

**Applications of Remote Sensing and GIS Technologies in Groundwater Hydrology: Past, Present and Future.** Madan Kumar Jha and Stefan Peiffer. BayCEER Publisher, Bayreuth, Germany. 2006. 201 pp. Price: Euro 20.00.

Groundwater is one of the most valuable resources on earth, which supports socio-economic development and ecological diversity. However, overuse and unabated pollution of groundwater are threatening human life and various ecosystems. The sustainable management of freshwater in general and groundwater in particular, is a major challenge of the 21st century. Use of conventional techniques/tools is often severely limited by the lack of adequate data, particularly in developing nations. As a result, innovative technologies like remote sensing (RS) and geographic information system (GIS) have a big role to play. As we know, the role of RS and GIS techniques in surface water hydrology is well demonstrated and a plethora of research papers have been published in different journals, coupled with several conference proceedings. However, the applications of these promising techniques in groundwater hydrology have received only cursory treatment, mostly focusing on a specific aspect only, and are less documented as rightly pointed out by the authors.

The editors of a reputed international journal on groundwater, namely *Hydrogeology Journal* published by Springer, have published a special issue in 2007 on RS and GIS applications in hydrogeology, which reflects the global importance of the subject. However, in the era of information technology, a suitable book solely dedicated to the applications of RS and GIS techniques in groundwater hydrology or hydrogeology is lacking. The present book by Jha and Peiffer fulfils this gap. The book is indeed a timely and important contribution to the field of groundwater hydrology (or hydrogeology).

At the outset, the consequences of imprudent exploitation of the scarce groundwater sources are brought out. The usefulness of RS and GIS technologies for a succinct study of the problem is explained. The basic concepts, working principles and applicability of the two technologies to groundwater studies are elucidated with a detailed review of the relevant literature. Based on the literature study, the authors have identified six major groups for conducting the study, namely assessment and exploration of groundwater resources, selection of sites for artificial recharge and water harvesting, GIS based

sub-surface flow modelling, assessment of pollution, natural recharge distribution and data analysis. Under each of these groups, the pertinent studies are explained.

Two chapters (5 and 6) are contributed by different German authors. Chapter 5 presents the capability of RS technology in the field of hydrogeology with suitable examples. Some perspectives on future applications of satellite data are added. Chapter 6 presents the 'Hoelting method' for evaluating groundwater vulnerability with a case study. However, a comparative analysis of the salient methods for assessing the vulnerability is not provided. The presentation of this chapter does not match with that of the other chapters.

In the subsequent chapters, the authors present the current status of application of RS and GIS technologies in groundwater hydrology in collection of data using RS and processing by GIS, explaining the advantages as well as drawbacks, constraints and challenges presently faced. On-field examples of the constraints would have added to the value of the presentation. The authors have rightly given a 'wake-up-call' to planners in developing nations to tackle pollution, before it gets out of hand. I would suggest inclusion of some relevant case studies in the next edition. In my opinion, the book brings together, uniquely and lucidly, the various aspects of application of RS and GIS technologies in groundwater hydrology. This book would prove to be equally useful to students, researchers and on-field planners. The figures and tables are of good quality and useful to the readers. The book uniquely covers the past, present and future of these technologies in hydrogeology and is written in a lucid style with straightforward explanations.

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**Groundwater Governance: Ownership of Groundwater and its Pricing.** S. Romani *et al.* (eds). Capital Publishing Company, New Delhi. 2006. 514 pp. Price: Rs 1500.

Much is talked about groundwater governance or groundwater management. However, except for a few knowledgeable people, others can hardly guess the dimensions or nuances of governance, leave aside their roles in the resolution of con-

flicts. Since independence, the uncontrolled pace of groundwater development has resulted in over 1600 blocks in the country being categorized as overdeveloped, critical or semi-critical. This leaves a host of formidable environmental, ecological, economical and social fallouts like declining water levels, drying up of wells, increasing cost of water lifting, sea-water ingress, drinking water scarcity, degrading water quality, fall in agricultural output and income, unemployment of farm labourers, debt traps, etc. Only a paradigm shift from groundwater development to management holds the key to its equity and sustainability. To address the hazards of overexploitation, the administrative, technical and limited legislative measures adopted so far, including restrictions on well energization or control of lending facilities from financial institutions for well-drilling, have been rather ineffective. This book, the first of its kind, contains articles by experts from all over the country with valuable contributions on the theme. It embodies the Proceedings of the 12th National Symposium on Hydrology held at New Delhi in December 2006. The authors attempt to address almost all aspects of groundwater governance, starting from optimal utilization, overexploitation, and pollution of the resource to institutional and legal reforms, water rights, water pricing and sectoral allocation. The editors have divided the book into five parts devoted to these interrelated themes.

The first part of the book, which is in effect a preamble to the other sections, is devoted to the theme of groundwater management and its emerging challenges. There are eighteen articles in this section. In his lead paper, S. Romani underlines specific strategies in varied hydrogeological terrains for optimal groundwater development and management, and for ensuring equity and sustainability of the resource. According to Stephen Foster and Hector Garduno, management options in hard-rock areas, often hit by over-exploitation, involve cross-sector approaches, including agriculture, energy and trade-policy interventions. They advocate dry land agriculture, development of alternate livelihoods, crop-water planning to maximize farmer's income and minimize groundwater use, conservation of drinking water sources and groundwater augmentation. In sedimentary tracts, shared utilization and protection of large, inter-state aquifers are of prime concern. Authors have presented interesting case studies like groundwater abstraction systems in varied hydrogeological environs,