantity management issues, the article by *Drangert and Cronin* uses the history of perception regarding groundwater in industrialized and developing countries to develop a forward-looking approach to groundwater pollution management. It focuses on the concrete link between the groundwater resource and urban/peri-urban sanitation. Given the implications of worldwide urban growth, the authors establish a link between resource management and service provision, and they highlight the importance of involving individual users, not just user groups.

The article by *Alaerts and Khouri* also tackles groundwater pollution. By focusing on naturally occurring arsenic, they outline possible options for mitigation strategies and policies for dealing with this contaminant, which affects a number of countries around the world. They highlight the challenges, as well as the linkages to health and economic development in coming to grips with arsenic. As in the other articles, a pragmatic approach is strongly advocated.

Last but not least, the paper by *Foster* tackles a groundwater pollution issue that is not often highlighted, namely, the unintentional recharge of groundwater through wastewater irrigation. Many developing countries are grappling with these issues, given that such recharge happens spontaneously in many places and, again, solutions need to be sought to deal with the implications.

This compilation of papers, while it cannot be exhaustive, takes the reader through a variety of some of the most pertinent groundwater management issues worldwide. It ranges from groundwater scarcity issues to groundwater pollution, and shows the necessity of dealing with this vital resource in an innovative, open-minded and multidisciplinary manner. While some of the cases are

quite advanced regarding implementation of management approaches, some are just beginning. Others, while suffering from the same problems and challenges, have not yet moved at all to more active approaches. Hopefully, the increasing emphasis on addressing groundwater as an important part of the global development agenda will lead to more active, and improved groundwater management worldwide, permitting long-term economic growth and social development.

Third World Water Forum— Interministerial Conference Thematic Statement

Theme: Groundwater—from Development to Management

*Key issues: groundwater resources—
importance and sustainability*

- Groundwater is vital to many nations, irrespective of their stage of economic development. Worldwide some 2.0 billion people, large numbers of industrial premises and innumerable farmers depend on it for their water supply.
- Accelerated groundwater development over the past few decades has resulted in great social and economic benefits, by providing low-cost, drought-reliable and (mainly) high-quality water supplies for urban areas, for the rural population, and for irrigation of (potentially high-value) crops. However, investment in resource management has been seriously neglected. Further development and protection of the underlying resource base will be vital for the economical achievement of “UN Millennium Goals”.
- Whilst groundwater storage is vast (over 99% of freshwater reserves), its rate of replenishment is finite and mainly limited to the shallower aquifers, whose quality can also be seriously (and even irreversibly) degraded. Excessive resource development, uncontrolled urban and industrial discharges, and agricultural intensification are causing increasingly widespread degradation of aquifers.
- In some areas the consequences are far from trivial—falling water tables frustrating poverty alleviation, irrevocably salinized or polluted groundwater, serious land subsidence, and reduction of groundwater flow to sustain wetlands.

*Actions: making management
and protection more effective*

- The sustainability of groundwater is closely linked with a range of micro- and macro-policy issues influencing land-use and surface water, and represents one of the major challenges in natural-resource management. Practical advances are urgently needed but there is no simple blueprint for action, due to the inherent variability of groundwater systems and of related socio-economic situations.

- It is always feasible, however, to make incremental improvements. Government agencies need to be enabled as “guardians of groundwater”—working flexibly with local stakeholders as partners in resource administration, protection and monitoring, whilst also acting on broader water-resource planning and management strategy.
- Both short- and long-term mechanisms to increase the economic productivity of groundwater use, whilst renegotiating and reallocating existing abstractions, will be important components of overall strategy. Enhanced public awareness, improved scientific understanding, and local capacity building are also key elements for improving groundwater management.
- The “competent professional association”, supported by its UN agency partners, is pledging to put much greater effort into promoting constructive dialogue on groundwater policy issues, and into disseminating international experience in best practice for aquifer management and protection.

The experience of the “Theme Coordinators” and “Session Conveners” covers a wide range of geographic settings and a broad base of responsibilities. Significant initiatives taken in response to the 2nd World Water Forum are central to the focus, including the World Bank/Global Water Partnership Groundwater Management Advisory Team (GW-MATE) supported by Dutch and British trust funds, various components of the UNESCO-International Hydrological Programme (IHP) implemented in association with the International Association of Hydrogeologists (IAH) and other UN agencies, and the SINEX-Intensive Groundwater Use project promoted with Spanish public and private funds.

Recommendations: priority areas for political commitment

- Time is of the essence. Many developing nations need to appreciate their social and economic dependency on groundwater, and to invest in strengthening institutional provisions and building institutional capacity for its improved management, before it is too late and groundwater resources are irrevocably degraded.
- The “international development agencies” of donor nations and “international development banks” are urged to put higher priority on supporting realistic initiatives to strengthen governance of groundwater resources and local aquifer management. Sustainable human livelihoods, food security and key ecological systems will be dependent upon such initiatives.

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