
IGM Author Biographies

Fatah Ameur is a PhD student at IAV Hassan II, Rabat (Morocco). He is an agricultural engineer, specializing in water management. He earned a master's degree in irrigation and water control. Currently he undertakes research on the inequalities in access to groundwater in a context of overexploitation in the Saiss (Morocco).

Juliette Anglade is a PhD student at the University Pierre and Marie Curie (UPMC, Paris, France). She completed an MSc in Hydrology-Hydrogeology at the UPMC. Her research focuses on assessing the agronomic and environmental performances of low-inputs systems, and their effects on surface and groundwater resources, with emphasis on nitrate contaminations.

Muhammad Arshad is a civil engineer and PhD research scholar in Managed Aquifer Recharge at the Australian National University and the National Centre for Groundwater Research and Training. He has worked for more than 15 years with United Nations and consulting engineers on water resource management and delivery of water infrastructure projects. Arshad specializes in delivering large scale water sanitation and hygiene (WASH) programs including WASH emergency response and coordination.

Fabienne Barataud is a Research Engineer at the National Research Agricultural Institute (INRA) and she currently holds the assistant direction of the ASTER unit (Mirecourt, France). Her research focuses on analyzing cooperative agreements for water protection, studying the interactions between stakeholders and the place of knowledge, and building original tools to accompany collective actions.

Olivier Barreteau is senior water scientist at IRSTEA, Director of the UMR G-EAU in Montpellier. He has 20 years of experience of interdisciplinary research at the interface between hydrology, modelling, and management sciences in projects on local water governance, using social simulation with Agent based modelling and role playing games. He is founder member of the Companion Modeling network. He is in charge of coordination of the joint Land and Water program for the French Ministry of Environment.

Okke Batelaan is Strategic Professor in Hydrogeology, Flinders University, Adelaide, Australia. He has an extensive teaching, research and publication record in hydro(geo)logy and project experience from four continents. He is editor-in-chief of Journal of Hydrology: Regional Studies and MDPI-Hydrology.

Marc Benoît is a Research Agronomist within the National Research Agricultural Institute (Inra). He currently holds a position of Senior Scientist in the Research for Action and Development Department, at the Aster Research Unit (Mirecourt, France). His research focuses on

landscape agronomy, and investigating water resources protection through agrarian systems transitions.

Henning Bjornlund holds two academic positions; he is a Canada Research Chair in Water Policy and Management at University of Lethbridge and a Professor at the University of South Australia. He has researched water policy and management issues in Australia since 1993 and in Canada since 2005. Henning has written widely about water policy and management issues with around 300 publications and presentations.

Rachel S. Blakers is a PhD Scholar at the Australian National University with support from the National Centre for Groundwater Research and Training. Her PhD research is on hydrological model development and uncertainty analysis in the context of integrated assessment projects.

Nate Booth is the Chief, Office of Water Information at the U.S. Geological Survey (USGS). Nate is a hydrologist with significant interest and experience within the areas of geo and hydro informatics. He is responsible for the collection, storage and delivery of water information for the USGS.

Mark A. Borchardt, Ph.D is a Research Microbiologist at the Agricultural Research Service, United States Department of Agriculture, and Program Leader for the Laboratory for Infectious Disease and the Environment, United States Geological Survey, Wisconsin Water Science Center located in Marshfield, Wisconsin. His research focus is on waterborne infectious disease as related to contamination from human and livestock faecal sources.

Boyan Brodaric is a research scientist at the Geological Survey of Canada working primarily on data interoperability, including applications in hydrology, natural hazards, and geology. He sits on the board of several journals and conferences, is involved in the development of international geospatial data standards, and leads the Canadian Groundwater Information Network, a national cyber-infrastructure for groundwater information.

Nicholas Brozović is Director of Policy at the Robert B. Daugherty Water for Food Institute at the University of Nebraska. He is an economist with extensive experience in water policy and management worldwide. His research focuses on using economic analysis to evaluate and design management policies for spatial, dynamic natural resource systems. He is currently working to establish functioning resource markets, such as groundwater markets, that can be used as research and teaching platforms and as models of sustainability for industry.

Yvan Caballero is a senior hydrologist and hydrogeologist at BRGM, France, where he coordinates the scientific program on Groundwater Resources Potential Characterization. His main topics are on global change impact on surface and groundwater resources, including karstic groundwater resources, integrated water management, and exploring recharge estimation methods.

Joël Casanova BRGM – French geological survey, has 28 years of experience as an Expert Geochemist and Project Leader in charge of R & D projects concerning environmental geochemistry based on the use of multi-element and multi-isotope techniques. He is also involved in various fields related to surface and ground water resource management which include: tracing of groundwater circulation, managed aquifer recharge and defining exploration methods.

Alessandro Comunian is Assistant Professor with the Department of Earth Sciences “Ardito Desio”, at University of Milan. His research focuses on the characterization of the geological heterogeneity using geostatistical methods, with a focus of multiple-point statistics.

Daniel Connell works in the Crawford School of Public Policy at the Australian National University where he teaches courses on environmental and water policy. His research focuses on the governance arrangements applying to rivers in multilayered political systems such as Australia, South Africa, the United States, Mexico, the European Union (Spain), India, China and Brazil. He is also a co-editor of *Federal Rivers* published by Edward Elgar in 2014.

Julian Conrad is a consulting geohydrologist and director of the groundwater consultancy GEOSS, based in Stellenbosch, South Africa. He joined the CSIR (Council for Scientific and Industrial Research), based in Stellenbosch, in 1990. After 11 years at the CSIR, Julian then started the groundwater consultancy, GEOSS.

Richard Cresswell is a Senior Associate with Jacobs Engineering Group, providing hydrogeological advice to the mining, coal seam gas and large infrastructure industries, specialising in hydrogeochemical and isotopic investigations. He was previously a Principal Research Scientist at CSIRO's Division of Land and Water, leading sustainable yields projects and the salinity dynamics end at the CRC for Landscapes, Environment and Mineral Exploration. Prior to that Richard was a project leader for the Salinity Monitoring and Management Support Program at the Federal Bureau of Rural Sciences.

Allan Curtis is a strategic research professor at Charles Sturt University and is a Principal Investigator with the National Centre for Groundwater Research and Training. His research focuses on the contribution of human and social capital to sustainable development. He has specific expertise in the role of local organisations, understanding rural landholder adoption of sustainable practices and program evaluation.

Nicolas Devau is Biogeochemist at BRGM – French geological survey, specializing in hydro-geochemistry and soil sciences, with specific skills on mineral-aqueous interactions and biogeochemical processes. He developed and used new numerical approaches and modelling tools in order to better understand how geochemical and microbiological processes affect inorganic pollutants mobility/stability in the vadose zone-aquifer continuum of several systems, notably in the theme of active management of water resources.

Peter Dillon is Honorary Fellow, CSIRO working in a team on managed aquifer recharge for 20 years, particularly associated with aquifer storage and recovery with stormwater and recycled water. He is a founding co-chair of the IAHR Commission on Managing Aquifer Recharge, and aims to foster improved scientific knowledge and its uptake in improved governance of MAR through new water resources management policies and health and environmental protection guidelines.

Guillermo Donoso is Professor of Water Economics at the Pontificia Universidad Católica de Chile. He has researched water governance and water allocation mechanisms with an emphasis on water markets the past 20 years. He has consulted for the United Nations Development Programme (UNDP), the Inter-American Development Bank (IADB), the GTZ and the World Bank in projects for Latin America.

Derek Eamus is Professor of Environmental Sciences at the University of Technology Sydney. He has researched the ecophysiology of groundwater dependent woodlands for the past 20 years in temperate and tropical Australia. For the past 5 years he was a Chief Investigator in the National Centre for Groundwater Research and Training and was lead author for the textbook "Ecohydrology: vegetation function, water and resource management" published by CSIRO Press.

David J. Eaton is a Professor in Natural Resource Policy Studies with the Lyndon B. Johnson School of Public Affairs at The University of Texas at Austin, Texas, USA. Dr. Eaton's research

focuses on sustainable development in international river basins, evaluation of energy-water conservation programs, and prevention of pollution.

Sondoss Elsawah is a Research Fellow at University of New South Wales and adjunct fellow at the Australian National University specialising in development of integrated models and Decision Support Systems. Her work focuses on using systems thinking approaches to support social learning and policy making in social-ecological systems. She has worked on a number of projects including climate change assessment, water allocation planning, and mining impact assessment. She has received the prestigious Australian Water Association award for water research.

Nicolas Faysse is a social scientist at the joint research unit on Water Resource Management, Actors and Uses and at CIRAD (France). He is currently posted at ENA Meknes, Morocco. He works on water management institutions, development policies and projects, and approaches for farmer capacity-building.

Guilherme Fernandes Marques is a Civil Engineer and associate professor at Instituto de Pesquisas Hidraulicas (IPH), Universidade Federal do Rio Grande do Sul, Brazil. His field of research involves application of optimization methods to water and environmental problems, including hydro-economics, conjunctive use of surface and groundwater, reservoir operation and hydropower optimization.

Michael Fioren is a Research Hydrologist specializing in groundwater modeling, parameter estimation, statistical and probabilistic modeling, and uncertainty analysis at the U.S. Geological Survey (USGS) Wisconsin Water Science Center. He is also an adjunct assistant professor in the Department of Geoscience at the University of Wisconsin – Madison.

Peter Fitch is a research scientist with CSIRO Land and Water flagship. His research projects are in the areas of environmental informatics with particular interest in web delivery and use of hydrological information using a broad range of technologies including standards based. He has significant industry experience designing and developing hydrological measurement systems, and has more recently focussed on scientific transparency.

Baihua Fu is a Research Fellow at the Australian National University and the National Centre for Groundwater Research. She has extensive experience in hydro-ecological modelling, environmental knowledge engineering and uncertainty assessment of environmental models. Her recent research focuses on assessing impacts of climate change and water management on water quality and freshwater ecology.

Patrice Garin is senior agronomist and geographer at IRSTEA, at the joint research unit “Water Management, Stakeholders and Uses” (UMR G-EAU) in Montpellier. He is the manager of the Master Eau – special field “Water and Society” in Montpellier II university. His research focuses on the analysis of irrigation practices and participatory processes in water management, mainly in irrigated areas.

Francesca Greco is a PhD candidate at King’s College London, Department of Geography. She has analysed water policy issues in the Middle East and in Sub-Saharan Africa. Her main research interests are: groundwater use and sustainability, food supply-chain and trade, hydro-hegemony power-analysis, and virtual water “flows” dynamics. She is currently working at the United Nations World Water Assessment Programme (UNESCO) on regional water monitoring and gender-sensitive water indicators for the post-2015 agenda.

Timothy R. Green is a research hydrologist with the USDA Agricultural Research Service in Fort Collins, Colorado, USA. His career includes research with the USGS Water Resources Division and CSIRO Australia Land and Water. Tim has served on the UNESCO-GRAPHIC project, and was Guest Professor at ETH Zurich, Switzerland. Tim is a fellow of the American Society of Agronomy and the Soil Science Society of America.

Richard Greene is a Senior Lecturer in Soil and Land Management in the Fenner School of Environment and Society at the Australian National University, Canberra, Australia. He was previously a Senior Research Scientist at CSIRO's Division of Wildlife and Ecology, researching the management of semi-arid rangelands soils. Prior to that he was a Soils Research Officer with the Victorian Department of Agriculture, based at the Irrigation Research Institute, Tatura, where he worked on the physico-chemical properties of soils under irrigated agriculture.

Joseph H. A. Guillaume is a Postdoctoral Researcher with the Water and Development Research Group at Aalto University, Finland. He completed his PhD at the Australian National University with the National Centre for Groundwater Research and Training (NCGRT). His research focuses on taking a critical systems approach to improving the management of uncertainty in modelling.

Meriem Farah Hamamouche is a PhD student at IAV Hassan II (Morocco). She studies the integration of groundwater resources in a surface irrigation system in the Algerian Sahara. She obtained her MSc in irrigation and water control at IAV Hassan II in 2012 and graduated as an agricultural engineer at ENSA, El Harrach (Algeria) in 2011.

Serena Hamilton is a Postdoctoral Research Fellow at the Australian National University and Edith Cowan University. Her research interests include integrated assessment and modelling, Bayesian networks and decision support tools for natural resources management. Her recent research has focused on modelling freshwater ecological systems under limited data and knowledge.

Ali Hammani is a Professor and head of the "Sustainable Water Management" research unit at IAV Hassan II (Morocco). He is a senior scientist in irrigation and water management with more than 20 years of experience in Morocco and the Mediterranean. He coordinated several research projects on water management.

Julien J. Harou is Professor of Water Management and Water Engineering Chair at The University of Manchester and Honorary Professor at UCL. Recently he has worked with DEFRA, the European Commission, UK water regulators, water utilities, the World Bank, IUCN, and WWF on assessment of water policies and investments.

Tarik Hartani is a senior agricultural water management scientist at ENSA (Algeria). He has more than 15 years of professional experience in the Mediterranean region and Africa. He supervises several PhD's in irrigation and agricultural water quality management, and coordinated 10 R&D national and international projects.

Masaki Hayashi is a Professor in the Department of Geoscience, University of Calgary, where he holds a Canada Research Chair in Physical Hydrology. His research interests are in the connection between groundwater and surface water, and how it is affected by land use change and climatic variability.

Cécile Hérivaux has 10 years' experience in applied research at BRGM in the field of groundwater resources management. She has been involved in assessing the economic benefits of

groundwater protection, adaptation strategies to climate change, water scarcity and sea level rise issues.

Cameron Holley is Senior Lecturer/Senior Research Fellow (DECRA), UNSW Law, University of New South Wales Australia. He is a member of the Connected Waters Initiative Research Centre (UNSW) and Research Affiliate at the National Centre for Groundwater Research and Training. His areas of expertise include collaborative governance, water planning, water law, environmental law and water regulation.

Randall J. Hunt is a Research Hydrologist with the United States Geological Survey. He completed his MSc and PhD at the University of Wisconsin-Madison, where he currently holds a position of Adjunct Professor within the Department of Geoscience. His research focuses on investigating groundwater flow and its effects on natural resources including wetland, stream, lake, and ecological systems.

Karen Hussey is Associate Professor at the Fenner School of Environment and Society, and a Public Policy Fellow with the Australian National Institute of Public Policy (ANIPP), at the Australian National University. Her research interests include policy, institutional and economic dimensions of sustainable development, particularly with respect to water, energy and climate security. Prior to taking up her position at the Fenner School, Karen was based in Brussels for 4 years as the ANU Vice Chancellor's Representative in Europe.

Anthony John (Tony) Jakeman is Professor, Fenner School of Environment and Society, and Director of the Integrated Catchment Assessment and Management Centre, The Australian National University. Interests include system identification, integrated assessment methods and decision support systems for water and associated land resource problems. He is Professor, University of Queensland and recently leader of the National Centre for Groundwater Research and Training Program on Integrating Socioeconomics, Policy and Decision Support. He has held visiting positions at Stanford, Cambridge and Lancaster Universities, CSIRO, Cemagref/IRSTEA in France and the US Geological Survey.

Marcel Kuper is a senior irrigation scientist at CIRAD (Montpellier, France), and Visiting Professor at IAV Hassan II (Rabat, Morocco). He has more than 25 years of professional experience in Asia, Africa, and the Mediterranean. He supervises several PhDs in irrigation management, and is project leader of international research projects. He works currently on issues of groundwater governance, and innovation systems related to irrigation.

Jie Liu a PhD in hydrogeology from the University of Alabama. She was a postdoctoral fellow at Peking University from 2007 to 2009. Since 2009, she has been an associate professor in the Center for Water Research, Peking University. She has been chairing the Water Ethics working group of UNESCO since 2008. Liu's major research interests include groundwater flow and transport modelling, basin-scale groundwater management, and surface water-groundwater interactions.

Elena Lopez-Gunn runs ICATALIST, a company specializing in social innovation and knowledge transfer with clients like Repsol, an energy company and FAO. She is an Associate Professor at IE Business School. She was an Alcoa Research Fellow at the London School of Economics. Her areas of expertise include collective action, water resources governance, climate change adaptation, public policy evaluation and social innovation.

Jay R. Lund is Director of the Center for Watershed Sciences and a Professor of Civil and Environmental Engineering at the University of California – Davis. He has long engaged on many

aspects of theory and practice for water management and policy, usually trying to integrate economics and operations research with traditional engineering.

Serge Marlet is a senior water management and agronomy scientist at CIRAD (France). He has been hosted by INRGREF in Tunisia since 2006. He has 30 years of professional international experience in sustainable soil and water management in irrigation systems and is currently working with Water Users Associations.

Emily Mendham is a Research Fellow at Charles Sturt University. Her research focuses on the social dimensions of natural resource management on private land. Her expertise includes understanding the drivers and implications of changing ownership and management of rural land and landholder adoption of practices.

Michael Mitchell is a Research Fellow with the School of Land and Food at the University of Tasmania. His fellowship is provided through the Landscape and Policy Hub, funded through the Australian Government's National Environmental Research Program. His research interests relate to the social dimensions of natural resource management, and he is currently investigating strategies to apply resilience thinking techniques into regional and landscape-scale planning processes.

Marielle Montginoul is research director in Economics in the National Research Institute of Science and Technology for Environment and Agriculture (IRSTEA) at the Joint Research Unit G-Eau. Her work focuses on understanding and modeling farmers and households' water consumption behaviors. She more specifically studies instruments that can be used to reveal these behaviors when information is incomplete. Her research also focuses on economic tools to manage water withdrawals, with a focus on water pricing. She mobilizes a wide range of methodologies including surveys, experimental economics, and scenarios workshops.

Clemence Moreau focuses on issues of social justice related to water allocation, participatory methods for water management and social learning. She has been involved in projects in France and Tunisia. She is currently working for Agricultural Research for Development (CIRAD).

Marian J. Neal (Patrick) has an interdisciplinary research background in wetland/landscape ecology, water governance, transboundary water management and social and environmental justice. Her interests include water allocation decision making, understanding the multi-scale, multi-level governance of complex socioecological systems and social justice. Marian is currently Programme Manager for Transboundary Water at the Stockholm International Water Institute (SIWI), Sweden.

Rebecca Nelson is the Law Council of Australia's Australian Young Environmental Lawyer of the Year 2013–2014. She consults on water law and policy in the US and Australia for government agencies and NGOs. She holds Bachelor degrees in law and environmental engineering (University of Melbourne); and a Master of the Science of Law and Doctor of the Science of Law (Stanford University). Her dissertation focused on groundwater law.

Marie Pettenati is at BRGM – French geological survey, and has 7 years of experience as a Specialist in reactive transport models conceptualization for organic and inorganic pollutants in the vadose zone-aquifer continuum, particularly in the theme of active management of water resources. Her hydrogeology and hydrogeochemistry skills are applied to study equilibrium in natural aquifers, transfer of inorganic pollutants in soils, aquifers and mining sites, hydrogeochemical and thermo-kinetic modelling to study water-rock-gas interactions and consideration of biogeochemical processes in the hydrogeochemical modelling.

Suzanne A. Pierce is the Texas Advanced Computing Center and with the Environmental Sciences Institute of the Jackson School of Geosciences at The University of Texas at Austin, Texas, USA. A hydrogeologist, She studies decision support systems and participatory processes for application to groundwater management and energy-water problems.

Jamie Pittock is Senior Lecturer in the Fenner School of Environment and Society at The Australian National University. He worked for non-government environmental organisations in Australia and internationally from 1989 to 2007, including as Director of WWF's Global Freshwater Programme from 2001 to 2007. His research focuses on better governance of the interlinked issues of water management, energy and food supply, responding to climate change and conserving biological diversity.

Manuel Pulido-Velazquez is an Associate Professor at the Technical University of Valencia (UPV), Spain, and senior researcher and Vice Director of the Research Institute of Water and Environmental Engineering (IIAMA). His main research focus is on the development of computer models for integrated management of water resource systems, using hydrology, engineering, economics and system analysis techniques. He has published extensively on conjunctive use of surface and groundwater from different perspectives.

Philippe Quevauviller is a Research Programming and Policy Officer at the European Commission in Brussels in the area of water and security policies. He has been a researcher in chemical oceanography. Besides his work at the European Commission, he is Associate Professor at the Hydrology Department of the Vrije Universiteit Brussel (VUB).

Pichu Rengasamy is a Senior Research Fellow in the School of Agriculture, Food and Wine of the University of Adelaide, Australia. He has devoted most of his research on the chemical and physical properties of salt-affected soils, particularly sodic soils. He has collaborated with Plant Scientists on soil-plant interactions in various categories of salt-affected soils with the aim of developing plants to adapt to different abiotic stress found in these soils. His recent research includes waste water irrigation affecting soil structural stability and Al toxicity in highly alkaline soils.

Jean-Daniel Rinaudo is senior economist at BRGM (French Geological Survey) where he coordinates the scientific program on Environmental and Risk economics. Trained as an agricultural and resource economist, he started his career at the International Water Management Institute, studying corruption in large irrigation systems in Pakistan. He then joined BRGM where his work focuses on the economics of groundwater management. In his research, he frequently combines the use of quantitative approaches (mathematical programming, econometrics, forecasting models, hydro-economic modeling) with more qualitative participatory methodologies.

Andrew Ross is a visiting fellow at the Australian National University, and until recently contracted to the Groundwater Section of UNESCO's Division of Water Sciences in Paris. His major current work is on transboundary aquifer management, groundwater governance and conjunctive water use. He is also interested in policy integration and implementation, and the research-policy interface.

Edella Schlager is a Professor at the Institute of the Environment and School of Government and Public Policy, The University of Arizona. She has a PhD from the University of Indiana. Her areas of expertise include comparative institutional analyses of water laws, policies, property rights, and compacts, polycentric systems of water governance and their adaption to changing environmental, legal, and social circumstances.

Karina Schoengold is an assistant professor of natural resources and environmental economics with a joint appointment in the Department of Agricultural Economics and the School of Natural Resources in the University of Nebraska–Lincoln. Her main interests are environmental and natural resources economics, water resource economics, natural resource pricing, technology adoption, irrigation technology options and agricultural economics.

John M. Sharp, Jr is a Professor in the Jackson School of Geosciences at The University of Texas at Austin, Texas, USA. His hydrogeological research covers flow in fractured and carbonate rocks, thermohaline free convection, sedimentary basin hydrogeology, subsidence and coastal land loss, groundwater management, and the effects of urbanization.

Darren Sinclair is a Research Fellow at The Australian National University. His position is funded under an ARC Linkage Grant, in partnership with the NSW Office of Water. Darren was also a Research Fellow at the National Centre for Groundwater Research and Training, Fenner School of Environment and Society, The Australian National University. His areas of expertise include water regulation, enforcement and governance, and environmental, health and safety regulation more broadly.

Abraham E. Springer is Professor of Hydrogeology and Past Director of the School of Earth Sciences and Environmental Sustainability at Northern Arizona and was the Fulbright Visiting Chair of Water and Environment at the University of Lethbridge, Alberta, Canada studying the cohydrology of springs of Western Canada.

Matt Stenson is a technology specialist with Australia's Commonwealth Scientific and Industrial Research Organisation's (CSIRO) Land and Water Flagship. His areas of research include environmental informatics, information management and transparency. He has considerable experience in the development of modelling and information systems, especially in the areas of hydrology and hydrogeology.

Lawrence E. Stevens is an evolutionary ecologist and the Director of the Springs Stewardship Institute at the Museum of Northern Arizona in Flagstaff. He has published on a wide array of topics, including biogeography, riparian and springs ecosystem ecology, regulated stream ecology, and rare species biology.

Andrew Stone has 35 years' experience in Africa and the US as a university professor, consultant, groundwater advocate and educator. As Executive Director of the non-profit American Ground Water Trust he develops programs to promote effective groundwater management, communicate the environmental and economic value of groundwater, showcase science and technology solutions, increase citizen, community and decision-maker awareness and facilitate stakeholder participation in water resource decisions.

Wendy Timms is a Senior Lecturer at the UNSW School of Mining Engineering, and is affiliated with the UNSW Connected Waters Research Centre, and the Australian Centre for Sustainable Mining Practices and was a Chief Investigator with the National Centre for Groundwater Research and Training. She has 20 years of experience as a hydrogeologist, across Australia and Canada, on water and waste issues in mining and agriculture. Her experience spans consulting engineering, government and research focused on sustainable management of groundwater and water quality, particularly with regard to interaction of saline water and low permeability clayey sediments and rock.

Kelly Warner is a Supervisory Hydrologist with the United States Geological Survey and is in charge of national and state water-quality and groundwater investigations. She has led the USGS

National Water-Quality Assessment study of the glacial aquifer system for 15 years. Her research focuses on groundwater-quality relations to environmental and human -induced change.

Sarah Ann Wheeler is Associate Professor and Australian Research Council Future fellow at the University of Adelaide. Her research interests are irrigated farming, organic farming, water markets, crime and gambling. Sarah is currently an Associate Editor of the Australian Journal of Agricultural and Resource Economics, a guest editor for a special edition for Agricultural Water Management, and on the editorial board of Agricultural Science.

Chunmiao Zheng holds the positions of Chair Professor and Director of the Center for Water Research at Peking University, and the George Lindahl III Endowed Professor at the University of Alabama. The primary areas of his academic research are hydrologic modelling, water management, and eco-hydrological processes.

Index

A

- Aboriginal, 271
- Active DSS, 651
- Active management areas (AMAs), 242, 245, 248, 249
- Adaptability, 150, 659, 696
- Adaptation, 13, 15, 51, 76, 89, 91, 98, 124–127, 147, 150, 152, 161–163, 224, 236, 245, 426, 429, 513, 575, 640, 694, 714, 722, 730–731
- Adaptive, 6, 13, 67, 125, 126, 161, 162, 230, 437, 605, 620, 626, 658, 698, 730 management, 124, 161, 162, 198, 232, 308, 485, 658, 730
- Adoption, 6, 10, 126, 156, 189, 204, 360–362, 484, 486, 576, 640, 644, 659–660, 677, 683, 715
- Aeolian dust, 381
- Agricultural contaminant, 36, 358, 364, 657
- Agriculture, 59, 62–65, 68, 79, 87, 88, 103, 104, 108, 111, 113, 115, 116, 123, 146, 149, 151, 173, 181, 192, 200, 202, 210, 218, 220, 238, 243, 258, 260, 263, 266, 267, 269, 273–291, 362, 385, 387, 393, 394, 396, 398, 400, 414, 418, 426, 437, 473, 494, 506, 507, 559, 561–563, 575 irrigated /irrigation, 63, 79, 151, 202, 220, 243, 258, 260, 267, 393, 396, 398, 426, 494, 586, 587, 592–595, 600, 602–604, 610, 702–704
- Algeria, 31, 584–594, 596, 599, 604, 607, 608
- Allocation, 77, 78, 126, 147–149, 151, 152, 155–159, 161–166, 168, 175–179, 181, 182, 187, 188, 191, 223, 231, 234, 235, 241–243, 248, 254–256, 258, 263, 267, 269, 273–291, 409, 441, 445, 482, 494, 496, 499, 502–504, 510–513, 552, 553, 556, 559–562, 569–572, 577, 593, 621, 641, 644, 652–654, 658, 660, 661, 695, 697, 699–702, 705, 707, 714
- Almeria, 237, 238, 246, 248, 704
- Alternative, 19, 39, 42, 50, 77, 78, 102, 126, 162, 202, 205, 207, 230, 240, 249, 257, 262, 274, 277, 281, 291, 384, 387, 389, 418, 419, 426, 438, 439, 481, 498, 522, 530, 555, 556, 564, 624, 631, 647, 648, 650, 651, 653, 656, 658–660, 686, 700–702, 704, 712–714, 716–719, 721–731 model, 19, 713, 714, 718, 719, 721, 722, 724, 728, 729, 731
- Ammonia (NH₃), 83
- Analytical, 12, 17, 168, 206, 207, 214, 369, 623, 642, 644, 647, 701 analyses, 647 support, 200, 205–207
- Anarchy, 584–611
- Andalusia, 238
- Anthropogenic threats to groundwater, 334–336
- Aquifer performance, 641, 642, 644, 648, 649 recharge, 51, 60, 61, 77, 79, 80, 85, 181, 234, 238, 255, 352 salinization in coastal areas, 386–387 salinization in inland areas, 385
- Aquifer storage and recovery (ASR), 230, 352, 416, 436, 445
- Aquifer thermal energy systems (ATES), 83
- Aquifer yield, 629, 641, 645, 657
- Arboriculture, 603
- Arizona, 180, 238, 241–243, 245–249, 329, 500, 506–508
- Arsenic, 23, 37, 59, 349, 421
- Atrazine, 349, 359, 363, 364
- Attribute, 338, 642, 645–647
- Augmentation plans, 231, 243, 244, 246, 248

- Australia, 15, 17, 18, 28, 31, 32, 36, 37, 39, 51, 59, 62, 77, 78, 80, 82, 84–86, 88, 89, 91, 109, 147, 150–153, 156–157, 159, 161, 163, 165–166, 168, 173–186, 188–192, 198, 218–221, 223–225, 231–249, 258–261, 273, 274, 278, 282, 306–307, 315, 318, 323, 327, 337, 338, 349, 350, 383, 388, 389, 391, 393, 398, 402, 407, 408, 421, 436–449, 470, 478, 480, 482, 483, 486, 493–514, 552, 654, 656, 668, 672, 673, 677, 679, 685, 706
law, 505
Automatic knowledge capture, 651
Availability, 17, 26, 29, 40, 41, 68, 77, 113, 114, 121, 126, 184, 236, 248, 301, 348, 352, 369, 406, 414, 417, 418, 425, 442, 496, 499, 500, 571, 593, 599, 644, 660, 673, 677, 679, 686–688, 696, 700, 703, 704, 707, 715
- B**
Base flow, 23, 27, 77, 104, 105, 107, 111, 115, 117, 185, 231, 304, 306, 314, 315, 318, 321
Basin, 28, 31, 34, 51, 61, 65, 69, 77, 82, 89, 106, 112, 117, 121, 122, 124, 125, 127, 150–155, 157, 160, 161, 163–165, 167, 168, 174, 177–183, 186–188, 190, 192, 193, 198–206, 209, 212, 213, 218–221, 231, 237, 239–241, 243–246, 248, 263, 290, 291, 307, 315, 323, 327, 340, 354, 388, 389, 391, 393, 398, 404, 408, 416, 423, 426, 439, 442, 445–449, 460, 462, 463, 467, 471, 499, 502–504, 509, 511, 513, 524–526, 529, 563, 568, 574, 577, 590, 593, 594, 605, 609, 647, 653, 654, 656, 701, 704, 705, 731
infiltration, 422, 428, 445–449, 731
Bayesian Networks (BNs), 13, 14, 480, 658, 659
Behaviour change, 478
Bengal – West, 89
Best management practice (BMP), 201, 405, 406
Biodiversity, 76–92, 107, 186, 225, 269, 304, 494
Biofuel
ethanol, 39, 78, 79
jatropha, 79
palm oil, 78
Biomass, 79, 85
Biotic assemblages, 323–324
Borehole, 80, 81, 83, 84, 110, 120, 121, 125, 157, 266, 354, 446, 552, 555, 561, 676
Brazil, 78, 499
Break-even analysis, 731
- C**
California, 27, 36, 38, 82, 88, 126, 127, 177–179, 182, 184, 185, 192, 218, 277, 355, 437, 479, 500, 506–509, 513, 514, 695–697, 699, 702–704, 706
Candidate solutions, 642, 648, 658, 659
Carbon
carbon capture and storage (CCS), 84
sequestration, 15, 76, 78, 84–86
soil, 76
Carbon dioxide (CO₂), 84
Catalonia, 237, 238, 246, 248, 249
Cation ratio of soil structural stability (CROSS), 384, 385
Chemical, 37, 50, 55, 57, 58, 63, 83, 105, 115, 116, 119, 123, 154, 180, 181, 189, 191, 209–211, 238, 299, 318, 348, 350, 355, 356, 358, 378, 381–392, 407, 416, 418, 419, 422, 425, 428, 429, 520, 523, 642, 696, 723
tracing, 642
China, 5, 17, 26–28, 30, 34, 37–39, 86, 88, 110, 326, 335, 352, 437, 456–473, 494, 499, 525, 527, 552, 658
Chinese groundwater governance, 461
Clay micro-aggregates, 383
Clean development mechanism (CDM), 85
Climate change
adaptation, 76, 86–90
direct impacts, 15, 76, 77
indirect impact, 117
mitigation, 15, 76–86, 91, 126
Climate proofing, 125
Climate variability, 98, 102, 107–109, 113–116, 119, 174, 230, 340, 499
Coal bed methane (CBM), 39, 80, 183, 184, 388, 407
Collaborative approaches, 17, 482–483
Collaborative planning, 168, 232, 233, 247
Collective action, 7, 16, 147, 230–249, 483, 487, 598
Collective tube-wells, 596, 598
Colorado, 158, 162, 163, 184, 185, 188, 239, 241–249, 323, 332, 339, 505, 568, 702
Communicating uncertainty, 718, 729
Communication, 6, 8, 12, 14, 32, 41, 64, 160, 162, 207, 481, 630, 631, 647, 648, 651, 695, 718, 719
Community engagement, 165, 629, 632
Complexity, 12, 15, 18, 25, 50–69, 91, 100, 102, 108, 123, 149, 184, 188, 199, 205,

- 206, 236, 241, 256, 278, 290, 308, 361, 369, 420, 423, 466, 470, 477–478, 486, 498, 499, 532, 590, 621, 630, 631, 633, 634, 640, 644, 645, 647, 658–660, 668, 696, 697, 725, 727
- Complex system, 50, 587, 589, 700
- Compliance, 148, 160, 177, 189–191, 201, 208, 211, 354, 404, 407, 408, 420, 483, 554, 555, 632, 653, 715
- Conceptual model uncertainty, 716, 719
- Concerns, 50, 66, 69, 81–84, 88, 115, 126, 154, 174, 175, 178, 183, 190, 192, 193, 198, 201, 202, 207, 209, 213, 254, 257, 258, 263, 304, 308, 351, 352, 356, 357, 365, 366, 370, 388, 389, 400, 419–421, 425, 426, 442, 462, 466, 467, 482, 513, 527, 528, 536, 537, 545, 564, 565, 568, 569, 575, 586, 594, 632, 634, 641, 642, 644, 647, 649, 657, 673, 677, 684, 689, 694
- Conflict, 7, 9, 22, 23, 604, 605, 625, 629, 632, 635, 644, 660
- Conjunctive management, 695–697, 701
- Conjunctive use, 655, 658, 694–698, 700–707
- Consensus, 590, 620, 641, 648, 651, 695
yield, 648
- Consultation, 629, 647
- Contaminant, 81, 116, 117, 189, 190, 299, 348, 352–369, 424
transport, 116, 117, 352, 365
- Contamination, 34–38, 58, 59, 63, 79–81, 108, 117, 124, 175, 192, 215, 304, 318, 335, 336, 355, 358, 362–368, 387, 416, 421–423, 429, 456, 460–462, 467, 470, 487, 522–524, 528, 530
- Cooperation, 23, 40, 41, 127, 159, 188, 207, 208, 219, 340, 466, 556, 648
- Coordinate, 127, 159, 178, 189, 203, 208, 219, 241, 244, 246, 339, 361, 467
- Correlative groundwater rights, 177
- Courts, 91, 154, 158, 160, 177, 184, 188, 257, 512, 513, 559, 561
- Crisis, 16, 232, 242, 245, 247–249, 513, 590, 604, 606, 610, 702
- Criterion, 284, 351, 417, 423, 424, 429, 627, 646, 648
- Cross-boundary groundwater management, 187
- D**
- Daily fluctuations in groundwater depth, 320
- Data management life cycles, 668–674
- Data model, 676–677
- Data network, 18, 33, 674, 678, 679, 681, 684, 687–689
- Dataset, 122, 216, 338, 641, 645, 689, 728
- Decision analytic techniques, 657
- Decision makers, 4, 9, 14, 19, 92, 126, 182, 183, 186, 193, 199, 238, 249, 301, 308, 624, 625, 641, 644, 645, 647, 648, 652, 660, 717
- Decision-making, 4, 6–8, 12, 66, 90, 127, 147, 163, 167, 183, 188, 205, 208, 213, 217, 230, 235, 238, 245, 247, 249, 255, 257, 258, 269, 275, 287, 291, 298, 300, 301, 308, 348, 358, 368, 426, 479, 480, 482, 484, 495, 498, 629, 650, 660, 701, 715, 718–720, 724, 727
- Decision objectives, 648
- Decision problem, 640, 642, 644, 646–648, 651, 655, 657
- Decision support systems (DSS), 18, 640–661, 701–702, 706, 707
type, 650, 651
- Decline, 5, 28, 30, 52, 77, 104, 111–113, 115, 116, 158, 254, 305, 322, 326, 334, 335, 337, 339, 387, 437, 460, 462, 466, 534, 553, 557, 600, 605, 610, 704
- Definitions of groundwater, 175
- Deliberation, 647, 649–651, 657
- Demand, 61, 64, 65, 76, 77, 79, 82, 87–89, 104, 111, 112, 115, 116, 123, 125–127, 162, 185, 223, 225, 274, 314, 333, 414, 419, 426, 428, 436–439, 494, 495, 499, 503, 504, 507, 511, 514, 557, 562, 564, 574, 578, 587, 588, 593, 594, 599, 606, 610, 646, 652, 660, 696–700, 702, 703, 706, 707
management, 15, 17, 76, 78, 125, 162, 436, 437, 593, 594, 610, 696, 698
- Depletion, 22–33, 41, 59, 76, 79, 82, 87, 111, 112, 121, 146, 155, 156, 158, 173, 175, 188, 263, 289, 333, 335, 378, 406, 437, 438, 456, 466, 494, 511, 533, 564, 565, 568, 569, 572, 577, 634, 643, 694, 696, 701
- Deployment, 78, 83, 91, 609, 660, 680, 684, 687
- Deserts, 39, 82, 119, 259, 263, 276, 277, 302, 326
- Deuterium, 321
- 2,4-D (2,4-dichlorophenoxy acetic acid), 363
- Discharge, 56, 77, 104, 107, 108, 111–112, 115, 117, 121, 124, 180, 190–192, 215, 264, 298, 299, 305, 307, 314, 316, 318–321, 323, 327, 328, 330, 331, 334–337, 339, 340, 379, 380, 382, 386, 388, 389, 419, 420, 422, 463, 469, 495, 587, 590, 597, 643, 646, 654, 723

- Dispute, 81, 155, 208, 213, 234, 257, 263, 634, 640, 641, 647, 660
- Drinking water, 52, 86, 98, 124, 146, 151–153, 156, 165, 190, 202, 205, 255, 302, 303, 349, 353–357, 362, 364–368, 389, 390, 399, 404, 415, 418, 420, 421, 423, 426–429, 437, 439, 459, 464, 493, 501, 520–522, 524, 528, 530, 536, 537, 563, 591, 729
- Drip irrigation, 51, 60, 576, 588, 594, 599, 601, 606, 607, 609
- Dry cooling, 82, 91
- E**
- Earthquakes, 59, 81
- Ecohydrology, 16, 298–309, 329
- E. coli*, 366, 368
- Ecology, 11, 16, 116, 120, 264, 299–303, 308, 314, 321, 327, 337, 340, 487, 622
- Economic, 11, 41, 80, 180, 260, 449, 513, 521
cost, 82, 348, 356, 367, 368
- Ecosystem functions, 223
- Electricity, 63, 79, 80, 82, 83, 88, 89, 91, 500, 554, 557, 587, 599, 654, 673
- Emergent decision problems, 657
- Emission, 77, 79, 83–85, 99–101, 110, 117, 123, 125, 154, 191, 201, 202
- Endangered species, 10, 105, 156, 158, 164, 244, 505, 511, 512, 564, 565, 568
- Energy
coal/coal-fired, 80, 84
fossil, 77, 80, 83
renewable, 15, 63, 78, 83
- Engagement, 127, 150, 151, 481, 485, 629, 644, 648
- Environmental
flows, 40, 89, 219, 235, 260, 389, 443, 468, 497, 507, 509
justice, 16, 254–269
management, 6, 224, 260, 431, 478, 645
water(ing), 89, 148, 156, 158, 179, 219, 230, 232, 248, 266, 442–444
- Equity, 16, 255, 263, 276, 513, 555, 594
- Eucalyptus*, 307, 323
- Europe, 5, 15, 28, 32, 37, 82, 83, 105, 115, 127, 151, 152, 154, 157, 161–163, 173, 239, 348–370, 415, 428, 430, 520, 527, 553, 555, 557, 678
Law, 154
- European Union (EU), 15, 78, 124, 146–168, 174, 176–179, 181, 183, 184, 187–192, 198, 200, 202, 209–211, 218, 303, 304, 349, 353, 360, 414, 470, 558
- European Water Framework Directive (WFD), 152, 154, 161, 163, 166, 168, 176, 188, 199, 204, 238
- Evaporative basins, 81
- Evapotranspiration, 24, 25, 52, 62, 77, 86, 103–105, 109, 110, 114, 116, 122, 299, 300, 302, 307, 325, 328, 331, 340, 378, 380, 381, 418, 643
- eVI, 326, 327, 329
- Exchangeable sodium percentage (ESP), 383
- Externalities, 51, 66, 78, 91, 466, 494, 496, 498, 513, 514, 567, 695, 697
- Extraction rate, 40, 501, 646
- Extractive resource industries, 387–389
- F**
- Facilitators, 651
- Fairness, 149, 157, 158, 267, 275, 482, 561
- Farmer, 16, 51, 59, 63, 65, 66, 89, 124, 126, 149, 163, 164, 179, 230, 233, 235, 236, 238, 239, 266, 269, 273–275, 277–291, 358, 361, 362, 388, 394, 398, 442, 447, 480, 482, 500, 514, 520, 524, 540, 554, 555, 557, 559, 561–564, 576, 589, 596, 598, 605, 608
- Farming systems, 285, 587, 598, 599, 607, 610
- Feasibility space, 648, 649
- Feedback, 6, 13–15, 23, 53, 66, 69, 100, 105, 106, 114, 115, 125, 128, 150, 280, 299, 308, 409, 426, 479
- Fen, 299, 324, 325
- Flood, 51, 59, 60, 77, 86, 105, 110, 117, 150, 159, 200, 206, 340, 387, 394, 436, 439, 441–449, 468–470
- Floodwater, 442, 446, 447
- Flow-net construction, 642
- Food
production, 30, 76, 79, 86–89, 219, 585
security, 29, 473, 484, 494, 610
- Forest, 6, 61, 77, 85, 90, 107, 127, 315, 335, 418, 554
- Framing, 76, 640, 642, 649
- Freshening processes, 401–402, 404, 408
- G**
- Gaining reaches, 89
- Gas
coal bed/seam, 81, 183, 225, 388, 442, 486
produce water, 80
shale, 81
unconventional, 39, 78, 80–82, 91
- Geomorphology, 323, 339
- Geophysical methods, 642

- Geostatistics, 722, 725
 Geothermal, 63, 64, 78–80
 hot rock, 80
 Global change, 15, 63, 76–92, 98, 99, 118–122,
 125, 127
 Global water data, 107
 The Gngangarra Mound, 338
 Goal, 4, 7, 23, 54, 79, 148, 154, 155, 166, 168,
 178, 180, 181, 183, 187, 189–191, 202,
 205, 257, 260, 267–269, 306, 308, 357,
 406, 436, 467, 473, 566, 620, 646,
 648, 695
 Governance, 7–9, 15–16, 50, 51, 64, 67–69, 76,
 78, 79, 84, 90–92, 124, 146–156,
 163–168, 176, 183, 184, 223, 231, 235,
 242, 254–256, 258–266, 268–269, 456,
 470, 472, 478–480, 482–484, 488, 620,
 621, 630, 642, 644, 645, 647–650,
 659, 669
 Governing laws, 212
 Government, 63, 67, 76, 78, 80, 84–86, 88–90,
 124, 127, 147–150, 152, 153, 155,
 158–161, 163, 164, 167, 174, 176–178,
 186, 190, 191, 200, 213, 215, 219, 221,
 222, 224, 231–236, 241, 242, 244,
 247–249, 260, 261, 268, 279, 290, 368,
 369, 406, 439, 441, 449, 461, 467, 469,
 470, 472, 478–483, 485, 486, 495, 496,
 501, 505, 507, 514, 551, 559, 561–563,
 568, 601, 605, 606, 628, 630, 647, 673,
 685, 686
 Greenhouse, 99, 238, 596, 598
 Greenhouse gas (GHG), 77, 79, 84, 99–101,
 117
 emissions, 38, 78, 80, 83, 440
 Groundwater
 access, 149, 158, 214, 484, 499, 501, 585,
 607, 610
 attributes, 314–318
 availability, 16, 17, 24, 29, 82, 147, 156,
 160, 307, 314, 315, 318, 320, 332, 340,
 578, 601, 644–646, 703
 bodies, 154, 155, 183, 190, 191, 206, 209,
 210, 212, 304, 414, 428, 529, 695
 database, 32
 dependent ecosystem, 16, 147, 153, 165,
 166, 186, 225, 231, 248, 259, 261, 274,
 304, 314–340, 406, 437, 460, 501, 520,
 522, 540, 645, 717
 economy, 584, 585, 587–589, 591, 592,
 596, 599–601, 604–611
 governance, 7, 9, 15–17, 79, 90, 146–168,
 184, 254–269, 456, 470, 472, 478–488,
 585, 641, 642, 644, 648, 655
 infrastructure, 59–60
 licences and permits, 182
 management, 50, 53, 57, 60, 63, 64, 66–69,
 76–92, 98, 114, 124, 128, 147–150, 152,
 159, 160, 164, 165, 167, 174, 179, 184,
 187, 193, 198, 199, 202, 208, 212, 224,
 225, 234, 238, 244, 254, 258, 269,
 299–302, 304–309, 316, 348, 350–353,
 355, 357, 358, 360, 362, 364, 367, 399,
 406, 414, 428, 456, 463, 465, 466,
 468–472, 478–480, 483, 486, 494, 497,
 504, 505, 507, 512, 513, 528, 531, 540,
 552, 554, 555, 558, 562, 564–568, 570,
 575–578, 620, 622, 631–634, 640, 644,
 649, 656–661, 668, 696, 700, 703, 712,
 713, 716–718
 management districts, 306, 569, 659
 managers, 126, 644, 713
 modelling, 646, 714, 724
 monitoring, 28, 30, 33, 160, 161, 174, 209,
 369, 402, 406, 464, 465, 467, 473, 576,
 645, 655, 679, 684
 overdraft, 441, 460, 465–467, 605, 606, 696
 plan, 153, 234
 planning, 159, 163, 168, 179, 209, 234,
 629, 632
 quality, 5, 6, 10, 11, 16, 17, 23, 26, 27, 31,
 36, 50, 52, 58, 59, 62, 63, 65, 83, 84,
 108, 115–118, 147–149, 153, 156, 159,
 166, 174, 184, 189–191, 211, 223, 224,
 266, 318, 333, 334, 336, 340, 352, 357,
 360, 369, 389, 399, 404, 406, 408, 414,
 419, 429, 449, 456, 460–461, 463, 464,
 466, 467, 470, 495, 520, 521, 523, 528,
 529, 531, 539–541, 645, 696, 703
 recharge, 7, 27, 35, 36, 38, 60–62, 68, 76,
 77, 85, 86, 99, 104, 106, 108–111, 114,
 117, 122, 127, 128, 264, 266, 318, 334,
 388, 414, 428, 445, 458, 463, 468, 506,
 556, 557, 576, 593
 resource, 5, 7, 9, 10, 16, 18, 22, 23, 29, 31,
 32, 36, 40, 41, 50, 52, 54–57, 61–64, 76,
 78–80, 83, 86–92, 98, 104, 108, 109,
 111, 113–116, 122, 124–127, 129,
 146–148, 150, 153, 156–159, 166, 167,
 183, 190, 209, 222, 223, 225, 232, 233,
 239, 254, 266, 267, 298, 303, 305, 314,
 329, 358, 359, 361, 362, 399, 404, 414,
 449, 456–464, 466, 469, 470, 472, 473,
 483, 504, 506, 511, 520–523, 527–530,
 532, 538–540, 572, 578, 584, 586, 587,
 591–594, 596, 598, 599, 604, 606, 609,
 620, 631, 633, 640, 646, 647, 659,
 694, 699

- Groundwater (*cont.*)
- salinity, 120, 153, 330, 385, 387, 388, 398–407, 441, 728
 - storage, 32, 33, 61, 69, 77, 107, 112, 113, 120–122, 126, 298, 437, 442, 466, 508, 648, 694, 697, 698, 702, 716, 717
 - studies, 19, 303, 671, 674, 676, 679, 684, 689
 - surface water connectivity, 52, 153
 - use, 7, 15, 25–27, 29, 31, 51, 59–63, 68, 76, 125, 146, 147, 149, 151, 153, 156, 157, 160, 162, 167, 183, 184, 188, 193, 219, 225, 237, 239, 273, 274, 279, 282, 321, 327, 330, 348, 350, 409, 459, 468, 482, 483, 494–498, 501, 502, 505, 506, 508, 510–512, 514, 520, 529–531, 552–554, 556–558, 562, 564–567, 571, 572, 578, 584–611, 635, 660, 694, 697, 703, 706
 - user, 8, 9, 146, 147, 150, 155, 167, 187, 243, 279, 482, 494, 505, 509, 511, 512, 527, 554, 555, 557, 559, 565, 568, 578, 585, 590, 593
 - withdrawal limits, 178–181
- Groundwater dependent ecosystems (GDEs), 16, 41, 147, 153, 165, 166, 168, 179, 183, 186–187, 223, 225, 231, 248, 255, 259, 261, 274, 299, 304, 306, 314–340, 406, 437, 460, 501, 520, 522, 540, 564, 645, 694, 717
- Groundwater management district (GMD), 306, 569, 659
- Groundwater-surface water interaction, 58, 114, 187, 221, 236
- Group facilitation, 651
- H**
- Heterogeneity, 162, 275, 445, 564, 679, 725
- Horticulture, 52, 115, 586, 596, 598, 600, 602, 604, 605
- Human, 9–10, 17, 34, 50, 52, 59–61, 66, 77, 87, 88, 90, 98, 99, 104, 111–113, 115, 117, 118, 123, 125, 127, 153, 155, 166, 174, 182, 184, 191, 193, 200, 206, 209, 254, 255, 257, 268, 275, 301, 314, 318, 333, 335–337, 348, 350–352, 354–369, 380, 382, 417, 463, 466, 471, 478, 479, 481, 484–486, 488, 529, 554, 559, 576, 661
- behavior, 640
 - capital, 17, 478, 485
 - contaminant, 364
 - right to water, 174, 184–185, 193
- Hydrogen, 83, 383
- Hydrogeochemical changes, 390–392
- Hydrogeologic, 17, 18, 40, 112, 116, 300, 423, 442, 462, 641–643, 646–647, 654, 661, 676
- attributes, 642
- Hydrogeology, 11, 58, 163, 300, 443, 445, 462, 487, 496, 642, 645, 646, 648, 674, 678
- Hydrological connectivity (connections), 232
- Hydrological cycle, 61, 99, 108, 122, 230, 254, 418, 668
- Hydrological modelling, 235, 236, 320, 430
- Hydrology, 58, 76, 102–118, 122–123, 163, 299–303, 308, 327, 339, 426, 496, 553, 646, 676, 678, 684, 698, 700
- Hygrophyte plant, 303
- Hypothesis testing, 308, 722
- I**
- Identifying GDEs, 319–329
- India, 5, 26–29, 33, 34, 36–40, 42, 59, 86, 88, 89, 124, 335, 436, 437, 483, 494, 499, 500, 585, 608
- Indicator, 7, 13, 99, 121, 148, 211, 213–215, 288, 302, 303, 320, 323, 327, 328, 338, 355, 366, 368, 383, 385, 510, 522, 538, 540, 646, 697, 699, 705, 716
- Indigenous, 225, 259–261, 480
- Individual tube-well, 596, 598
- Indus Valley, Pakistan, 379, 385
- Inequalities, 276, 281, 283–287, 291, 479, 585, 608–610
- Informatics, 658, 674
- Information, 56, 58, 76, 81, 90, 101, 102, 107, 118, 124, 125, 128, 157, 159–163, 167, 183, 198, 200, 204–208, 213, 214, 222, 233–236, 243, 247, 256, 274, 290, 320, 322, 324, 329, 353, 354, 364, 367, 390, 442, 449, 457, 460, 463, 464, 467, 470–473, 481, 495, 498, 508, 522, 527–529, 532, 536, 538, 540, 545, 552–558, 561, 563, 575–578, 588, 590, 592, 627, 629, 630, 633, 634, 640, 642, 644–646, 648, 651, 661, 673, 677, 678, 680–682, 684–686, 689, 704, 712, 713, 719–721, 726–728, 730
- management, 329
- Informative, 642, 647, 648
- Input, 24, 33, 61, 117, 154, 201, 210, 212, 216, 230, 255, 264, 301, 319, 320, 330, 357–363, 379, 388, 395, 398, 557, 587, 589, 603, 640, 646, 647, 651, 669, 687, 703, 714, 715, 717, 721–723

- Institutional**
 arrangements, 127, 247, 486, 499
 framework, 200, 238, 273, 472, 496, 520,
 558–560, 570–572
 reforms, 17, 472, 593
 settings, 168, 230, 249, 470, 552, 558
 variables, 248
- Institutions**, 32, 68, 90, 91, 127, 147, 149,
 152–157, 163, 166, 167, 185, 198, 199,
 219, 236, 241, 254, 263, 268, 472, 478,
 497, 504, 512–514, 558, 559, 568, 578
- Integrated assessment (IA)**, 6, 7, 10–14, 67,
 480, 520–541, 651, 655
- Integrated assessment and modelling (IAM)**,
 646, 651, 657
- Integrated data**, 22, 640, 671
 management, 32
- Integrated groundwater data**, 668–689
- Integrated groundwater management (IGM)**,
 4–19, 25, 30, 50, 90, 98, 124–128, 199,
 298–309, 348–370, 456–473, 486,
 640–642, 646, 731
- Integrated management**, 15, 23, 41, 91, 154,
 168, 174, 198, 200, 206, 223, 231,
 232, 236, 237, 245, 246, 248, 249, 309,
 404, 405, 427, 469, 472, 509, 568,
 701, 703
- Integrated model**, 7, 12–14, 645, 646, 651, 658,
 671, 675, 676, 685, 689
- Integrated water planning**, 198–225, 230, 469
- Integrated water resources management**
 (IWRM), 90–92, 125, 266, 357, 436,
 472, 473, 593, 641, 696
- Integration**, 7, 10–12, 14, 32, 41, 50, 59–61, 91,
 122, 123, 154, 163, 166, 198, 230, 301,
 322, 350, 407–409, 442, 456, 464–472,
 520, 608, 640, 646, 658, 660, 668,
 675–678, 688, 689, 695, 696, 701
- Intensive Groundwater Use Control Areas**
 (IGUCAs), 179, 180, 306
- Interactive deliberation**, 650
- Interdependency**, 269, 644, 660
- Internationally shared aquifers**, 207
- Interstate water allocation agreements**, 243
- Interstate water sharing agreement**, 244
- Invisible**, 9, 466, 483, 520, 589, 608, 631
- Irrigated agriculture**, 31, 88, 104, 108, 111,
 113, 586, 587, 591–595, 600,
 602–604, 610
- Irrigation**, 35, 51, 52, 54, 57, 60, 62, 65, 66, 78,
 79, 87, 88, 91, 98, 111, 113, 124–126,
 146, 151, 157, 164, 179, 218, 219, 225,
 230, 234, 239, 241, 243, 259, 260, 263,
 264, 266, 273, 277, 280, 284, 286–288,
 305, 306, 334, 335, 378–382, 385, 386,
 388–391, 393–402, 404–409, 414, 426,
 436–449, 460, 468, 469, 480, 481,
 493–495, 500, 502, 503, 510, 526,
 553–557, 559–561, 563, 565, 567, 570,
 576, 584–596, 598–601, 604–610, 652,
 653, 694, 695, 703, 704, 722
 frontiers, 584–611
- J**
 Jucar, 237, 239, 240, 246, 248, 249
 Justice, 154, 208, 254–269, 275–282, 284–291,
 479, 482, 487
- K**
 Knowledge management, 645, 649
 Knowledge processes, 641
- L**
 La Mancha, 237
 Land management, 11, 395, 400, 402, 715
 Land use, 15, 50, 52, 58, 61–69, 85, 105,
 108–111, 115, 123, 126–128, 157, 160,
 191, 200, 203, 224, 289, 333, 336, 352,
 394, 409, 449, 484, 485, 587, 645, 654,
 660, 694, 698
 Law, 68, 99, 154, 155, 158, 162, 173–193, 207,
 208, 213, 245, 248, 263, 283, 353, 359,
 360, 368, 420, 463, 465, 468–472, 505,
 506, 509, 510, 558–561, 563, 569–571,
 576, 577, 589, 633, 719
 Legal, 61, 68, 91, 148, 149, 161, 174, 175, 183,
 185, 187, 199, 201, 208–210, 218, 234,
 238, 247, 248, 254, 255, 306, 368, 466,
 468–470, 472, 473, 482, 497, 499, 505,
 507, 509, 512, 513, 520, 552, 558–560,
 562, 564, 570–572, 576, 644, 653, 661,
 695, 697
 Legislation, 16, 17, 24, 153, 155, 159, 175, 181,
 182, 184, 191, 192, 201, 210, 211, 213,
 217, 218, 223, 268, 471, 472, 479, 512,
 513, 589, 685
 Levelised cost, 440, 441, 448, 449
 Level of uncertainty, 39
 Liberation, 387, 584–611
 Licence-exempt wells, 174
 Limits of acceptability, 727

M

- Managed aquifer recharge (MAR), 8, 17, 67, 77, 87, 174–176, 190, 223, 225, 237, 414–431, 436–449, 468, 731
- Managed groundwater storage, 32, 61, 69, 436, 693–707
- Management, 6–12, 14, 30, 50, 53–54, 61, 64–66, 69, 76–78, 81, 86–91, 102, 113, 123–128, 147, 148, 150, 152–157, 159–168, 174, 176, 179–183, 186–188, 190, 192, 198–210, 212, 218, 219, 221–225, 230–249, 255, 258, 260, 263, 266, 268, 274, 280, 282, 287, 300–309, 314, 315, 329, 339, 348, 350–369, 378, 381, 385, 387, 388, 392–400, 402, 404–409, 414, 415, 425, 427, 429, 431, 436–449, 456, 461–473, 478–480, 483–488, 493, 494, 497, 498, 501, 504–506, 508, 509, 511, 513, 528–530, 532, 535, 536, 539, 552, 553, 559, 562, 565, 566, 568, 569, 572, 575–578, 585, 587, 590, 591, 593, 594, 598, 606, 608, 620, 622, 624, 630, 632–634, 640, 641, 644, 645, 647–661, 668–689, 694–706, 712–731
- Management of salt-affected soils, 379, 385
- Market incentives, 61, 91
- Maximum Contaminant Level (MCL), 348, 353, 356
- Mediation, 651
- Mediators, 651
- Mediterranean, 127, 237, 238, 337, 415, 418, 439, 593, 605, 655
- Meinzer, O.E., 25, 303, 316
- Methane, 39, 80, 81
- Metric, 22, 26, 30, 53, 84, 106, 298, 299, 308
- Mexico, 5, 26, 36, 40, 86, 188, 242, 322, 323, 354, 437, 499, 552
- Micro-irrigation, 593, 609
- Middle East, 28, 40, 59, 98, 303, 593
- Mine water, 389
- Misconceptions, 24, 631, 640, 644
- Mixing diagram, 391, 392
- Model, 56, 90, 99–102, 106, 114, 122, 123, 187, 202, 206, 214, 236, 240, 256, 257, 274, 283, 290, 291, 322, 327, 328, 340, 391, 420, 498, 531, 536, 538, 541, 542, 545, 553, 557, 624, 626, 630, 631, 643, 646, 649, 651–655, 657–659, 669–671, 674–678, 680, 686, 687, 698–707, 712–716, 718–731
- calibration, 720
- construction, 719
- mediated negotiation, 659
- structure uncertainty, 721
- Modelling, 7, 12–14, 18–19, 67, 102, 115, 211, 232, 236, 240, 249, 320, 325, 329, 388, 391, 405, 406, 425, 429, 430, 446, 480, 482, 590, 625, 630, 631, 640, 644, 658, 685, 686, 697, 699–702, 713–716, 719, 721, 723, 724, 730
- Models as discussion points, 731
- Moderate-resolution Imaging Spectroradiometer (MODIS), 121, 326, 327
- Mohammed ibn al-Hasan al-Hasib al-Karaji, 302
- Monitoring, 55, 57, 58, 110, 118, 120–122, 127, 128, 149, 152–154, 159–162, 165, 166, 174, 187, 190, 191, 201, 205, 206, 209–211, 221, 222, 224, 225, 230, 232, 235, 236, 238, 266, 308, 316, 329, 339, 340, 353, 354, 365, 366, 369, 379, 385, 388, 399, 400, 402, 404–406, 408, 415, 425, 428, 446, 464, 465, 467, 469, 473, 496–498, 503, 505, 506, 510, 520, 553, 554, 565, 566, 568, 571, 575–577, 592, 648, 655, 668, 681–684, 687, 689, 719, 728, 730
- Feedback, 648
- Monte Carlo, 100, 656, 723, 727
- Morocco, 31, 584–594, 600, 604, 605, 607–609
- Multi-criteria analysis, 658
- Multi-disciplinary, 76, 205, 300, 303, 327, 426, 487, 640, 644, 659, 660
- Multi-objective parameter estimation, 722
- Multiple-point statistics, 725, 726
- Murray-Darling Basin (MDB), 31, 77, 89, 151, 153, 161, 178, 181, 218–221, 232, 237, 307, 391, 398, 404, 408, 442, 499, 502–504, 514
- N**
- Namoi catchment, Australia, 399
- National data network, 19
- National Water Initiative (NWI), 91, 152, 153, 178, 180, 221–223, 232, 233, 260, 261, 501
- Natural attributes, 642, 643, 646
- Natural capital, 521
- Natural contaminants, 23, 80, 356
- Natural resource management (NRM), 17, 86, 223, 258, 260, 478, 479, 483, 485, 486, 628
- Nature of uncertainty, 719
- Nebraska, 28, 111, 178, 188, 244, 355, 505, 506, 509–511, 513, 565, 566, 568–569
- Negotiation, 69, 126, 204, 208, 219, 235, 239, 240, 242, 263, 274, 275, 278, 279,