BOOK REVIEW

GROUNDWATER ASSESSMENT AND MODELING by C.P. Kumar. Create Space Independent Publishing Platform (An Amazon Company), MARCH 2015, 322p. Price INR 2945.

A few decades back groundwater used to be treated as an issue of civil engineering rather than science. Groundwater development was confined mainly to drinking water wells, like dug wells, hand pump fitted tube wells. Of course, use of step wells or other similar structures to meet water needs has been age old tradition in arid areas. There was no worry about its availability as the draft was minimal and the resource is annually replenishable. Limitations of the resource and its exploitation started coming to the fore following acceleration of its development since seventies and adverse fallouts of its uncontrolled development like dipping water levels, drying of wells, falling well yield, polluted well waters etc. Further, with passage of time increased knowledge of subsurface geology and hydrology also led to the realization that groundwater development calls for scientific planning and management. Groundwater potentials depend upon aquifer distribution and recharge, and also groundwater flow characteristics. Flow equations involve complex mathematical computations. In this context the key issues are resource assessment and estimation, prediction of impact of its development, and alternative development options or scenarios. Hence in the last three decades or so mathematical modeling has come up as indispensable tool in groundwater management in the country. It clearly describes groundwater system and flow dynamics. C.P. Kumar, a scientist of repute in National Institute of Hydrology and with wide experience in the field, has brought out this highly valuable and educative lecture series as a Treatise on 'Groundwater Assessment and Modelling' for the benefit of young hydrogeologists and water managers. Kumar enlightens the students of groundwater science in this emerging knowledge field for disciplined development of this valuable resource of the country which is otherwise susceptible to manifold problems.

Keeping in mind the targeted readership the first six chapters of the book are devoted to the basics of groundwater hydrology like water resources potential of India, water balance analysis, management of aquifer recharge, assessment of groundwater potential, groundwater data requirement and analysis. These chapters no doubt serve as valuable introduction for the students leading to the main theme "modeling". He has covered almost every aspect of groundwater assessment from water table contouring to GIS, Kriging, introducing modern techniques of resource investigation, analysis and assessment.

The objective being clear, the author has smoothly sailed through the subsequent chapters 7-17, focusing on all relevant aspects of groundwater modelling. No doubt these chapters are sequenced in a step wise approach which helps the students of modeling enormously. The ultimate focus is ofcourse on groundwater modeling, and the treatment of the book addresses all its nuances like data requirements, basic guidelines, model

limitations, selection of groundwater modelling software, pitfalls and sensitivities, and common errors in modeling exercises. In the next chapters the author has given an overview of groundwater models, details the process of construction of a modular three-dimensional groundwater model, pitfalls and sensitivities of groundwater modelling, and modelling of unsaturated flow, so very important to understand infiltration and recharge processes. Kumar has also presented several examples of groundwater models like sea water intrusion, soil moisture movement etc. Both being important from groundwater management point of view, have been dwelt upon in fair details. I have not seen any other book on modeling to delve so deep into the subject, but written so concisely and in so simple and systematic approach.

The author is also alive to the day's burning issue adding a valuable chapter on climate change and global warming narrating the modalities and processes of climate modelling with focus on its impact on groundwater nicely depicted in the flow-chart (p.291). He has covered all aspects of modelling with due care. Even important contributions of other scientists have not gone unreported, followed by priceless reference list at the end of each chapter for further study.

Groundtruthing is an important step, – a must in modelling exercises. All should have knowledge of data types needed to get the desired results and have a clear understanding of the ultimate results of modelling or product to be expected. One has to calibrate the model at every stage matching with field data.

Keeping an eye on some major groundwater management problems raging in the country, a few live models (NIH, CGWB sponsored) might be added in the book, such as conjunctive use in canal commands (Indira Gandhi Nahar Project), groundwater flow modelling in typical fractured rocks (basement crystallines, Deccan traps), pumping cycles and optimal rates in a well field vis a vis upconing of saline water (Palla Well field) etc. A subject index to help the readers will be a welcome addition. These are mere suggestions which may enrich the volume.

I have come across very few student-friendly books such as this one so systematically sequenced in steps and approach. This is a book mooted to furnish a sound foundation to modelling exercises in varied hydrogeological problems and their solutions. The book will be welcomed by all concerned with country's groundwater resources management. I am sure Kumar's book will be successful in spurring more and more application of modelling in groundwater studies in India. Such a book has been awaited for long. C.P. Kumar, the author of this 'Treatise' does deserve encomiums.

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