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Edited by R. Quentin Grafton and Karen Hussey
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WATER RESOURCES PLANNING AND MANAGEMENT

Water is an increasingly critical issue at the forefront of global policy change, management and planning. There are growing concerns about water as a renewable resource, its availability for a wide range of users, aquatic ecosystem health, and global issues relating to climate change, water security, water trading and water ethics. There is an urgent need for practitioners to have a sound understanding of the key issues and policy settings underpinning water management. However, there is a dearth of relevant, up-to-date texts that adopt a comprehensive and interdisciplinary focus and which explore both the scientific and hydrological aspects of water, together with the social, institutional, ethical and legal dimensions of water management.

This book will address these needs. It provides the most comprehensive reference ever published on water resource issues. It brings together multiple disciplines to understand and help resolve problems of water quality and scarcity. Its many and varied case studies offer local and global perspectives on sustainable water management, and the ‘foundation’ chapters will be greatly valued by students, researchers and professionals involved in water resources, hydrology, governance and public policy, law, economics, geography and environmental studies.

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Foreword

Water Resources Planning and Management provides a unique insight into the problems our planet faces in terms of water quantity and quality, and what to do about it. It is the only book that adopts both a comprehensive and interdisciplinary focus to combine scientific and hydrological understanding with the social, institutional, ethical and legal dimensions of water management. Its contributions from some of the world's leading water experts, across many disciplines and with varied case studies from 19 different countries, makes it the ideal source of information for students, scholars and water practitioners.

Business as usual in terms of water management in many parts of the world cannot continue. This book provides an essential guide to change. It offers: (1) foundation chapters to understanding water (such as the water cycle, surface and groundwater interactions, and water ecosystems); (2) contributions on water planning and management (such as managing water trade offs, adaptive management of water, and managing environmental flows); and (3) chapters on the challenges and experiences of water management (such as Tar Sands of Alberta and Indigenous access to water in Australia). Whether you are concerned about groundwater contamination from arsenic in Bangladesh that has affected millions of people, want to understand Hydrology 101, or how to cope with the challenges of water scarcity in cities, this book has it all.

Simply put, *Water Resources Planning and Management* is a must read book for all who wish to make a difference in how to plan and manage our scarce water resources.

Until, and unless, the insights from this book are widely adopted, we risk further degradation to the most precious of all our natural resources.

The Earl of Selborne KBE FRS
Chairman
The Foundation for Science and Technology

Preface

The importance of water cannot be overstated: it is essential for all life on Earth. So while the world is preoccupied by the threat of climate change, all those involved in the debate understand that when we talk about climate change the subtext is, how will water be managed? When we discuss the need to ‘adapt’ to climate change, we are, in one aspect, addressing the need to deal with either more, or less, water. At the same time, anyone who has been involved in water resource management will tell you that we have been ‘adapting’ to our climate ever since the Bronze Age, when humans decided to settle down and establish organised agriculture. Some 4000 years and 7 billion people later, and with all our clever water infrastructure and technology, we are still trying to get it right.

A simple but true fact illustrates the point: before the 1990s, water resources planning and management was the domain of engineers and hydrologists; after that time, the emphasis shifted to ‘least cost’ solutions. And yet, at our home university (as elsewhere), we now recognise that solutions which will deliver positive outcomes to society, the environment and the economy, must also engage a spectrum of hydrologists, engineers, and economists; moreover, they must also engage sociologists, ecologists, lawyers, political scientists, environmental historians, anthropologists, geographers and others.

Our ‘holistic’ epiphany coincided with the visit to Canberra by Lord (John) Selborne. In early 2008, both of us (RQG and KH) had the good fortune to be seated next to him at an official dinner, and we three lamented the lack of a truly interdisciplinary, contemporary text for policy-makers, planners and researchers. We all were seeking a book that combined the scientific and hydrological aspects of water as a resource, with the social, institutional, economic, ethical, and legal dimensions of water management. The idea for this book was born. Together we formed an advisory committee, under John’s Chairmanship, and in 2008–09 the book started to take shape.

Our goal was that this book would be the first of its kind to bridge the many areas of water management and planning; it would set out innovative ideas, detailed case studies, and governance frameworks. We would have liked to have included more but, in the end, time and the size of the book prevented us from covering everything from everywhere.

The book offers a global perspective on problems in water management; it gives an extensive coverage of water quality and water quantity issues, institutional and governance arrangements for management and planning, Indigenous water use, engineering solutions

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Preface

and their feasibility, the geo-politics of water security, and the implications of embedded water in the related areas of energy, health and biodiversity conservation and other issues. We believe this volume, combining the insights and research of so many talented people, provides an important step towards a global vision of integrated water resources, planning, and management. The world will need this guidance today and in the years to come.

R. Quentin Grafton and Karen Hussey

Acknowledgements

How can we manage our water resources more sustainably? In 2006, The Australian National University (ANU) established the ANU Water Initiative, an interdisciplinary research project aimed at answering that key question. With the help of the talented and energetic members of the ANU Water Initiative steering committee, and the financial support of our university, the editors and the advisory committee for this book have tried to bridge disciplinary divides in water management and to take a broader view and understanding of water.

We are especially grateful to the members of an advisory committee for this volume that helped guide us, the editors, in terms of what to include in the book and how to make the wider vision of water management a reality. Lord (John) Selborne chaired the committee and we could not have found a better group of individuals with diverse experiences to help us – Colin Chartres, Jackie King, Asit Mazumder, and Tom McMahon. They all freely gave us their time and insights, especially in the planning stage of the book. Without their experience, expertise, and wisdom this book would not have achieved the breadth, depth, and global outlook that we sought.

This book was only made possible by the willingness of many outstanding scholars and practitioners to contribute. Our authors, from so many different disciplines, countries, and professional backgrounds were a pleasure to work with. As an economist (RQG) and a political scientist (KH), we were privileged to be the first to glean insight and inspiration from the chapters. To our authors, thank you for your time and for sharing your knowledge.

We also offer our gratitude to those people whose names do not appear in this book but who nevertheless made an important contribution. We especially appreciate the tireless efforts of Noel Chan and gratefully acknowledge the highly professional copy editing of Andrew Bell. We also thank Matt Lloyd at Cambridge University Press (CUP) for his strong support and belief that this book needed to be published, and the help of Chris Hudson and Laura Clark at CUP during the editing process.

On a personal note, we are especially grateful for the support and forbearance of Carol-Anne, Arian and Brecon (RQG); and Martin, Ella and Tara (KH).

Our final acknowledgement is to all the many people whose very lives depend on effective water planning and management. To them, we hope this book can make a difference.

Introduction

There is a pressing global problem of increasing freshwater scarcity. Lack of water has led to the threat of water rationing in one of the wealthiest regions in the world, California. In one of the world's poorest countries, Yemen, a rapidly growing population and overuse of water for irrigation may mean that its capital, Sana'a, will literally run out of water in the coming decade unless there is a change in how its water is managed.

The other side to the problem is diminishing water quality, and the quality of water that is available to billions of people is dire. The Food and Agriculture Organization of the United Nations estimates that about 3800 children die every day – almost exclusively in poor countries – as a direct result of unsafe drinking water and lack of sanitation.

Without shift in how water is used and governed, scarcity and quality problems will be made much worse with the twin challenges of a growing world population and climate change; both these factors are expected to increase the frequency and severity of droughts in mid latitudes.

As per capita water volumes decrease, water conflicts will be exacerbated. In response to water scarcity, diversions of water from one area or catchment to another are likely to increase. Unfortunately, there are few places left in the world where additional water can be tapped without imposing substantial costs on existing users or on the environment. Moreover, in agricultural terms, a growing world population will place a greater strain on water resources to grow the food to sustain upwards of 2 billion more people. Since agriculture uses some 70% of total freshwater withdrawals, this will place an even greater challenge on food security.

Against this sobering background, *Water Resources Planning and Management* provides an ambitious guide to both understand and help overcome our water challenges. No one discipline or single set of experiences can provide the insights necessary to solve the world's water problems, so this book brings together different perspectives on water from a range of disciplines and with many detailed case studies. The message is that to truly tackle the challenges we have to go beyond the proximate causes (overuse and misuse of water) and understand the drivers and levers that can be brought to bear to effect change. We must understand the immensity of the water cycle and the interconnectedness of ecosystems so

that our management practices work with, and not against, nature. We must learn the causes of our failures and of our successes. In summary, we must see not only the ‘big picture’ but also grasp the causal loops and the day-to-day practicalities of implementing effective changes.

Collectively, the 35 chapters in this book offer the seeds of knowledge needed to understand the problems we face, how we might resolve these difficulties, and who should be part of the solution. The book is structured so that we begin with fundamentals of the key physical processes, proceed to the practicalities of water resource planning and management, and then document the many ways to implement better water practice – be it problems of water quality in groundwater or water scarcity in cities.

There are many insights and recommendations in the book, but some recur many times. In particular, a constant theme is the need for policy-making to be supported by robust support systems, not only in terms of data and modelling but also through the involvement of key stakeholders, including the general public, in planning processes. Almost all successful water planning outcomes can be traced to a collaborative, inclusive engagement process. A second theme that emerges is the need for capacity building ‘on the ground’: water managers, regional planners, and local and regional governments all need sufficient knowledge of water – in all its facets – to be able to adequately address their regions’ water needs. This in turn raises the importance of research, development, and education in water planning and management; the next generation of water professionals should be trained holistically, with a strong sense of water’s role as the lifeblood of our earth, preserver of the social fabric, and driver of national economies. Finally, a third theme is the need to establish strong, dedicated institutional arrangements for overseeing and managing water resources centrally, particularly in the case of sustaining groundwater quality and quantity. This latter point runs contrary to much of the literature, which largely focuses on the need to manage at catchment or river-basin level alone; in fact, it would seem that a combined bottom-up (implementation and stakeholder engagement) and top-down (regulation, standards, integrated policy) approach is optimal.

The underlying goal of the book is to be transformational: to promote better water planning, practices and management – in brief, better water governance – to improve water availability and quality for our ecosystems and ourselves. There are many ways this might be achieved but, ultimately, our decisions need to be guided by best practice, the latest research and development, and a commitment to obtaining the optimal outcome for society, the economy, and the environment. By changing what we can change, and improving water governance, we can shift from ‘trying not to make things worse’ to making the world a better place and one we can be proud of.

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