**Environmental Expertise**

An important goal of environmental research is to inform policy and decision making. However, environmental experts working at the interface between science, policy, and society face complex challenges, including how to identify sources of disagreement over environmental issues, communicate uncertainties and limitations of knowledge, and tackle controversial topics such as genetic modification or the use of biofuels. This book discusses the problems environmental experts encounter in the interaction between knowledge, society, and policy on both a practical and a conceptual level. Key findings from social science research are illustrated with a range of case studies, from fisheries to fracking. The book offers guidance on how to tackle these challenges, equipping readers with tools to better understand the diversity of environmental knowledge and its role in complex environmental issues. Written by leading natural and social scientists, this text provides an essential resource for students, scientists, and professionals working at the science–policy interface.

ESTHER TURNHOUT is a professor at the Forest and Nature Conservation Policy Group of Wageningen University, the Netherlands. Her research programme, 'The Politics of Environmental Knowledge', includes research into the different roles experts play at the science–policy interface, the political implications of policy-relevant environmental knowledge, and the interaction between science, society, and citizens.

WILLEMIJN TUINSTRA works as an independent advisor on knowledge development for environmental policy. She advises research institutes and civil servants on procedural aspects of stakeholder participation, scenario development, and dealing with uncertainties. She has been involved in projects for the European Environment Agency and the International Institute for Applied Systems Analysis.

WILLEM HALFFMAN is an associate professor in the Faculty of Science at Radboud University, Nijmegen. His work focuses on studying how scientific knowledge is validated and how scientists advise public decision making. He has more than 20 years' experience teaching science and society courses to natural scientists.

"The novel perspectives in this book, as well as its cases and conceptual advances, will come as a welcome resource for those interested in understanding the controversies around the use of environmental expertise. Equally, it will be welcomed by environmental scientists seeking to navigate the shoals of practicing and representing science on the one hand, and effective communication and making a difference in the world on the other."

*– Arun Agrawal, University of Michigan*

"This book is important and timely. There has never before been such great need for evidence to underpin environmental policy, and yet there is also a growing appreciation among researchers of the complexities and risks associated with engaging with the policy community. The book is rooted in the latest theoretical understandings from social science, explained in an accessible way, and it very quickly moves from theory to practice, showing how these insights can inform how environmental scientists work around controversial topics. The use of in-depth case studies complements the widespread use of helpful examples throughout the text. I have found reading this book both inspiring and instructive, and believe that many researchers will benefit considerably from reading it. I will certainly be recommending it to colleagues."

*– Mark Reed, Newcastle University*

"The principal authors have done a very smart and novel job with this book, bringing together insights from environmental science, policy studies, science studies and the philosophy of science in a thoroughly practical way. The book should really help practitioners appreciate ways to handle the complexities of environmental policy-making in contexts of uncertainty, conflicting beliefs and competing societal values."

*– Steve Yearley, IASH, University of Edinburgh*

# Environmental Expertise

## Connecting Science, Policy, and Society

ESTHER TURNHOUT
*Wageningen University, the Netherlands*
WILLEMIJN TUINSTRA
*Open Universiteit, the Netherlands*
WILLEM HALFFMAN
*Radboud University, Nijmegen, the Netherlands*

With contributions from
Silke Beck, Heleen de Coninck, Thomas Gieryn, Mike Hulme, Marga Jacobs, Phil Macnaghten, Clark Miller, Katja Neves, Martin Pastoors, Ad Ragas, Claire Waterton, and Laurence Williams

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# Contents

# Contributors

**Silke Beck**
Helmholtz Centre for Environmental Research – UFZ, Leipzig, Germany

**Heleen de Coninck**
Department of Environmental Science, Radboud University, Nijmegen, the Netherlands

**Willem Halffman**
Institute for Science in Society, Radboud University, Nijmegen, the Netherlands

**Mike Hulme**
Department of Geography, University of Cambridge, Cambridge, UK

**Thomas Gieryn**
Department of Sociology, Indiana University, Bloomington, IN, USA

**Marga Jacobs**
Faculty of Management, Science and Technology (MST), Open Universiteit, Heerlen, the Netherlands

**Phil Macnaghten**
Knowledge, Technology and Innovation Group, Wageningen UR, Wageningen, the Netherlands

**Clark Miller**
School for the Future of Innovation in Society, Arizona State University, Tempe, Arizona, USA

**Katja Neves**
Department of Sociology and Anthropology, Concordia University, Montreal, Canada

**Martin Pastoors**
Chief Science Officer, Pelagic Freezer-trawler Association, Zoetermeer, the Netherlands

**Ad Ragas**
Faculty of Management, Science and Technology (MST), Open Universiteit, Heerlen, the Netherlands

**Willemijn Tuinstra**
Faculty of Management, Science and Technology (MST), Open Universiteit, Heerlen, the Netherlands

**Esther Turnhout**
Forest and Nature Conservation Policy Group, Wageningen UR, Wageningen, the Netherlands

**Claire Waterton**
Department of Sociology, Lancaster University, Lancaster, UK

**Laurence Williams**
Science Policy Research Unit, University of Sussex, Brighton, UK

# Preface

This book was designed to prepare environmental scientists for work in, and with, society. It covers a wide range of examples and case studies, from fisheries and biodiversity conservation to climate change and pesticide pollution, to cover the kinds of issues environmental scientists might work on, as well as providing a healthy dose of conceptual understanding of the problems involved. The primary aim of the book is therefore educational, aiming specifically at environmental scientists with a natural science background, on a Master's or early career researcher level, but also at practitioners in environmental advice or policy.

As such, the book aims to complement the kind of knowledge that dominates natural science education: that is, how to solve well-structured, clearly defined problems with objective and instrumental knowledge, using trusted methods. However, in a societal context, problems are often *ill-structured*, problem definitions are *contested*, facts and methods may be *controversial*, and science is *not automatically trusted* (and often with good reason, because science has created problems in the past, such as organochlorine pesticides, nuclear waste, failed planning megalomania, or plastic soup).

When faced with a critical society, even the most powerful and well-intentioned drive to find optimal solutions for environmental problems and support instrumental reasoning may run into often unforeseen problems and resistance. For example, to many scientists' surprise and disappointment, genetic modification raised fundamental objections, the promises of biofuels were unexpectedly challenged by NGOs, and meticulous assessments of environmental problems were simply pushed aside as irrelevant. This book provides insights that will help us to understand and cope with these dynamics. We need to stress that our aim is not to negate the value of the sciences and their potential for emancipation and the betterment of humanity, but to better accommodate their

particular modes of operation with societal deliberation and collective problem solving.

Many educational programmes in the natural sciences (and the environmental sciences in particular) currently include courses to reflect on the role of scientists in society – courses such as 'Science in Society', 'The Social Responsibility of the Scientist', and 'Environmental Science and Policy'. Using insights from the social sciences, such courses explain how the logic of science-in-society differs from that of science-in-the-lab, and especially from science-in-the-textbook. They prepare scientists to become professionals: academically trained researchers operating in a society that is critical, ever more highly educated, at times also blinded by passion or prejudice, political, mediatised, divided, demanding, concerned. This book is intended to offer reflection and deeper conceptual understanding, as well as practical advice for use in such courses.

We hope the book will also be useful for self-study or reflection by environmental professionals working for research, advisory, policy, industry, or civil society organisations. A primary focus of the book is on the complications of providing science-based advice to collective decision making, either in cooperation with governments or in governance configurations that involve civil society and/or companies. It describes how scientific advice comes to be seen as useful, but also how science gets challenged in environmental controversies.

The book's insights and approach are based on the authors' many years of experience in interdisciplinary teaching and of working in professional environments between science and policy, combining social- and natural-science ways of thinking. All of our contributors have taught courses on environmental controversies or 'science in society' for natural scientists, or have tried to engage in the difficult conversation between social and natural science conceptions of environmental expertise. In fact, in our view, it is especially after some experience of working as a professional that environmental scientists and experts come to experience the limitations of throwing certified facts at society to make it do things. Pointing out the problems *ahead* of such experience, to students trained in laboratories and computer models alone, is both necessary and also much harder.

Our book tries to fill a gap we ourselves experienced when looking for reading material for these difficult courses. We wanted to combine the conceptual work that inspired our own research (and that is often very critical of the way the sciences are currently deployed) with practical advice on how to operate as an environmental science professional, but in ways that are sensitive to the academic criticism and conceptual contributions. Prominent among the conceptual inspiration are critical understandings in interpretative Policy Studies or Science

and Technology Studies (such as Flyvbjerg, 1998; Jasanoff, 2005; Scott, 1998; Wynne, 1996). This book complements and differs from Science and Technology Studies handbooks (e.g. Felt, Fouché, Miller, and Smith-Doerr, 2016; Sismondo, 2004; Yearley, 2005) by translating some of these insights specifically for communication with the natural sciences. We are well aware that this may have come at the expense of theoretical sophistication, but that is a risk we are willing to take for the benefit of wider application.

At the practical end of the spectrum, we also made use of more concrete instructions for environmental scientists. These include protocols or checklists for handling uncertainty (Halffman and Ragas, 2016; Petersen et al., 2013; Van Asselt, 2000; Van der Sluijs et al., 2004), for writing expert policy reports, for participating in expert committees, for organising expert advice (Commission of the European Communities, 2002; UK Government, 2005; Young, Watt, and Van den Hove, 2013), and even for how to address the media or position oneself with respect to policy makers (Pielke, 2007). We combined such practical instruction with the theoretical and conceptual rationale behind these instructions, as reflective practitioners should be able to derive their own principles, even in situations that are entirely new and for which there are no protocols (Schön, 1995).

As an educational text, the book is intended as an integrated package that builds on shared conceptual foundations in interpretative social sciences, comprising chapters describing specific issues or providing practical advice. It starts with a conceptual understanding of the nature of scientific and societal framing of problems, and the limitations of the attempt to rationalise the world in an instrumental way (Introduction and Chapter 2 on the nature of the sciences). From experience, we know that some students find these concerns too remote or abstract, in which case it may be useful to return to Chapters 2 and 3 at a later stage. The later chapters in the book focus on more specific issues, such as controversies, the challenges of creating 'integrated' knowledge, and the value of non-scientific forms of lay or local knowledge. Most chapters have at least one case study, providing more elaborate examples, illustrative practical experience, or deeper understanding of the material discussed in the main text. If used as a textbook, lecturers may wish to select the cases closest to their students' interests. We also plan to provide more such material on the book's website and facilitate the sharing of such material among its users. We should point out that the book provides course material, but does not impose a specific instructional method, such as problem-based learning, seminar discussions, or flipped classrooms. Hence, there are no schedules, study questions, or tests provided in the book, although such tools can be shared online. We would be very keen to hear about your experience of using the book and welcome suggestions for improvement.

Writing this book has been a long process, involving the efforts of many authors and reviewers. The idea for this book was born out of a Dutch Open University course, in which we were able to try out the approach and some of the materials. We would like to thank Joop de Kraker and Ron Cörvers of the Open University for the original assignment to develop a course. It had always been Joop's intention to develop a book related to the course, while Ron's original idea can be recognised in the book's approach: starting with problems, to the organisation of knowledge, via the individual role of experts, towards approaches to improved knowledge development. In addition, some of the original work of the Dutch Open University would not have been possible without the contributions of Bertien Broekhans. At the same time, this book takes an extra step from the original course text: all of the material was thoroughly rewritten and supplemented with extra case descriptions and chapters, to accommodate an international audience. We would also like to thank Dave Huitema of the Dutch Open University and Emma Kiddle of Cambridge University Press for convincing us to turn this into a book project. Special thanks also to Zoë Pruce for guiding us through the publication process. We further need to thank our patient friends and colleagues for continuing to enquire about the book's progress and for shaming us into its completion. We thank the Dutch Open University for allowing us to reuse Table 4.1 in Chapter 4 and parts of the text in Chapters 6 and 9, which draw on the original course materials.

We are grateful to the book's reviewers, Alan Irwin, Mark Reed, and Steve Yearley, along with colleagues who reviewed chapters or otherwise helped us along with suggestions and ideas, including Marjolein van Asselt, Rob Maas, Claire Marris, and Andrew Stirling. As editors, we thank the many patient authors who contributed case descriptions and editorial comments on the main text, and Jerry van Dijk for his support in preparing some of the images. Last, Willem Halffman would like to thank the Science, Technology and Innovation Studies unit and the Institute for Advanced Studies in the Humanities at Edinburgh University for their hospitality and stimulating environment during writing breaks in 2015 and 2016.

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# Abbreviations

| | |
|---|---|
| BGCI | Botanical Gardens Conservation International |
| BECCS | Bio-energy with carbon capture and storage |
| BEIS | Department for Business, Energy and Industrial Strategy |
| CBA | Cost–benefit analysis |
| CBD | Convention on Biological Diversity |
| CCS | Carbon dioxide capture and storage |
| CCVS | *Conservatoire des Collections Végétales Spécialisées* |
| CDM | Clean development mechanism |
| CERN | European Organization for Nuclear Research |
| CFCs | Chlorofluorocarbons |
| CIAM | Conventions' Centre for Integrated Assessment Modelling |
| CLRTAP | Convention on Long-range Trans-boundary Air Pollution |
| CUDOS | Communalism, Universalism, Disinterestedness, Organised Scepticism scientific norms |
| DECC | Department of Energy and Climate Change |
| DG | Directorate General (of the European Commission) |
| ECN | Energy Research Centre of the Netherlands |
| EIA | Environmental impact assessment |
| EMEP | Cooperative Program for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe |
| ETS | Emissions trading scheme |
| GM | Genetic modification |
| GMO | Genetically modified organism |
| GSPC | Global Strategy for Plant Conservation |
| IAMs | Integrated Assessment Models |
| IPBES | Intergovernmental Platform for Biodiversity and Ecosystem Services |

| | |
|---|---|
| IPCC | Intergovernmental Panel on Climate Change |
| LCP | Loweswater Care Project |
| LEK | Local ecological knowledge |
| LRTAP | Long-range transboundary air pollution |
| MA | Millennium Ecosystem Assessment or Millennium Assessment |
| MCA | Multi-criteria analysis |
| MNP | *Milieu en NatuurPlanbureau*, Netherlands Environmental Assessment Agency, now PBL |
| NGO | Non-governmental organisation |
| OPEC | Organisation for Petroleum Exporting Countries |
| PBL | *Plan Bureau voor de Leefomgeving*, Netherlands Environmental Assessment Agency |
| PLACE | Proprietary, local, commissioned, expert counter-norms |
| RAINS | Regional acidification information and simulation model |
| R&D | Research and development |
| RIVM | *Rijksinstituut voor Volksgezondheid en Milieu*, Netherlands National Institute for Public Health and the Environment |
| SPM | Summary for Policymakers |
| SRCCS | Special Report on Carbon Dioxide Capture and Storage |
| STS | Science and Technology Studies |
| TBG | Toronto Botanical Gardens |
| TEK | Traditional ecological knowledge |
| TFIAM | Task Force on Integrated Assessment Modelling |
| UN | United Nations |
| UNECE | United Nations Economic Commission for Europe |
| UNEP | United Nations Environment Programme |
| UNFCCC | United Nations Framework Convention on Climate Change |
| VOCs | Volatile organic compounds |
| WBGU | German Scientific Advisory Council for Global Environmental Change |
| WHO | World Health Organization |
| WMO | World Meteorological Organization |