

A photograph of a desert canyon with a winding river. The river is dark blue and reflects the sky. The canyon walls are made of layered, reddish-brown rock. In the distance, more canyon walls and a small body of water are visible under a clear blue sky.

Water Resources

An integrated approach

Edited by Joseph Holden

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Water Resources

The world faces huge challenges for water as population continues to grow, as emerging economies develop and as climate change alters the global and local water cycles. There are major questions to be answered about how we supply water in a sustainable and safe manner to fulfil our needs, while at the same time protecting vulnerable ecosystems from disaster.

Water Resources: An Integrated Approach provides students with a comprehensive overview of both natural and socio-economic processes associated with water. The book contains chapters written by 20 specialist contributors, providing expert depth of coverage to topics. The text guides the reader through the topic of water, starting with its unique properties and moving through environmental processes and human impacts upon them, including the changing water cycle, water movement in river basins, water quality, groundwater and aquatic ecosystems. The book then covers management strategies for water resources, water treatment and reuse, and the role of water in human health before covering water economics and water conflict. The text concludes with a chapter that examines new concepts such as virtual water that help us understand current and future water resource use and availability across interconnected local and global scales.

This book provides a novel interdisciplinary approach to water in a changing world, from an environmental change perspective and interrelated social, political and economic dimensions. It includes global examples from both the developing and developed world. Each chapter is supplemented with boxed case studies, questions, project ideas and further reading, as well as a glossary of terms. The text is richly illustrated throughout with over 150 full-colour diagrams and photos.

Joseph Holden holds the Chair of Physical Geography at the University of Leeds. He is Head of water@leeds, the largest interdisciplinary water research centre in the UK, and he is also Director of Research for the School of Geography.

Contributors

Dr Anamika Barua, Department of Humanities and Social Sciences, Indian Institute of Technology, Guwahati, 781039, India; abarua@iitg.ernet.in

Dr Nesha C. Beharry-Borg, water@leeds, School of Earth and Environment, University of Leeds, LS2 9JT, UK; n.c.beharry-borg@leeds.ac.uk

Megan Beresford, water@leeds, School of Earth and Environment, University of Leeds, LS2 9JT, UK; megan.beresford@britishsugar.com

Dr Lee E. Brown, water@leeds, School of Geography, University of Leeds, Leeds, LS2 9JT, UK; l.brown@leeds.ac.uk

Dr Pippa J. Chapman, water@leeds, School of Geography, University of Leeds, Leeds, LS2 9JT, UK; p.j.chapman@leeds.ac.uk

Dr Frances Drake, water@leeds, School of Geography, University of Leeds, Leeds, LS2 9JT, UK; f.drake@leeds.ac.uk

Dr Alison M. Dunn, water@leeds, Institute of Integrative and Comparative Biology, University of Leeds, Leeds, LS2 9JT, UK; a.dunn@leeds.ac.uk

Dr Dabo Guan, water@leeds, School of Earth and Environment, University of Leeds, Leeds, LS2 9JT; d.guan@leeds.ac.uk

Professor Joseph Holden, water@leeds, School of Geography, University of Leeds, Leeds, LS2 9JT, UK; j.holden@leeds.ac.uk

Dr Nigel J. Horan, water@leeds, School of Civil Engineering, University of Leeds, Leeds, LS2 9JT, UK; n.j.horan@leeds.ac.uk

Dr Paul Kay, water@leeds, School of Geography, University of Leeds, Leeds, LS2 9JT, UK; p.kay@leeds.ac.uk

Professor Adrian T. McDonald, water@leeds, School of Geography, University of Leeds, Leeds, LS2 9JT, UK; a.t.mcdonald@leeds.ac.uk

Dr Gordon Mitchell, water@leeds, School of Geography, University of Leeds, Leeds, LS2 9JT, UK; g.mitchell@leeds.ac.uk

Dr Noelle E. Odling, water@leeds, School of Earth and Environment, University of Leeds, Leeds, LS2 9JT, UK; n.e.odling@leeds.ac.uk

Dr Colin S. Pitts, water@leeds, School of Earth and Environment, University of Leeds, Leeds, LS2 9JT, UK; c.pitts@leeds.ac.uk

Professor Stephen Sitch, Geography, College of Life and Environmental Sciences, University of Exeter, EX4 4RJ, UK; s.a.sitch@exeter.ac.uk

Dr Rebecca J. Slack, water@leeds, School of Geography, University of Leeds, Leeds, LS2 9JT, UK; r.j.slack@leeds.ac.uk

Dr Sonja S. Teelucksingh, Economics Department and Sir Arthur Lewis Institute for Social and Economic Studies, University of the West Indies, St. Augustine, Trinidad and Tobago; sonja.teelucksingh@sta.uwi.edu

Dr Martin R. Tillotson, water@leeds, School of Civil Engineering, University of Leeds, Leeds, LS2 9JT, UK; m.r.tillotson@leeds.ac.uk

Kitriphar Tongper, water@leeds, School of Earth and Environment, University of Leeds, Leeds, LS2 9JT, UK; ktongper@gmail.com

Dr L. Jared West, water@leeds, School of Earth and Environment, University of Leeds, Leeds, LS2 9JT, UK; l.j.west@leeds.ac.uk

Preface

Water is of fundamental importance to life on Earth. It also has huge economic and cultural significance. This book examines water and water resources from scientific, economic and social perspectives. It is aimed at university students of all levels and water practitioners and policy makers who want to obtain a good grounding in the subject of water across the disciplines. The world faces grand challenges for water as population continues to grow, as emerging economies develop and as climate change alters the global and local water cycles. There are major questions to be answered about how we supply water in a sustainable and safe manner to fulfil our needs, while at the same time protecting vulnerable ecosystems from disaster. These grand challenges require an interdisciplinary approach to address them because there are scientific and technological issues to be addressed, there are economic and political issues to be addressed and there are social and cultural issues to be addressed and these all interconnect. Solving a technological problem on water supply may be futile if there is no political or social will, nor the economic means to utilise that technological advance.

The team of twenty authors who have contributed their knowledge and understanding to this book have compiled their experiences from around the world. This book begins by outlining the nature of water, some of its unique properties, the challenges for water resources and the role of water in society. It then moves in Chapter 2 to examine the global water cycle and the importance of water in moving energy around the planet and how climate change is affecting the water cycle through a series of feedback mechanisms. Chapter 3 covers the water cycle at a more local scale, looking at processes within river basins, including water movements through and over soils and in rivers. The pathways for water through river basins and the way we manage the landscape affect both water quality in rivers and lakes and such surface water quality issues are covered in Chapter 4. The discussion is supplemented by a detailed treatment of groundwater processes, water supply and groundwater quality in Chapter 5. Water bodies form an important part of ecosystems and also host a diverse community of organisms. Aquatic ecosystems and their modifications through human action are given attention in Chapter 6.

The demand for water needs to be managed and the supply of water to people, industry and agriculture needs to be planned for. Thus, Chapter 7 provides an overview of issues around water resource management. The quality and quantity of water both for drinking water supply and within the local environment has a fundamental role to play in human health. Droughts and periods of water scarcity can lead to famine and death. Too much water through flooding can kill not only by drowning but through the spread of disease, food shortages, loss of shelter and livelihood disruption. Infectious diseases associated with water and chemicals carried within water can have huge impacts on human health and therefore these topics are covered in Chapter 8. Techniques for providing clean water for consumption and for treating wastewater (and utilising the resources that wastewater provides) are described in Chapter 9.

Water is an economic good and is crucial for agriculture, industry and many other things from which we derive benefit. It is therefore essential, as described by Chapter 10, to examine the principles of economics and different types of valuation techniques which might be applied to water in order to understand some of our water problems and potential water solutions. Because water is so fundamental to life, is in such demand by humans and has economic value, it is also a cause of conflict around the world. Determining who has the rights to access, extract and use water, a substance that is fluid and mobile, is a complex issue with different traditions operating in different parts of the world. Chapter 11 looks at different types of water conflict and water rights issues from around the world and how these conflicts can be managed. Finally, in Chapter 12,

the book looks at new concepts that can help us to understand current and future water resource use and availability across interconnected local and global scales, including the water footprint and 'virtual' water flows.

Each chapter contains some boxed features, which are grouped into one of four themes: case studies, contemporary challenges, techniques or the future of water. These boxed features allow interested readers to study more detail on the selected topics, should they wish. As you read the book you will also notice some words that are typeset in bold within the text. These words are highlighted the first time they appear in each chapter and can be found in the glossary with an explanation of their meaning. Each chapter also contains reflective questions and some project ideas.

The book's interdisciplinary nature reflects my own personal role as head of water@leeds, which is the largest water research group in any UK university. water@leeds members work together as scientists, social scientists and humanities experts to tackle water challenges facing the world. Research is often in partnership with external bodies such as government bodies, NGOs, industry and practitioners to ensure that the research is applicable to societal needs. The water challenges we face are crucial to the survival of the human race, stability and peace around the world and to the sustainability of the Earth's ecosystems. It is therefore vital that around the world we improve understanding of water resource issues from an interdisciplinary perspective. This book is part of that mission and I hope that you will feel inspired to join us in trying to make a real difference to people's lives through sharing an understanding of water resource issues with others.

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Contents

<i>List of figures, tables and boxes</i>	vii
<i>List of contributors</i>	xv
<i>Preface</i>	xvii
<i>Acknowledgements</i>	xix
1 Water fundamentals	1
<i>Joseph Holden</i>	
2 The changing water cycle	19
<i>Stephen Sitch and Frances Drake</i>	
3 River basin hydrology	49
<i>Joseph Holden</i>	
4 Surface water quality	79
<i>Pippa J. Chapman, Paul Kay, Gordon Mitchell and Colin S. Pitts</i>	
5 Groundwater	123
<i>L. Jared West and Noelle E. Odling</i>	
6 Aquatic ecosystems	161
<i>Lee E. Brown, Colin S. Pitts and Alison M. Dunn</i>	

7	Water demand planning and management	203
	<i>Adrian T. McDonald and Gordon Mitchell</i>	
8	Water and health	223
	<i>Rebecca J. Slack</i>	
9	Potable water and wastewater treatment	265
	<i>Nigel J. Horan</i>	
10	Water economics	293
	<i>Sonja S. Teelucksingh, Nesha C. Beharry-Borg and Dabo Guan</i>	
11	Water conflict, law and governance	315
	<i>Kitriphar Tongper and Anamika Barua</i>	
12	The future of water: water footprints and virtual water	333
	<i>Martin R. Tillotson, Megan Beresford, Dabo Guan and Joseph Holden</i>	
	<i>Glossary</i>	351
	<i>Index</i>	365

Figures, tables and boxes

FIGURES

1.1	A schematic diagram showing water molecules and the covalent and weak hydrogen bonds	2
1.2	Pond skaters are invertebrates that move across the water surface	4
1.3	Water forms droplets on most solid materials it comes into contact with	4
1.4	Capillary action in two glass tubes	5
1.5	When dissolved in water, each of the sodium and chloride ions is hydrated	5
1.6	Categories of world water resources	10
1.7	Declining per capita water availability in India	13
1.8	Competing water uses for main income groups of countries	14
2.1	The global hydrological cycle, with estimated flows and storage	20
2.2	The Clausius–Clapeyron (CC) relation	22
2.3	Saturated pressure–temperature curves for water and ice	23
2.4	Land–atmosphere coupling strength in June, July and August	25
2.5	The static jet stream of summer 2010, which led to different extreme events across Europe and Asia	26
2.6	Summer 2007 rainfall amount as a percentage of the 1971–2000 average	27
2.7	Conditions in the Pacific during (a) normal periods and (b) El Niño	29
2.8	Winter weather anomalies during (a) El Niño and (b) La Niña over North America	29
2.9	Severe conditions during the 1930s Dust Bowl of North America	31
2.10	Temperature and precipitation anomalies for the Dust Bowl drought from the Climate Research Unit (CRU) climate model simulations	32
2.11	Precipitation difference from long-term average 1900–2011 in the Sahel region showing the prolonged dry period since the 1970s	34
2.12	Changes in glacial extent for selected glaciers around the world	36

2.13	Leaf stomata regulate the uptake of carbon dioxide for photosynthesis, and water loss through transpiration	38
2.14	Mechanisms connecting changes in leaf conductance to canopy evapotranspiration and soil moisture changes	38
2.15	Population exposed to severe water scarcity (red)	40
2.16	Schematic showing example feedbacks of enhanced water vapour in the atmosphere	42
2.17	Robust findings on regional climate change for mean and extreme precipitation, drought and snow	42
3.1	An example gentle rainfall event resulting in a reduction in the infiltration capacity of the soil over time and the subsequent production of infiltration-excess overland flow	51
3.2	Production of saturation-excess overland flow	51
3.3	Soil water energy status on a slope	53
3.4	Macropore flow is indicated by the staining white dye solution where fingers of dye extend downward from the main body of dye in a soil profile	54
3.5	A large soil pipe with some flowing water emerging from the pipe which is at the head of a gully	54
3.6	A rain gauge flush with the ground surface surrounded by a metal mesh to reduce errors from turbulence and splash	55
3.7	Storm hydrographs (a) where infiltration-excess overland flow dominates, and (b) where throughflow dominates	57
3.8	Two example annual river flow records showing regimes of each river	58
3.9	The endorheic river basins of the Earth	59
3.10	A worked velocity-area calculation for river discharge	60
3.11	Predicted river storm flow discharge using the unit hydrograph model	62
3.12	New housing development in Calgary with a sustainable urban drainage system with a storm water storage lake	64
3.13	Mean monthly total discharge change (%) in the Pinios River for a 24-year modelling period	65
3.14	A river basin showing what happens to the main channel flood hydrograph after forestry plantation within a tributary basin due to flood wave synchronisation	67
3.15	The main types of drainage network pattern	68
3.16	Examples of river channel forms: (a) braided river; (b) meandering river, and (c) a straight river	69
3.17	Helicoidal flow through a meandering channel	70
3.18	River meanders tend to become more exaggerated until eventually the meander is cut through by the river, leaving behind an oxbow lake	71
3.19	Temporal variation of water and sediment discharge in the main channel of the Indus River below Kotri	73
3.20	Re-meandering on the River Kissimmee	74
4.1	The different hydrological pathways that precipitation may take to reach surface waters and their effect on solute concentrations	80
4.2	Eh-pH diagram for the simple ions and hydroxides of iron at atmospheric pressure and 25°C	82

4.3	Relationship between mean annual runoff and (a) discharge weighted mean total dissolved solids concentrations, and (b) mean annual dissolved load for a sample of 496 world rivers	85
4.4	Cross-section of a thermally stratified eutrophic lake in summer	87
4.5	The influence of geology and climate on the total dissolved solids (TDS) and major chemical composition of surface waters	88
4.6	Dissolved oxygen concentrations and temperature recorded at 15 minute intervals at a stream in the North Pennines, UK	90
4.7	Changes in stream discharge and silicon and dissolved organic carbon concentrations during a storm event in a headwater stream in NE Scotland	90
4.8	Mean monthly concentration in stream water collected weekly from the headwaters of the River Tees, northern England (1993–2010)	91
4.9	Long-term trends in the concentration of (a) sulphate (SO_4), (b) hydrogen (H^+) ions and (c) dissolved organic carbon in weekly samples collected from 11 streams	92
4.10	Slurry being injected into a field by a specialist machine	96
4.11	Farm advice activities being undertaken as part of the England Catchment Sensitive Farming Delivery Initiative	98
4.12	Long-term NO_3 concentrations and fluxes in the River Stour	99
4.13	Acid mine discharge at Jackson Bridge on New Mill Dyke, Yorkshire, UK	106
4.14	(a) Semi-natural wetland and (b) artificial reed bed wetlands, River Pelenna, South Wales, UK	108
4.15	Critical load exceedance maps for the UK freshwaters in 2004	112
5.1	Role of groundwater in the hydrological cycle	124
5.2	Factors influencing rainfall recharge to groundwater	125
5.3	Interactions between streams and groundwater	126
5.4	Map of the Nubian Sandstone Aquifer System	128
5.5	Well drilling in Egypt	129
5.6	Confined and unconfined aquifers	131
5.7	Sedimentary rock aquifers in the United Kingdom: (a) Permo-Triassic Sandstone; (b) Cretaceous Chalk	132
5.8	Column experiment that can be set up in the laboratory illustrating Darcy's Law for flow in sand	133
5.9	Hydraulic gradients in unconfined aquifers	134
5.10	Flow in a fracture of aperture b and hydraulic gradient i is described by the Cubic Law	135
5.11	Two-dimensional computer simulation of flow through a fractured rock where the rock matrix is itself permeable and porous	136
5.12	Hydrogeological map showing the River Wylfe flowing over unconfined Cretaceous Chalk aquifer in southern England	137
5.13	Impact of groundwater abstraction on flow at a gauging station in the River Worfe, West Midlands, UK	137
5.14	Hand dug wells	138
5.15	Cross-section illustrating the construction of a qanat	139
5.16	Modern groundwater abstraction wells	141
5.17	Well loss and well efficiency	142

5.18	Buildup of iron bacteria on the intake of a submersible pump	143
5.19	Artificial recharge in the Llobregat Delta Aquifer, Barcelona, Spain	144
5.20	Schematic diagram of dominant chemistry in the Cretaceous Chalk aquifer of southern England	148
5.21	Acid mine drainage showing precipitation of ferric hydroxides	149
5.22	Contaminant source characteristics: (a) landfill site representing point source; (b) agrochemical application representing diffuse source	150
5.23	Trends in nitrate fertiliser application in the United Kingdom	151
5.24	Behaviour of Non Aqueous Phase Liquids in groundwater aquifers	153
5.25	Well-head or source protection zones as defined by Environment Agency, England	155
6.1	Hierarchical structure of river ecosystems	162
6.2	Visible changes occur to the river environment from headwaters to lowland: (a) an open canopy UK moorland stream; (b) a meltwater-fed river in the French Pyrenees; (c) a densely forested stream in southeast Alaska; (d) a forested river in northwest North America; (e) a mid-reach on the River Aire, UK; (f) the River Danube in the lowlands of Austria; and (g) the braided Matukituki River in New Zealand	163
6.3	Diversity of lake habitats in the Windermere catchment, northwest England	164
6.4	A general scheme of littoral and profundal habitats in a freshwater lake	165
6.5	Examples of aquatic producers	167
6.6	The life cycle of the trophically transmitted parasitic worm <i>Echinorhynchus truttae</i>	170
6.7	Schematic outline of (a) a simple aquatic food chain, and (b) a simple aquatic food web	171
6.8	Connectance food webs from (a) Felbrigg Hall Lake, UK, and (b) Broadstone Stream, UK	173
6.9	Food web structure of Muskingham Brook, New Jersey, USA, during fall 2003	174
6.10	Examples of the various methods used by freshwater ecologists to study primary production	176
6.11	A battery-powered peristaltic pump being used to deliver small quantities of dissolved NO_3^- , NH_4^+ and organic carbon from a tank into an Arctic tundra stream as part of an experiment to measure nutrient spiralling lengths and uptake velocity	179
6.12	Nutrient-diffusing pots with wooden (brown) and clay (orange) substrate	179
6.13	River channel fragmentation and flow regulation effects of dams on 292 of the world's major river systems	181
6.14	Regulated river channel below Digley Reservoir, West Yorkshire, UK	182
6.15	The Spöl River, Switzerland, (a) before and (b) during an artificial flood generated by water release from a reservoir	183
6.16	Channelised urban streams	184
6.17	Intense algal growth on a eutrophic water body next to a public footpath	187
6.18	Fish farm in a sheltered bay off the Isle of Skye, northern Scotland	192
7.1	(a) A dumb meter, which simply records accumulated usage, and (b) a smart meter, which provides continuous data on usage through time	206
7.2	Current and forecast global water demand and resource availability	210
7.3	Populations living in areas of water stress	211

7.4	Global water scarcity distribution map	211
7.5	Water demand in different countries – average water use per person per day	212
7.6	Household water use indexed against water prices across a range of countries	213
8.1	John Snow's map of the area surrounding the Broad Street pump, representing each cholera death by a bar	225
8.2	Faecal contamination of water supplies is one of the commonest routes for the spread of water-related disease	232
8.3	The life cycle of the <i>Schistosoma</i> spp. trematode worm	236
8.4	Map showing countries affected by malaria	237
8.5	The life cycle of the mosquito is dependent on the presence of a water body	238
8.6	Adult female mosquitoes become infected after feeding on human blood	238
8.7	Human sewage effluent can alter both the biological and chemical content of water	240
8.8	Cyanobacteria blooms can have considerable impacts on water quality	244
8.9	Too much water can have health consequences	250
8.10	Cross-section through the city of New Orleans, showing dependence on levees and floodwalls	251
8.11	Population tracking and the impact of Hurricane Katrina on New Orleans	252
8.12	The immediate aftermath of the Japanese tsunami, March 2011	253
8.13	Irrigation of crops may be needed to obtain food with optimal nutritional content	254
8.14	Collecting water can often involve a walk of several kilometres	254
8.15	Age weightings applied to calculation of DALYs	256
8.16	An appropriate hand-washing technique to minimise the spread of disease	257
9.1	Typical process flow train for producing water of potable quality that meets the WHO guidelines summarised in Table 9.1	268
9.2	Schematic diagram of (a) rapid and (b) slow gravity filters that are able to take out smaller particles from water	269
9.3	Underdrain design for a rapid gravity filter showing the many roles this has to perform	270
9.4	Arrangement of membranes used in a range of water treatment applications	272
9.5	The oxygen sag curve that develops when wastewater is discharged to a watercourse with a concentration of organic material in excess of the available oxygen dissolved in the water	275
9.6	Annual distribution of biochemical oxygen demand in the effluent from a wastewater treatment plant	277
9.7	(a) A combined sewer overflow serves to protect the sewer from flooding; and (b) innovation processes to remove coarse material from combined sewer overflows	279
9.8	Screens are the first stage of treatment, and remove solid material which is larger than the holes in the screen	280
9.9	Primary settlement tanks proved a relatively cheap and simple option for removing up to half the pollution in sewage	281
9.10	Attached growth processes maintain a viable population of microorganisms by the provision of an inert support such as plastic or mineral media	282

9.11	The activated sludge process with air introduced into the tank	283
9.12	A belt thickener allows the water contained in primary and waste activated sludge to drain away to produce a thickened sludge	286
9.13	A flow scheme for the anaerobic digestion of sludge, demonstrating the range of options for energy recovery	287
10.1	The three-tiered approach to economic value	294
10.2	The balance between water demand and water supply	296
10.3	A typology of economic value	302
10.4	Linkages between ecosystem services, human well-being and drivers of change	303
10.5	Part of Tram Chim National Park	304
10.6	The goods and services provided by wetland ecosystems	305
10.7	Total Economic Value versus ecosystem services of wetland ecosystems	305
10.8	Economic valuation techniques for water resources	306
10.9	Ditch through a peatland in Nidderdale, UK	309
11.1	The Farakka Barrage	319
12.1	Examples of indirect and direct water use for a home	335
12.2	Green, blue and grey water footprint contributions for sugar beet, sugar cane and high fructose maize syrup	338
12.3	The water footprint of nations averaged per person for drinking, washing, food consumption and consumption of other consumer goods	340
12.4	The total water footprint of nations	340
12.5	The proportion of national water footprints dependent on imports	341
12.6	Virtual water balances for major global regions for the water flows associated with agricultural trade	341
12.7	Map showing China separated into seven regions, shaded by their freshwater availability per person per year in m ³	343

TABLES

1.1	Typical water use to produce some common human foodstuffs	7
1.2	Water-rich and poor countries of the world	11
2.1	Average residence time in major water stores	21
4.1	Nitrate-N concentrations and discharge for a 24-hour period 2–3 January 2013 for Eagle Creek, at Zionsville, Indiana	86
4.2	The nature, sources, effects and control of some major types of pollutants	94
4.3	Some urban diffuse pollutants and their sources	100
4.4	Pollutant concentrations in wastewater and storm water across Europe and North America	100
4.5	Causes of low river quality in Scotland	101
4.6	Typical sustainable urban drainage system devices	103
4.7	Some chemical data from mine discharges	107
4.8	Changes in typical chemical composition of the Bullhouse mine discharge into the River Don, Yorkshire, UK, before and after remediation	109
6.1	Functional Feeding Groups (FFG) of invertebrates, their feeding mechanisms, food sources and typical size range of particles ingested	169