

Groundwater Resources Sustainability Management And Restoration

The book collects seven original contributions in the field of climate and underlying human influences on renewable groundwater resources and/or stream–aquifer interactions. The first contribution introduces the following six ones into the overall framework of the topic. The second contribution assesses the impact of climate change scenarios on land subsidence related to groundwater level depletion in detrital aquifers. The third contribution studies the patterns of river infiltration and the associated controlling factors by using a combination of field investigations and modeling techniques. The fourth contribution introduces a method to improve the modeling of streamflow in high-permeability bedrock basins receiving interbasin groundwater flow. The fifth contribution discusses the role of resilience of hydrogeological systems affected by either climate and/or anthropic actions in order to understand how anticipating negative changes and preserving its services. The sixth contribution analyzes the water balance of wetlands, which are systems highly sensitive to climate change and human action. The seventh contribution identifies groundwater bodies with low vulnerability to pumping to be used as potential buffer values for sustainable conjunctive use management during droughts.

The book embodies the groundwater issues and challenges in India focusing its sustainable use. It is a compilation of papers presented by the eminent experts from Government departments, academia, research institutes, NGOs and stakeholders who assembled at Kurukshetra on 21st August, 2015 in the event of Bhujal Manthan or “Churning of Groundwater” organized for the first time by Ministry of Water Resources, River Development and Ganga Rejuvenation, the apex Ministry of Water Resource under Government of India. India, as a country, is the highest groundwater extractor in the world. Its service towards attaining the food and clean drinking water security is well documented. This volume addresses the issues of aquifer characterization, groundwater contamination, groundwater resource availability and its sustainable management through community participation in pan-India scenario. This book provides a unique opportunity for its readers to understand groundwater domain in India in its entire gamut. The papers included in the volume were selected carefully from the presentations made in the following four broad topics during the Manthan; (i) groundwater quality, (ii) conjunctive use of surface and groundwater, (iii) management intervention and sustainable use of this resource, and (iv) groundwater problems and application of various techniques. The book contains 20 papers including an introductory chapter by the editors. The content of the book is enriched by contributions from eminent researchers and activists in groundwater domain, like Prof. Tushar Shah, Prof. Himanshu Kulkarni, Dr. D. K. Chadha, Dr. Bharat Sharma and others. The recommendations in the individual papers are of immense significance for keeping the groundwater of the country clean and sustainable. The volume will help the readers to understand the groundwater issues of the country and also assist policy makers to prepare strategies for its better governance and management with environmentally sustainable ways.

Sustainable Water Resources Management presents the most current thinking on the environmental, social, and political dimensions of sustainably managing the water supply at local, regional, or basin levels.

Global Groundwater: Source, Scarcity, Sustainability, Security, and Solutions presents a compilation of compelling insights into groundwater scenarios within all groundwater-stressed regions across the world. Thematic sub-sections include groundwater studies on sources, scarcity, sustainability, security, and solutions. The chapters in these sub-sections provide unique knowledge on groundwater for scientists, planners, and policymakers, and are written by leading global experts and researchers. Global Groundwater: Source, Scarcity, Sustainability, Security, and Solutions provides a unique, unparalleled opportunity to integrate the knowledge on groundwater, ranging from availability to pollution, nation-level groundwater management to transboundary aquifer governance, and global-scale review to local-scale case-studies. Provides interdisciplinary content that bridges the knowledge from groundwater sources to solutions and sustainability, from science to policy, from technology to clean water and food Includes global and regional reviews and case studies, building a bridge between broad reviews of groundwater-related issues by domain experts as well as detailed case studies by researchers Identifies pathways for transforming knowledge to policy and governance of groundwater security and sustainability

Groundwater is the most important source of domestic, industrial, and agricultural water and also a finite resource. Population growth has created an unprecedented demand for water, with the situation most critical in the developing world, where several million people depend on contaminated groundwater for drinking purposes. Geogenic contaminants, Due to the increasing demand for adequate water supply caused by the augmenting global population, groundwater production has acquired a new importance. In many areas, surface waters are not available in sufficient quantity or quality. Thus, an increasing demand for groundwater has resulted. However, the residence of time of groundwater can be of the order of thousands of years while surface waters is of the order of days. Therefore, substantially more attention is warranted for transport processes and pollution remediation in groundwater than for surface waters. Similarly, pollution remediation problems in groundwater are generally complex. This excellent, timely resource covers the field of groundwater from an engineering perspective, comprehensively addressing the range of subjects related to subsurface hydrology. It provides a practical treatment of the flow of groundwater, the transport of substances, the construction of wells and well fields, the production of groundwater, and site characterization and remediation of groundwater pollution. No other reference specializes in groundwater engineering to such a broad range of subjects. Its use extends to: The engineer designing a well or well field The engineer designing or operating a landfill facility for municipal or hazardous wastes The hydrogeologist investigating a contaminant plume The engineer examining the remediation of a groundwater pollution problem The engineer or lawyer studying the laws and regulations related to groundwater quality The scientist analyzing the mechanics of solute transport The geohydrologist assessing the regional modeling of aquifers The geophysicist determining the characterization of an aquifer The cartographer mapping aquifer characteristics The

practitioner planning a monitoring network

The Congress "Arsenic in the Environment" offers an international, multi- and interdisciplinary discussion platform for research and innovation aimed towards a holistic solution to the problem posed by the environmental toxin arsenic, with significant societal impact. The Congress has focused on cutting edge and breakthrough research in physical, chemical, toxicological, medical, agricultural and other specific issues on arsenic across a broader environmental realm. The Biennial Congress "Arsenic in the Environment" was first organized in Mexico City (As2006) followed by As2008 in Valencia (Spain), As2010 in Tainan (Chinese Taiwan), As2012 in Cairns (Australia), As2014 in Buenos Aires (Argentina) and As2016 in Stockholm (Sweden). The 7th International Congress As2018 was held July 1-6, 2018, in Beijing, P. R. China and was entitled Environmental Arsenic in a Changing World. The Congress addressed the broader context of arsenic research aligned on the following themes: Theme 1: Arsenic Behaviour in Changing Environmental Media Theme 2: Arsenic in a Changing Agricultural Ecosystem Theme 3: Health Impacts of Environmental Arsenic Theme 4: Technologies for Arsenic Immobilization and Clean Water Blueprints Theme 5: Sustainable Mitigation and Management Arsenic in drinking water (mainly groundwater) has emerged as an issue of global health concern. During last decade, the presence of arsenic in rice, possibly also other food of plant origins, has attained increasing attention. This is particularly true in the Asian countries, where the use of high arsenic groundwater as source of irrigation water and drinking water has been flagged as severe health concern. This has been accentuated by elevating arsenic concentrations in deep groundwater recharged from shallow high arsenic groundwater, which may have further detrimental effects on public health. Notably, China has been in the forefront of research on arsenic biogeochemical cycling, health effects of arsenic, technologies for arsenic removal, and sustainable mitigation measures. The Congress has attracted professionals involved in different segments of interdisciplinary research on arsenic in an open forum, and strengthened relations between academia, research institutions, government and non-governmental agencies, industries, and civil society organizations to share an optimal ambience for exchange of knowledge.

Institutional development / Farm income / Water scarcity / GIS / Remote sensing / Salinity control / Pumping / Rain / Water quality / Supplementary irrigation / Environmental sustainability / Sustainable agriculture / Water table / Water balance / Water requirements / Crop production / Models / Groundwater / Surface water / Conjunctive use / Water resource management

This book addresses the various challenges in achieving sustainable groundwater development, management, and planning in semi-arid regions, with a focus on India, and discusses advanced remote sensing and GIS techniques for the estimation and management of groundwater resources. The book is timely as there is a need for a better understanding of the various tools and methods required to efficiently and sustainably meet the growing demand for clean surface and groundwater in developing countries, and how these tools can be combined with other strategies in a multi-disciplinary fashion to achieve this goal in water-scarce regions. To wit, the book combines remote sensing and GIS techniques, runoff modeling, aquifer mapping, land use and land cover analyses, evapotranspiration estimation, crop coefficients, and water policy approaches. This will be of use to academics, policymakers, social scientists, and professionals involved in the various aspects of sustainable groundwater development, planning, and management.

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The aim of this book is to document for the first time the dimensions and requirements of effective integrated groundwater management (IGM). Groundwater management is a formidable challenge, one that remains one of humanity's foremost priorities. It has become a largely non-renewable resource that is overexploited in many parts of the world. In the 21st century, the issue moves from how to simply obtain the water we need to how we manage it sustainably for future generations, future economies, and future ecosystems. The focus then becomes one of understanding the drivers and current state of the groundwater resource, and restoring equilibrium to at-risk aquifers. Many interrelated dimensions, however, come to bear when trying to manage groundwater effectively. An integrated approach to groundwater necessarily involves many factors beyond the aquifer itself, such as surface water, water use, water quality, and ecohydrology. Moreover, the science by itself can only define the fundamental bounds of what is possible; effective IGM must also engage the wider community of stakeholders to develop and support policy and other socioeconomic tools needed to realize effective IGM. In order to demonstrate IGM, this book covers theory and principles, embracing: 1) an overview of the dimensions and requirements of groundwater management from an international perspective; 2) the scale of groundwater issues internationally and its links with other sectors, principally energy and climate change; 3) groundwater governance with regard to principles, instruments and institutions available for IGM; 4) biophysical constraints and the capacity and role of hydroecological and hydrogeological science including water quality concerns; and 5) necessary tools including models, data infrastructures, decision support systems and the management of uncertainty. Examples of effective, and failed, IGM are given. Throughout, the importance of the socioeconomic context that connects all effective IGM is emphasized. Taken as a whole, this work relates the many facets of effective IGM, from the catchment to global perspective.

Your Guide to Effective Groundwater Management Groundwater Assessment, Modeling, and Management discusses a variety of groundwater problems and outlines the solutions needed to sustain surface and ground water resources on a global scale. Contributors from around the world lend their expertise and provide an international perspective on groundwater management. They address the management of groundwater resources and pollution, waste water treatment methods, and the impact of climate change on groundwater and water availability (specifically in arid and semi-arid regions such as India and Africa). Incorporating management with science and modeling, the book covers all areas

of groundwater resource assessment, modeling, and management, and combines hands-on applications with relevant theory. For Water Resource Managers and Decision Makers The book describes techniques for the assessment of groundwater potential, pollution, prevention, and remedial measures, and includes a new approach for groundwater modeling based on connections (network theory). Approximately 30 case studies and six hypothetical studies are introduced reflecting a range of themes that include: groundwater basics and the derivation of groundwater flow equations, exploration and assessment, aquifer parameterization, augmentation of aquifer, water and environment, water and agriculture, the role of models and their application, and water management policies and issues. The book describes remote sensing (RS) applications, geographical information systems (GIS), and electrical resistivity methods to delineate groundwater potential zones. It also takes a look at: Inverse modeling (pilot-points method) Simulation optimization models Radionuclide migration studies through mass transport modeling Modeling for mapping groundwater potential Modeling for vertical 2-D and 3-D groundwater flow Groundwater Assessment, Modeling, and Management explores the management of water resources and the impact of climate change on groundwater. Expert contributors provide practical information on hydrologic engineering and groundwater resources management for students, researchers, scientists, and other practicing professionals in environmental engineering, hydrogeology, irrigation, geophysics, and environmental science.

This report contains a collection of papers presented at a workshop in Merida, Mexico --- Strengthening Science-Based Decision Making: Sustainable Management of Groundwater in Mexico. The cross-cutting themes of the workshop were the elements or principles of science-based decision making and the role of the scientific community in ensuring that science is an integral part of the decision making process. Papers included in this volume describe the groundwater resources of Mexico's Yucatan Peninsula, approaches to managing groundwater in Mexico and governmental and scientific institutions concerned with water resources. Other papers discuss US approaches to managing scarce water resources. Participants in the workshop included representatives from leading scientific and academic institutions, federal state and local governments, non-governmental organizations and businesses.

A comprehensive resource to sustainability and its application to the environmental, industrial, agricultural and food security sectors Sustainability fills a gap in the literature in order to provide an important guide to the fundamental knowledge and practical applications of sustainability in a wide variety of areas. The authors – noted experts who represent a number of sustainability fields – bring together in one comprehensive volume the broad range of topics including basic concepts, impact assessment, environmental and the socio-economic aspects of sustainability. In addition, the book covers applications of sustainability in environmental, industrial, agricultural and food security, as well as carbon cycle and infrastructural aspects. Sustainability addresses the challenges the global community is facing due to population growth, depletion of non-renewable resources of energy, environmental degradation, poverty, excessive generation of wastes and more. Throughout the book the authors discuss the economics, ecological, social, technological and systems perspectives of sustainability. This important resource:

- Explores the fundamentals as well as the key concepts of sustainability;
- Covers basic concepts, impact assessment, environmental and socio-economic aspects, applications of sustainability in environmental, industrial, agricultural and food security, carbon cycle and infrastructural aspects;
- Argues the essentiality of sustainability in ensuring the propitious future of earth systems; and
- Authored by experts from a range of various fields related to sustainability.

Written for researchers and scientists, students and academics, Sustainability: Fundamentals and Applications is a comprehensive book that covers the basic knowledge of the topic combined with practical applications.

Sustainable groundwater development requires knowledge of the appropriate recharge and transport-processes. This is a prerequisite to understanding: (i) groundwater resources and their availability, and (ii) the dependence between groundwater and the environment. Conceptual understanding of groundwater flow at both temporal and spatial scales (local and regional) is essential for management that will support engineering, industry, agriculture, ecology, and all environmentally related issues. This book has been prepared for scientists, researchers, students, engineers, water resources specialists, groundwater consultants, government administrators and teachers. It is of direct and applied interest to practitioners in hydrogeology and groundwater (resources, quality, pollution, protection and clean-up), geochemistry and hydrogeochemical modelling, and investigators into environmental hydrology, groundwater dependent ecosystems, and other practical environmental issues.

The hydrogeological aspect of groundwater science is universal and applied in nature to have a sustainable water resource development with social, economic, ecological, cultural and aesthetic background. Since 99% of the world's fresh available water is groundwater; yet, the majority of financial resources are directed to surface water found in rivers and lakes. This serious imbalance requires urgent redress. This volume addresses the issue to facilitate the joint analysis of groundwater management studies and problems faced by scientist, engineers, managers and other scholars from natural and applied sciences. Significant financial support is required for basic groundwater research if sustainable development is to be a realistic goal. As a fresh water resource, groundwater has major advantages over surface water. This is the basic idea that explicitly appears in almost all paper of this book. The authors have tried to focus their task on those topics that seemed to us more urgent and relevant and have paid much attention to questions related to management of aquifers, groundwater pollution, the long-term problems and the key issues in developing countries, where majority of world population live and where at present enormous groundwater abstraction occurs. We (editors) have disseminated proper information in a systematic scientific manner to make the concept of groundwater management and sustainability understandable to everyone, through this book. The book provides a platform to bring together earth scientists, professionals from chemical and engineering science disciplines, public health professionals and social scientists involved with the management and development of groundwater resources. The book is expected to reflect the current understanding of all the issues related to management of groundwater resources and their sustainable use.

An All-Inclusive Guide to Efficient, Cost-Effective Management of Groundwater Resources Groundwater Sustainability is a reliable, one-stop guide containing all the information you'll need to succeed in your groundwater management and development projects. It covers virtually every aspect of the subject, from how to characterize groundwater and evaluate its resources to determining the

interactions between surface water and groundwater. Packed with hundreds of illustrations, this expansive guide reviews both established and innovative aquifer restoration techniques and technologies, including the control and remediation of contaminant sources and groundwater contaminant plumes. You'll also find valuable information regarding resource augmentation, the engineering necessary for resource development, and building comprehensive databases for efficient, cost-effective assessment. Written in an inviting-to-read style by a recognized expert in the field, Groundwater Sustainability provides the last word on the all-important subject of how to maintain and manage the most precious natural resource. Inside: In-depth coverage of groundwater availability and sustainability Treatment options for groundwater contaminants Tools and techniques for effectively managing aquifers Proven tactics for protecting and restoring groundwater resources Case studies, figures, graphs, and photographs Tips on building assessment models using a GIS platform This all-in-one guide covers: Global Freshwater Resources Aquifer Evaluation Groundwater Resource Development Groundwater Recharge Climate Change and Its Impact on Groundwater Groundwater Chemistry Drinking Water Treatment Options Managing & Restoring Groundwater Resources

Groundwater Hydrology of Water Resource Series - Water is an essential environmental resource and one that needs to be properly managed. As the world places more emphasis on sustainable water supplies, the demand for expertise in hydrology and water resources continues to increase. This series is intended for professional engineers, who seek a firm foundation in hydrology and an ability to apply this knowledge to solve problems in water resource management. Future books in the series are: Groundwater Hydrology of Springs (2009), Groundwater Hydrology of River Basins (2009), Groundwater Hydrology of Aquifers (2010), and Groundwater Hydrology of Wetlands (2010). First utilized as a primary source of drinking water in the ancient world, springs continue to supply many of the world's cities with water. In recent years their long-term sustainability is under pressure due to an increased demand from groundwater users. Edited by two world-renowned hydrologists, Groundwater Hydrology of Springs: Theory, Management, and Sustainability will provide civil and environmental engineers with a comprehensive reference for managing and sustaining the water quality of Springs. With contributions from experts from around the world, this book covers many of the world's largest springs, providing a unique global perspective on how engineers around the world are utilizing engineering principles for coping with problems such as: mismanagement, overexploitation and their impacts both water quantity and quality. The book will be divided into two parts: part one will explain the theory and principles of hydrology as they apply to Springs while part two will provide a rare look into the engineering practices used to manage some of the most important Springs from around the world. Description of the spring and the aquifer feeding it Latest groundwater and contaminant transport models Description of sources of aquifer use Understanding of contamination and/or possible contamination A plan for management and sustainability

This book addresses groundwater governance, a subject internationally recognized as crucial and topical for enhancing and safeguarding the benefits of groundwater and groundwater-dependent ecosystems to humanity, while ensuring water and food security under global change. The multiple and complex dimensions of groundwater governance are captured in 28 chapters, written by a team of leading experts from different parts of the world and with a variety of relevant professional backgrounds. The book aims to describe the state-of-the-art and latest developments regarding each of the themes addressed, paying attention to the wide variation of conditions observed around the globe. The book consists of four parts. The first part sets the stage by defining groundwater governance, exploring its emergence and evolution, framing it through a socio-ecological lens and describing groundwater policy and planning approaches. The second part discusses selected key aspects of groundwater governance. The third part zooms in on the increasingly important linkages between groundwater and other resources or sectors, and between local groundwater systems and phenomena or actions at the international or even global level. The fourth part, finally, presents a number of interesting case studies that illustrate contemporary practice in groundwater governance. In one volume, this highly accessible text not only familiarizes water professionals, decision-makers and local stakeholders with groundwater governance, but also provides them with ideas and inspiration for improving groundwater governance in their own environment.

Provides an in-depth look at science, policy and management in the water sector across the globe Sustainable water management is an increasingly complex challenge and policy priority facing global society. This book examines how governments, municipalities, corporations, and individuals find sustainable water management pathways across competing priorities of water for ecosystems, food, energy, economic growth and human consumption. It looks at the current politics and economics behind the management of our freshwater ecosystems and infrastructure and offers insightful essays that help stimulate more intense and informed debate about the subject and its need for local and international cooperation. This book celebrates the 15-year anniversary of Oxford University's MSc course in Water Science, Policy and Management. Edited and written by some of the leading minds in the field, writing alongside alumni from the course, Water Science, Policy and Management: A Global Challenge offers in-depth chapters in three parts: Science; Policy; and Management. Topics cover: hydroclimatic extremes and climate change; the past, present, and future of groundwater resources; water quality modelling, monitoring, and management; and challenges for freshwater ecosystems. The book presents critical views on the monitoring and modelling of hydrological processes; the rural water policy in Africa and Asia; the political economy of wastewater in Europe; drought policy management and water allocation. It also examines the financing of water infrastructure; the value of wastewater; water resource planning; sustainable urban water supply and the human right to water. Features perspectives from some of the world's leading experts on water policy and management Identifies and addresses current and future water sector challenges Charts water policy trends across a rapidly evolving set of challenges in a variety of global areas Covers the reallocation of water; policy process of risk management; the future of the world's water under global environmental change; and more Water Science, Policy and Management: A Global Challenge is an essential book for policy makers and government agencies involved in water management, and for undergraduate and postgraduate students studying water science, governance, and policy.

This book presents a unique and up-to-date summary of what is known about groundwater on our planet, from a global perspective and in terms of area-specific factual information. Unlike most textbooks on groundwater, it does not deal with theoretical principles, but rather with the overall picture that emerges as a result of countless observations, Written by renowned experts in the field, this book assesses the status of groundwater models and defines models and modeling needs in the 21st century. It reviews the state of the art in model development and application in regional groundwater management, unsaturated flow/multiphase flow and transport, island modeling, biological and virus transport, and fracture flow. Both deterministic and stochastic aspects of unsaturated flow and transport are covered. The book also introduces a unique assessment of models as analysis and management tools for groundwater resources. Topics covered include model vs. data uncertainty, accuracy of the dispersion/convection

equation, protocols for model testing and validation, post-audit studies, and applying models to karst aquifers.

This book describes and analyses the diversity of possible approaches and policy pathways to implement sustainable groundwater development, based on a comparative analysis of numerous quantitative management case studies from France and Australia. This unique book brings together water professionals and academics involved for several decades in groundwater policy making, planning or operational management to reflect on their experience with developing and implementing groundwater management policy. The data and analysis presented accordingly makes a significant contribution to the empirical water management literature by providing novel, real world insights unpublished elsewhere. The originality of the contributions also lies in the different disciplinary perspectives (hydrogeology, economics, planning and social sciences in particular) adopted in many chapters. The book offers a unique comparative analysis of France, Australia and experiences in countries such as Chile and the US to identify similarities, but also fundamental differences, which are analysed and presented as alternative policy options - these differences being mainly related to the role of the state, the community and market mechanisms in groundwater management.

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This book deals with the challenges for efficient groundwater management, with a focus on South Asia and India, providing a balanced presentation of theory and field practice using a multidisciplinary approach. Groundwater of South Asia is increasingly confronted with overuse and deteriorating quality and therefore requires urgent attention. Management of the stressed groundwater systems is an extremely complex proposition because of the intricate hydrogeological set-up of the region. Strategies for sustainable management must involve a combination of supply-side and demand-side measures depending on the regional setting and socio-economic situations. As a consequence, the challenges of efficient groundwater management require not only a clear understanding of the aquifer configuration, but also demand for the development of a comprehensive database of the groundwater occurrences and flow systems in each hydrogeological setting. In addition, drilling and well construction methods that are appropriate to different hydrogeological formations need to be implemented as well as real-time monitoring of the status of the groundwater use. Also corrective measures for groundwater that is threatened with depletion and quality deterioration need to be installed. Finally, the legal framework of groundwater needs to be rearticulated according to the common property aspect of groundwater. These challenges should revolve around effective groundwater governance by creating an atmosphere to support and empower community-based systems of decision-making and revisit the existing legal framework and groundwater management institutions by fostering community initiatives. This book is relevant for academics, professionals, administrators, policy makers, and economists concerned with various aspects of groundwater science and management.

Groundwater is an indispensable resource in many parts of the world, where it supports domestic water supply, irrigated agriculture and industry. Its increased, and often intensive, use during the last half century has created problems and raised concerns regarding the potential depletion of local aquifers, water quality degradation and various geo

Climate change is expected to modify the hydrological cycle and affect freshwater resources. Groundwater is a critical source of fresh drinking water for almost half of the worlds population and it also supplies irrigated agriculture. Groundwater is also important in sustaining streams, lakes, wetlands, and associated ecosystems. But despite this,

This title offers more than 100 papers originating in 20 countries, covering research on a widening range of methods for recharge enhancement and groundwater quality protection and improvement. These include: bank filtration; aquifer storage and recovery; and soil aquifer treatment, as well as rainwater harvesting and pond infiltration. The emphasis is on understanding subsurface process to improve siting, design and operation and to facilitate use of stormwater and reclaimed water, particularly in water-scarce areas.

Groundwater is becoming increasingly scarce while the demand for water continues to grow at a global scale.

Understanding groundwater resources and their sustainable management is imperative for the future of groundwater use, conservation and protection. This revised and updated two-volume set, focused on sustainability, covers the economic values of groundwater production and use, including micro- and macroeconomic factors, groundwater markets, economic evaluation tools, climate change, transboundary issues and policy evaluation. It explores numerous applications and describes ways to evaluate the economics of groundwater use in the context of the larger ecosystem and the natural capital it provides. FEATURES OF THIS VOLUME Includes an important new chapter on groundwater sustainability management Addresses new examples of groundwater use that are applicable at both the local and international levels Provides the foundation for policy, program and project analysis for all major uses of groundwater Updates groundwater use data along with explanations of major production costs and use benefits Gives a new perspective on users' competition for the subsurface environment Production, Use, and Sustainability of Groundwater, Second Edition, the first volume of the two-volume set Groundwater Economics, is a must-have for any professional or student who needs to understand, evaluate and manage water resources from a range of production and use perspectives affecting groundwater resource sustainability.

A presentation of research investigations and pointers towards achieving sustainable groundwater supplies in challenging local community environments across the African continent, including situation sketch, implementation practice, and various case studies.

Increasing demand for water, higher standards of living, depletion of resources of acceptable quality, and excessive water pollution due to urban, agricultural, and industrial expansions have caused intense environmental, social, economic, and political predicaments. More frequent and severe floods and droughts have changed the resiliency and ability of water infrastructure systems to operate and provide services to the public. These concerns and issues have also changed the way we plan and manage our surface and groundwater resources. Groundwater Hydrology: Engineering, Planning, and Management, Second Edition presents a compilation of the state-of-the-art subjects and techniques in the education and practice of groundwater and describes them in a systematic and integrated fashion useful for undergraduate and graduate students and practitioners. This new edition features updated materials, computer codes, and case studies throughout. Features: Discusses groundwater hydrology, hydraulics, and basic laws of groundwater movement Describes environmental water quality issues related to groundwater, aquifer restoration, and remediation techniques, as well as the impacts of climate change \ Examines the details of groundwater modeling and simulation of conceptual models Applies systems analysis techniques in groundwater planning and management Delineates the modeling and downscaling of climate change impacts on groundwater under the latest IPCC climate scenarios Written for

students as well as practicing water resource engineers, the book develops a system view of groundwater fundamentals and model-making techniques through the application of science, engineering, planning, and management principles. It discusses the classical issues in groundwater hydrology and hydraulics followed by coverage of water quality issues. It also introduces basic tools and decision-making techniques for future groundwater development activities, taking into account regional sustainability issues. The combined coverage of engineering and planning tools and techniques, as well as specific challenges for restoration and remediation of polluted aquifers sets this book apart.

This book presents the most recent innovative studies in the field of water resources for arid areas to move towards more sustainable management of the resources. It gathers outstanding contributions presented at the 2nd International Water Conference on Water Resources in Arid Areas (IWC), which was held online (Muscat, Oman) in November 2020. Papers discuss challenges and solutions to alleviate water resource scarcity in arid areas, including water resources management, the introduction of modern irrigation systems, natural groundwater recharge, construction of dams for artificial recharge, use of treated wastewater, and desalination technologies. As such, the book provides a platform for the exchange of recent advances in water resources research, which are essential to improving the critical water situation and to move towards more sustainable management of water resources.

In 2007, the world's urban population surpassed the number of people living in rural areas and is still growing. The number of city dwellers who do not have access to piped water and rely on groundwater is also increasing. In many Asian cities, groundwater is not only the source of domestic water but also an important resource for industrial development, making better management of groundwater resources essential for sustainable development. Because groundwater is easier to access and costs less than water from piped systems, groundwater abstraction cannot be easily regulated. Policies for groundwater management adopted in Japan and other Asian countries are compared, and technologies for efficient use of groundwater are elucidated. Groundwater contamination is also a serious problem that exacerbates water scarcity in Asian cities. Case studies illustrate the cause and consequences of naturally occurring contaminants such as arsenic and fluoride, and groundwater contamination due to anthropogenic contaminants is described. Also discussed are technologies for treating contaminated groundwater to reduce the health risks of drinking contaminated groundwater.

This book provides a comprehensive review of the state of international law as it applies to transboundary groundwater resources and aquifers. The main focus is on recent developments and the emerging international law for transboundary aquifers as reflected in the practice of states and the work of the UN International Law Commission, UN Economic Commission for Europe, and International Law Association. The author takes an interdisciplinary approach to the subject matter and provides the scientific hydro-geological underpinning for the application of law and policy to transboundary groundwater resources. He also addresses the growing global dependence on this hidden resource, as well as both the historical and scientific context for development of the law. The book provides case examples throughout to illustrate the various concepts and developments. These include more detailed examinations of the few existing transboundary aquifer agreements in operation, such as for aquifers between France and Switzerland and Jordan and Saudi Arabia, as well as aquifers in North Africa and in South America.

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