This handbook applies to students starting the MSc (by coursework) in Water Science, Policy and Management in Michaelmas Term 2019. Most of the information applies also to those commencing the MPhil version of the course, although where different, the information in the separate MPhil handbook takes priority. The information in this handbook may be different for students starting in other years.

The Examination Regulations relating to this course are available at http://www.admin.ox.ac.uk/examregs/. If there is a conflict between information in this handbook and the Examination Regulations then you should follow the Examination Regulations.

If you have any concerns please contact Dr Lorraine Wild (Academic Administrator) via: Lorraine.wild@ouce.ox.ac.uk.

Disclaimer
The information in this handbook is accurate as at 1st October 2019, however it may be necessary for changes to be made in certain circumstances, as explained at www.graduate.ox.ac.uk/coursechanges. If such changes are made the department will publish a new version of this handbook together with a list of the changes and students will be informed.

MSc (by coursework) in Water Science, Policy and Management

2019: version 1.0

For the latest version of this handbook please see http://www.geog.ox.ac.uk/graduate/msc-wspm/handbook.html
Welcome to the School of Geography and the Environment

I am delighted to welcome you to the School of Geography and the Environment. The School consists of the Department of Geography and three associated research centres: the Environmental Change Institute, the Transport Studies Unit, and the Smith School of Enterprise and the Environment. Together, we are a unique hub in Oxford University for teaching and research on the interactions between people and environments. We aim to provide all our students – undergraduate, MSc, MPhil and DPhil – with the combination of social and natural science skills to engage effectively with the big challenges of the twenty-first century: from environmental change to globalisation; from philosophies of nature and society to biodiversity conservation; and from the frontiers of environmental science to the hard realities of public policy and corporate decision-making. The world-class quality of our research was recognised yet again in the latest national assessment exercise (REF 2014), and it underpins our teaching excellence. We believe that our learning environment will further hone your analytical and communication skills – with lifelong benefits to you and the contributions you will make to the wider world.

I hope that you will be very happy in the University of Oxford. I hope that you will flourish academically and personally. Within the School, I trust that you will become active participants and engaged with the many events and activities that we host. The collegiate University also offers a diverse and enriching series of opportunities to learn new skills, and I encourage you to make the most of what is on offer. And when you graduate, I very much hope you will become an active member of our global alumni community.

Gillian Rose, Professor of Human Geography
Head of the School of Geography and the Environment

... and to the International Graduate School

As Director of Graduate Studies (Taught Programmes), I am delighted to welcome you to the International Graduate School (IGS), within the School of Geography and the Environment.

The IGS is an intellectually demanding but supportive environment in which to study. We emphasise both independent and collaborative styles of working, providing a wealth of opportunities to engage in an energetic research and teaching culture through class discussions, seminars, reading groups, fieldwork and many other academic and social events. Gaining entry to our taught programmes is challenging and we therefore have great confidence that each of you brings something special to the cohort you are joining. I am sure you will be looking forward to getting to know your new classmates within the IGS and to tackling new challenges and new ideas within your chosen programme. I look forward to meeting you as your course progresses.

Jamie Lorimer, Associate Professor
Director of Graduates Studies (Taught Programmes)
… and, finally, to the MSc in Water Science, Policy and Management

A very warm welcome from the WSPM teaching staff.

Water is increasingly recognised as one of the defining global, national and local policy issues for economic growth, human development and environmental sustainability. The teaching staff provide some of the most authoritative scientists and practitioners working on these interdisciplinary issues at all levels around the world. This gives you an unprecedented opportunity to engage with enduring and emerging water research and practice challenges.

As you will read you have a packed schedule for the year ahead both in class, on field trips and through wider engagement with government, enterprise and NGOs who actively engage with the course. These activities will also give you the chance to engage with our diverse DPhil (PhD) community, many of whom are graduates of the WSPM programme; academics and researchers from across the Oxford Water Network; and our research partners and colleagues; all of whom who can further stimulate your thinking about the water security challenges and how you can help solve them throughout your career.

Professor Simon Dadson
Academic Director

Dr Jocelyne Hughes
Course Director
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1. INTRODUCTION

1.1. Course Introduction

This handbook provides an overview of the MSc in Water Science, Policy and Management (WSPM) course. The MSc in WSPM also serves as the first year (and qualifying examination) of the two year MPhil in Water Science, Policy and Management. MPhil students should also refer to the handbook for the MPhil course for the details of the MPhil examination conventions and the year two research thesis.

This handbook sets out the aims of the course, the content of the study programme and the various component parts of the course, including lectures, elective modules, seminars and dissertation. The booklet also contains important information about submitting coursework, guidelines for dissertations, attending examinations, and other aspects of course management. You should read through the handbook carefully and ensure that you understand your obligations throughout the course. We will provide you with more detailed material for particular parts of the course as appropriate during the year.

Most of all we would like to thank you for choosing to come to Oxford to study for the MSc in Water Science, Policy and Management. We hope that your year in Oxford will be a formative and memorable time. The 'core' WSPM team includes Dr Jocelyne Hughes (Course Director), Professor Simon Dadson (Academic Director), and Dr Faith Opio (MSc Co-ordinator with MSc in ECM). We are available to help you to get the most out of the course. The WSPM MSc is closely linked with the Oxford Water Network (www.water.ox.ac.uk), but draws on many aspects of research expertise in the School of Geography and the Environment, the Environmental Change Institute and the Smith School of Enterprise and the Environment, including research clusters on Climate Systems and Policy, Landscape Dynamics, and Economy and Society.

The course places great emphasis on the training and development of transferable professional and research skills in both the natural and social sciences to prepare students for advanced research careers, doctoral research and policy work in government, non-government and business organisations.

1.2. School of Geography and the Environment

The School of Geography and the Environment (SoGE), and its associated research institutes based in Oxford University Centre for the Environment (OUCE), is an internationally-recognised centre of excellence for environmental research and scholarship. The historical origins of SoGE lie in the former School of Geography, the first geography school to be established in Britain over 100 years ago by Halford Mackinder. The School was established through a co-operative effort involving the Royal Geographical Society and Oxford University. From these deep roots the School has grown and prospered. The ethos of SoGE is to promote research that is bold, innovative and challenging while remaining committed to the highest standards of scholarship.

Today, SoGE is one of the leading centres of scholarship for environmental and social change. It has been a leading global institution in developing cutting edge research not only in the UK, but around the world. SoGE is committed to training a new generation of graduate students in the core research fields of the environmental science and human
SoGE is home to the internationally recognised Environmental Change Institute (ECI) and other vibrant research hubs along with cross-departmental research groups, such as the Oxford Water Network. Creative combination of theory and practice provides a relevant and fertile training ground for our postgraduates. Our research programmes span the globe with researchers working in Africa, Asia, the Caribbean, and North America along with a strong record in European studies and, of course, the UK.

SoGE currently offers five thesis-based higher research degrees (DPhil and four MPhil courses) and four MSc courses:

- **MSc Biodiversity, Conservation and Management**
- **MSc Environmental Change and Management**
- **MSc Nature, Society and Environmental Governance**
- **MSc Water Science, Policy and Management**

The four MPhil programmes are two-year versions of the MSc programmes aimed at students who wish to have a substantial research component to their studies. In the first year, candidates take the coursework and examinations associated with one of the four MSc courses in the School of Geography and the Environment and in the second year, students devote most of their time to researching and writing a thesis of 30,000 words.

### 1.3. Transfer from MSc to MPhil

During the MSc course some students decide that they would like to extend their studies by transferring to the 2 year MPhil programme. In the first instance you should discuss the possibility of transferring with your Course Director. The deadline for making an application to transfer to the MPhil is Friday week 1 of Trinity Term. Applications should be submitted to Ruth Saxton, Research Degrees Coordinator (research-degrees-coordinator@ouce.ox.ac.uk). The application should include:

- an email of support from the agreed supervisor of your MPhil thesis (sent directly to Ruth Saxton by the deadline)
- a completed Change of Programme of Study form (GSO.28) signed by and approved by both your college and proposed dissertation supervisor.
- an MPhil dissertation proposal (to a maximum of 1000 words) outlining the context, aims, methods, and timetable of your proposed research.

All applications will be reviewed by a panel Chaired by the DGS (Taught Programmes) in early Trinity Term. Applications will be assessed on the basis of the academic performance of the applicant, the dissertation proposal, and any resource requirements from the School (including staffing and supervision resources). Applications will normally only be considered from students who have achieved at least 60% in their assessed essays from the two electives. Students will not be permitted to transfer to the MPhil if they do not pass all of their MSc examinations.
Final decisions on applications to transfer to the MPhil will only be confirmed after the meeting of the MPhil (Qualifying Examination) board in early July. The department retains the right to refuse a transfer. You should also note that your college will ask for evidence that you have the financial means to cover the fees and living expenses of the additional year of study.

1.4. Oxford Learning Environment

1.4.1. Learning Approach

During your time at Oxford you will experience a wide range of different formats and styles of teaching from small group discussions to field visits, and from traditional lectures to public talks by some of the world’s leading academics. In keeping with Oxford’s tradition of academic freedom, the exact nature of the learning experience within any particular tutorial, seminar or lecture is left to the discretion of the lecturer which, we hope, produces a dramatic variety of learning experiences. The most typical forum for teaching and learning remains the lecture complemented by workshops, class discussions, field work and laboratory work.

In the International Graduate School, we place strong emphasis on peer group and individual learning. Your peer group consists of exceptionally talented scholars from around the world, many of whom have practical experience or extensive knowledge of issues and topics that are covered during the MSc course. We strongly recommend that you form strong academic bonds with your peers and we encourage this with small group projects, reading groups and discussions.

There is an obligation on you as an individual to develop your own spheres of interest within the subject area and to work hard at identifying gaps in your knowledge and training. Oxford’s exceptional learning facilities provide unrivalled opportunities for individual learning, not to mention the array of international researchers and scholars who present their work at external lectures around the university. We urge you to take full advantage of all of these opportunities if you are to get the most out of your time at Oxford.

Staff members are available to advise students on reading, literature, and topics for individual modules. The course director can advise more generally on academic progress and assist where possible with individual academic queries. Colleges provide a personal advisor who can give additional pastoral, and in some cases, academic support.

Students should note the University guidelines on graduate students undertaking paid work: https://academic.admin.ox.ac.uk/policies/paid-word-guidelines-graduate-students

1.4.2. Feedback on Learning and Assessment

Throughout the year, there will be opportunities for informal feedback on your learning and understanding through class discussions, peer feedback on presentations and interactions with course staff. You will receive written and/or oral feedback on at least one piece of formative assessment for each elective and written feedback on your two summative elective essays. This feedback will focus on identifying the good points of your essay and give suggestions on how to improve the quality of your written work. You will also receive written feedback on your dissertation.
1.4.3. Monitoring Academic Progress
All students are assigned a supervisor for the duration of the course. Your supervisor will be responsible for monitoring your academic progress and each term your supervisor will complete a GSR report (Graduate Supervision Reporting). These reports will be read by the Course Director and the DGS (Taught Programmes). The GSR system also allows you to complete an evaluation of your own progress. Once you start work on your dissertation you will also be assigned a specialist dissertation supervisor.

1.4.4. Library and Learning Facilities
The Oxford University library system is extensive, with dozens of individual facilities around the city. The Social Science Library, which holds the Geography collections, will fulfil many of your needs, but over the course, you will also need to seek out books from other locations. A tutorial on using the library facilities will be provided during induction week. More information may be found at http://www.ox.ac.uk/libraries/

1.5. Canvas
Canvas is Oxford University’s Virtual Learning Environment. WSPM has its own space (rooms) where we post general course information along with lecture notes, reading lists and other materials specific to each module, workshop or field trip. https://canvas.ox.ac.uk/

1.5.1. IT Services
IT Services offer a wide range of Information Technology support including excellent training courses and a shop selling leading software at educational discount prices. http://www.it.ox.ac.uk/

1.6. Alumni Networks
The School of Geography and the Environment now runs active alumni networks. With over 1,000 Masters graduates as well as more than 5,000 thousand former geography undergraduates, this network is a growing source of professional contacts, knowledge, and advice. This includes over 350 WSPM alumni living and working all over the world, many of whom came back for our 15-year anniversary reunion in 2019.

You will be invited to become part of the alumni networks upon graduating. However, you can benefit from your own Masters network and the wider School network during your MSc year. For example, you can join the LinkedIn groups to get an idea of what alumni went on to do, find people to give you advice about internships or your dissertation, and attend networking events organised by SoGE.

For more information, please visit www.geog.ox.ac.uk/alumni/ or email the Alumni Relations Officer, Dr Christine Baro-Hone (alumni@ouce.ox.ac.uk). Alumni are always keen to hear what current students are up to – so do let the Alumni Relations Officer know about projects, field trips and events you think might be of interest to them.
2. COURSE INFORMATION

Master of Science in Water Science, Policy and Management
FHEQ level 7
Duration of course: 12 months

2.1. Aims/Objectives

Sustainable water management is an increasingly complex challenge and policy priority facing global society. Unprecedented climate, economic, technological and demographic change require a new generation of dedicated professionals who are committed to and trained in the interdisciplinary nature of water science, policy and management. The next generation of decision-makers will have to make increasingly challenging choices on water development, allocation and management issues at local, regional and international levels under conditions of increasing climate unpredictability and risk. Our programme is designed to provide a critical understanding of natural water science and the socio-economic, political, cultural and institutional environments within which water management decisions are made. The one-year course aims to equip the next generation with the blend of skills necessary to make a significant contribution to sustainable water management and pathways across competing priorities of water for ecosystems, food, energy, health, economic growth and human consumption.

The specific objectives of the MSc course include:

- To equip students with theoretical knowledge and applied skills necessary to make a significant contribution to water management at local, regional or global scales.
- To provide an advanced and integrated understanding of the scientific, legal, policy and political dimensions of water development, allocation and management.
- To foster a critical perspective and grounded understanding of issues relating to water development, use and access under considerations of extremes, equity and sustainability.
- To introduce students to transferable research skills necessary to undertake further advanced study by research at Oxford, or elsewhere.
- To enhance students’ personal and professional development, and their employment-related skills.

The intended learning outcomes are that students will develop a knowledge and understanding of:

- The physical, chemical and biological nature of water and their variations in time and space.
- The key concepts concerning nature and society in relation to water use and sustainability.
- Practical techniques for water resource assessment, monitoring and management.
- The key concepts concerning health issues associated with water.
- The key policy and legal approaches in water management, paying particular attention to the integration of theory and practice.
- The key research skills and methods of analysis for water management.
- Specialist topics consistent with candidate’s particular interests and the competency of the School.
2.2. Core Teaching Staff

This inter-disciplinary course is led by academics in SoGE, supported by experienced practitioners, all of whom have considerable national and international expertise (Appendix 1).

The core staff teaching on the course includes:

- Dr Jocelyne Hughes: Course Director, Departmental Lecturer
- Professor Simon Dadson: Academic Director, Professor of Hydrology
- Matilda Becker: Graduate Teaching Assistant
- Professor David Bradley: Distinguished Visiting Scholar
- Dr Katrina Charles: Associate Professor and Senior Research Fellow
- Dr Dustin Garrick: Associate Professor; Dept Research Lecturer in Environmental and Resource Management
- Dr Helen Gavin: Researcher, Environmental Change Institute (ECI) and Oxford Martin Programme
- Dr Michael Gilmont: Research Associate
- Professor David Grey: Visiting Professor of Water Policy
- Professor Jim Hall: Director of the Environmental Change Institute
- Dr Neil Hart: Departmental Lecturer in Physical Geography
- Professor Cameron Hepburn: Professor of Environmental Economics, Smith School of Enterprise and the Environment (SSEE)
- Professor Rob Hope: Professor of Water Policy and Director of the Water Programme, SSEE
- Dr Stefania Innocenti: Research Associate, Smith School of Enterprise and the Environment
- Dr David Johnstone: Distinguished Research Associate
- Bill Kingdom: WSPM Teaching Associate
- Dr Johanna Koehler: Researcher, Smith School of Enterprise and the Environment
- Dr Jack Longman: Laboratory Technician
- Dr Catharina Landström: Research Fellow
- Dr Linus Mattauch: Departmental Lecturer in the Economics of Environmental Change, ECI
- Dr Christine McCulloch: Visiting Research Associate
- Dr Catherine MacKenzie: Visiting Research Fellow and Dean of Degrees, Green Templeton College
- Dr Alex Money: Director, Innovative Infrastructure Investment Programme, SSEE
- Saskia Nowicki: Graduate Teaching Assistant
- Dr Homero Paltan: Research Associate
- Professor Edmund Penning-Rowsell OBE: Distinguished Research Associate
- Ben Piper: WSPM Teaching Associate
- Michael Rouse CBE: Distinguished Research Associate
- Dr Louise Slater: Associate Professor in Physical Geography
- Dr Pauline Smedley: Hydrogeochemist, British Geological Survey
- Dr Troy Sternberg: Research Fellow
- Dr Abi Stone: Lecturer in Physical Geography, University of Manchester
- Dr David Thomas: Process Engineer, Mott MacDonald Group
- Dr Kevin Wheeler: Research Associate, Environmental Change Institute
- Professor Paul Whitehead: Visiting Professor of Water Science
2.3. Course Description

The course is composed of eight core modules, two elective modules and a dissertation. Emphasis is placed throughout the course on critically and innovatively exploiting cross-disciplinary perspectives, outlooks and approaches between the taught components to provide a richer and more nuanced understanding of the integrated nature of water management. The mode of teaching is a combination of lectures, seminars, workshops, discussion/reading groups, computer and laboratory classes, and field-based activities.

The MSc course comprises:

- Seven core modules, which are assessed by written examination;
- Two elective modules, which are assessed through essays and/or coursework;
- A research dissertation;
- Research skills training;
- Workshops, seminars and field trips.

2.4. Course Structure

The course is structured around taught modules, elective modules, water security seminars and research skills with an independent dissertation project submitted by the first weekday in September of the year following matriculation.
2.5. Core Modules

A brief description of each of the three thematic areas and associated modules are given below. Full details on each module, lectures and reading lists can be found in Appendix 2.

2.5.1. Water Science

This thematic area develops knowledge and understanding in physical, chemical, ecological and epidemiological aspects of water science in temperate, tropical and semi-arid zones. It provides a foundation in basic processes in each key subject areas, as well as interactions throughout the hydrological cycle, the role of society in altering the ‘natural’ hydrological processes and function, and the impact this has on health.

Climate and Catchment Processes—The aim of the module is to provide an understanding of basic processes affecting the catchment hydrological cycle, and its variability: inputs, internal processes, and outputs. The module begins with a series of four lectures in Michaelmas term covering the principal features of the climate system, including an account of the general circulation of the atmosphere, catchment-scale climate drivers including precipitation and evaporation, key modes of climate variability such as El Niño and the North Atlantic Oscillation, and anthropogenic climate change. In Hilary Term, the focus switches to the physical hydrology of river catchments, including hillslope hydrology, channel hydrology, and groundwater flows. The module ends with two sessions that explore the ways in which models of climate and catchment processes can be used in decision making in the water sector.

Water Quality – This module investigates the chemical, geochemical and biological processes taking place within the hydrological cycle; water-rock interactions, aquatic ecology and ecological functions as well as the societal impacts affecting water quality. These relationships are all linked by water flows and reactions taking place at different rates within the cycle. An understanding of the processes and reactions in natural water systems is a necessary foundation for understanding human impacts on the hydrological cycle. Processes in surface and groundwater are closely linked and the introductory lectures stress the physicochemical and geochemical controls on the composition of natural waters. The subsequent lectures will highlight human impacts on the natural physical and ecological cycles. Topics covered include diffuse and point source contamination, including agricultural practices giving rise to eutrophication of surface waters and nitrate pollution which affects many groundwater sources, acidification from industrial emissions, and other pollution sources that are significant for both surface and groundwater. The module includes lectures on the influence of biogeochemical cycles on aquatic ecological processes, in rivers, lakes and wetlands.

Water and Health – Water plays a key part in the causation, transmission and prevention of many diseases as well as being essential for life and health. This core module explains the scale and nature of the health risks related to water, including domestic water use, waste water and sanitation, hygiene behaviour and water resource development. Its emphasis is on communicable diseases and their prevention by good water management. The epidemiology of the major water-related diseases will be taught in relation to a functional classification of these diseases. Rural and urban domestic water supplies are considered, both in tropical and temperate climates and in poor and rich societies, and the health problems related to both water access and water quality. The health effects of a range of water improvements are considered, and the methods of measuring these benefits critically examined. Sanitation, the disposal of human wastes, and hygiene behaviour are also dealt with. The range of diseases related
to surface waters and water resource developments are examined, together with their vectors and intermediate hosts, along with health impact and opportunity assessments, and interactions with conservation, and their environmental control. The module assumes no health background on the part of students. It therefore also teaches basic epidemiological principles (which are also of value beyond the health field), mainly through practical exercises in relation to water. Non-communicable diseases are introduced. By the end of the course, participants should have sufficient understanding of health issues in relation to water that they can ask appropriate questions on human health of any project they undertake, can critically read expert reports that they may commission; have a sense of the work involved in dealing with any health-related problem they encounter; and have a good basis for more specialized study if they wish to pursue health and water issues further.

2.5.2. Water and Society
This thematic area explores how contested domains of power, interests and knowledge influence water decision-making, illustrated through institutional, socio-economic and policy analysis. This covers areas of water security and governance, water services regulation, transboundary water, water access, ownership and rights, water for development, and interactions between the state and civil society within dynamic and varied political, cultural, social and economic contexts.

Water Policy – This module explores water policy providing an introduction to theory, methods and practice drawing upon case studies from around the world. The first three classes introduce key concepts around policy, politics and institutional analysis. The following five classes explore the translation of policy into thematic domains applicable in the global context, including Human Rights, Property Rights, Decentralisation, Competition, Social Choice and Evaluation. The overall learning outcome of the module is to provide students with the skills and knowledge to understand, interpret and evaluate policy from design to implementation to evaluation.

Institutional Governance and Regulation – The objective of this module is to provide an understanding of the elements of institutional governance and regulation which are necessary for the delivery of effective, efficient and sustainable water supply and sanitation services. There is exploration of critical governance policy matters such as separation of policy and delivery functions, roles and responsibilities of stakeholders and centralisation/decentralisation issues. There is discussion on myths and barriers to progress such as the emotive arguments on public or private provision of services. The module shows various public and private structures all of which can succeed if essential elements are in place, and all can fail if those essential elements are missing. Emphasis is given to sustainable cost recovery and failures of subsidies. Water is a capital intensive industry and approaches to financing major infrastructure development are considered. Examples of transparency and public involvement are given in the context of a participation structure with examples of community systems. Approaches to economic and quality regulation and regulatory bodies are considered. Drinking water safety and regulation is explored, as is sanitation safety, with emphasis on the management of risk. Approaches and standards related to environmental water quality are given. The module draws on experience from around the world on what has worked well and what has contributed to failures. Generally, the elements and principles apply equally to developed and developing countries, but the module considers circumstances where the requirements are different.
Economics of the Environment – This module will introduce economic frameworks, methods and tools to understand and address water management and sustainable development challenges. WSPM students will identify the main trends and debates related to the economics of environmental and water management in a logical and systematic way; acquire practical experience with methodologies for policy analysis, instrument design and evaluation; and learn to combine economics with other approaches in natural, social and engineering sciences. The module will be organised in two phases. Phase I covers the foundations of economics and the environment, examining markets and market failure, property rights and market-based instruments for addressing environmental and water management challenges. Phase II of the module shifts from foundations to applications, organising the students into specialised tracks tailored to each MSc. WSPM students will critically assess the application of economic theory to a range of water management challenges, including valuing water, pricing water and impact evaluation. Students will conclude by examining the degree to which water policy can be empirically measured using impact evaluation techniques. By the end of the module, students should have a critical understanding of how economic instruments differ from regulatory approaches, be familiar with a broad range of economic techniques and how they can be applied in the water sector, and be in a position to evaluate economic theory and evidence employed in the design and performance of policy directed to water resources and water services.

2.5.3. Water Management
This thematic area helps students to integrate the knowledge and understanding of water developed in the other thematic areas to better enable them to tackle the big water management challenges that we face. Geographic case studies are developed in the Water Security Case Studies sessions to compare the trade-offs that occur between science and society in these contexts. Interactions with experts with different perspectives and expertise will help students to understand the challenges faced by water managers. The module is taught via workshops, seminars, and fieldtrips to a variety of locations in the UK and overseas.

2.6. Elective Modules
Elective Modules offer a small-group, tutorial-style teaching and discussion environment, based on a suite of contemporary research themes that reflect the specific interests of core faculty and visiting research associates. Each student has the opportunity to identify elective modules of particular interest, though the selection process will be made through committee at the start of term. As such, the teaching aim is to foster discussion and debate between academic staff and students to identify and explore theory, methods and practice in an academic space that encourages a critical dialectic.

Students will be required to read and present work to the group throughout the term. Assessment will be by an essay of up to 4,000 words. For details of submission of elective essays see: https://intranet.ouce.ox.ac.uk/msc/submission/electives.html

There is a separate handbook that provides outlines of available elective modules in SoGE for the forthcoming year. Please note, however, that module details may change at short notice due to changes in staff availability.
2.7. Research Design and Skills

In order to equip students with the necessary skills to undertake high quality research, a suite of lectures and training activities are provided within the Research Design and Skills module. These include a linked number of Research Skills sessions where students can acquire the approaches and techniques they need to undertake their own dissertation research. The aim is to develop key transferable skills in order for students to execute high quality independent and original research, and expose students to applied research methods used widely in academic and professional research. Core faculty staff will lead a series of training sessions that will build core transferable skills in the natural and social sciences. Components may include: research ethics, academic writing, research design, hydrological modelling, water quality evaluation, and qualitative and quantitative research methods. The skills training will both focus on strengthening capabilities to conduct high quality research for their dissertation and for their future professional development.

2.8. Dissertation

With the support provided by the Research Design and Skills training, students will be in a position to undertake an independent and original research dissertation, despite many students never having completed an extended piece of independent and original research before the course. The dissertation is an integral and formal part of the course, and completing a good dissertation is essential for further research study in SoGE leading to the degree of D.Phil.

The dissertation gives you the opportunity to design and execute your own research. The choice of research topic is up to you, but it normally relates to one or more of the core or elective modules, or the research interests of one of the School of Geography staff. A supervisor will be appointed to guide you during this work, the bulk of which will be carried out after the examinations are over, and will be handed in on the first weekday of September.

Each student may have up to eight hours of supervision from their appointed supervisor.

It is expected that the best dissertations will be of publication quality, and all should show originality and creative scholarship. It is acceptable to submit the work in the form of a journal paper ready for submission. This should be discussed with your dissertation supervisor. All dissertations will be judged on the degree to which they fulfil the criteria of a comprehensive and coherent treatment of a suitable research question in an analytical and critical manner.

2.9. Fieldwork

Fieldwork is a significant and core element of the programme’s teaching philosophy. Each year there are a number of compulsory residential and one-day field trips that allow students to implement and gain practical experience in different areas of water management based on taught skills and techniques. As the fieldwork takes place in a range of unpredictable climates, students are encouraged to pay attention to pre-course information that details what they should bring to Oxford.
The induction field trip is a compulsory field course ahead of the International Graduate School induction programme. The trip will introduce the course and some core teaching staff and illustrate water management issues around the Swanage area of Dorset on the southern coast of England.

There will be a residential field trip to the Ebro Basin in northern Spain from the Pyrenean mountain source of the Ebro River to its delta region, south of Barcelona. Like many semi-arid countries, Spain has many conflicting demands on its increasingly scarce and unevenly distributed water resources. Aspects of current policy will be reviewed at various points down the river illustrating the political, social and scientific narratives and debates involved in water management. The field course will take a problem-based approach, allowing students to gain a deeper understanding of several aspects of water resource management and policy.

Field notebooks should be kept for all field work on the course and may be used as part of the assessment in exceptional circumstances.

The costs of all compulsory fieldtrips are covered by the department, although if students wish to stay at the destination after the fieldtrip they will have to pay for the costs of their return fare.

2.10. Induction

All new postgraduates are expected to attend a full-time orientation and induction programme in the week before term commences in Michaelmas Term. The purpose of this orientation is to provide an opportunity to lay out the structure and expectations of the programme in an informal setting. The first half of the induction programme comprises, among others, an introduction to SoGE, its component centres, and its facilities. It also introduces and explains the training and research programme, institutional and organisational procedures, the aims, objectives, structure, outline, and assessment methods of the course, and the key expectations and responsibilities of the students. Information about supervision arrangements is provided. In addition, specialist induction to library and database resources, electronic databases and Internet facilities, GIS and mapping, and the use of available equipment and facilities is provided.

The second half of the induction is organised by the student’s respective Colleges and includes induction and information concerning College facilities and arrangements, College computing and internet access, university affairs, and the like.

2.11. Health and Safety

Safety information for fieldwork, laboratory and working in SoGE is detailed on the website. You must read this section at the start of the course: [https://intranet.ouce.ox.ac.uk/dept/house-rules.html](https://intranet.ouce.ox.ac.uk/dept/house-rules.html)
3. ASSESSMENT

3.1. University Examinations

The procedure for entering for University examinations is explained on the University website: http://www.ox.ac.uk/students/academic/exams/entry. If you have any questions about your entry for the examinations or requesting alternative examination arrangements, you should contact the academic office at your college.

The examination timetable will be confirmed no less than five weeks before the examination. The provisional dates for the examinations are in Week 4 of Trinity Term. Once they are confirmed, the examination timetables may be found at: http://www.ox.ac.uk/students/academic/exams/timetables

Information on (a) the standards of conduct expected in examinations and (b) what to do if you would like examiners to be aware of any factors that may have affected your performance before or during an examination (such as illness, accident or bereavement) are available on the Oxford Students website: http://www.ox.ac.uk/students/academic/exams/guidance

The Examiners Reports on the previous year’s examination may be found at: https://intranet.ouce.ox.ac.uk/msc/

3.2. The Exam Board

The University appoints an exam board comprising three or four members of faculty and an external examiner. The current Chair of MSc in Water Science, Policy and Management is Professor Simon Dadson. The exam board is responsible for ensuring that the examinations are conducted fairly and according to University regulations. The board of examiners may be assisted in setting and marking assessed elements of the course by other internal staff members who are termed assessors.

The external examiner is a senior academic from a reputable external academic institution whose role is to verify the quality of the examination materials, advise the MSc course team on course content, and sit on the final examination board. The current External Examiner of the MSc in Water Science, Policy and Management is Professor Jamie Bartram (University of North Carolina). The external examiner has the right and the duty to modify marks if she or he sees fit.

Students are strictly prohibited from contacting external examiners directly. If you are unhappy with an aspect of your assessment you may make a complaint or appeal (see section on Complaints and Appeals).

3.3. Examinations Conventions

Examination conventions are the formal record of the specific assessment standards for the course or courses to which they apply. They set out how your examined work will be marked and how the resulting marks will be used to
arrive at a final result and classification of your award. They include information on: marking scales, marking and classification criteria, scaling of marks, progression, resits, use of *viva voce* examinations, penalties for late submission, and penalties for over-length work.

The Examination Conventions for this course may be found at: [https://intranet.ouce.ox.ac.uk/msc/examination-conventions/](https://intranet.ouce.ox.ac.uk/msc/examination-conventions/)

These conventions are the definitive version to apply to examinations in 2020.

4. **ASSESSMENT COMPONENTS**

4.1. **Written Examination**

Core courses will be examined by means of three three-hour written examinations in Trinity Term. These examinations are designed to determine the student’s critical understanding and knowledge of the range of issues covered, and also provide opportunity for students to display the results of their individual study, and use information gained from field courses and seminar series.

For ease of reference, the official course Schedule provides the following examination rubric:

**(a) Core courses**

The core courses will be examined under the following heads:

1. **Water Science**
   Candidates will be expected to have knowledge and a critical understanding of the physical, chemical and biological processes, and interactions across the hydrological cycle at the global, basin/catchment and hillslope scale, of the relationship of water to health and disease, and of the engineering and technological solutions to water supply and sanitation.

2. **Water and Society**
   Candidates will be expected to have knowledge and a critical understanding of the arguments and issues related to the legal, social, political and institutional dimensions of water decision-making, along with the economic approaches, modelling tools and analysis techniques that can be used to support policy.

3. **Water Management**
   Candidates will be expected to have knowledge and a critical understanding of the relevant debates and issues concerning water management.

**(b) Elective courses**

Candidates will be expected to show advanced knowledge of two of the elective courses on offer in any year.
4.2. Elective Modules

Elective courses: candidates will be expected to show advanced knowledge of two of the option elective courses on offer in any one year.

Students are required to submit written essays (of no more than 4,000 words plus 150-word abstract) on two elective courses, no later than 12 noon on the first Monday of the following term after which the elective module was taken (i.e. a Michaelmas elective module requires submission on the first Monday of Hilary Term).

Full details on the required format and how to submit the elective essays can be found at: https://intranet.ouce.ox.ac.uk/msc/submission/electives.html

4.3. Dissertation

You must submit a proposal to the Water Science, Policy and Management MSc Course Director before the end of Hilary Term in the year in which you enter the examination, the title and details of your dissertation as set out in the proposal template, together with the name of a person who has agreed to act as your supervisor during preparation of the dissertation.

While many dissertations are submitted in a traditional thesis format (e.g. a series of chapters covering introduction, literature review, methods, results, discussion), it is also permissible to submit a dissertation in journal paper format, prepared as if for submission to a specified international journal. Students should discuss this option with their supervisor. All ‘paper format’ dissertations should contain at least two separate sections:

a) an academic paper in the appropriate format for submission to an international journal, where students should follow the published ‘Instructions for Authors’ for the journal in question and should prepare the paper according to the exact requirements of submission to that journal, including a copy of those instructions bound in as an appendix to the thesis; and

b) up to 7,000 words framing the content of the academic paper, potentially including research questions, further literature review, discussion of methods and results. This can be divided into sections before and after the paper to promote a logical flow and reduce repetition.

The total text of the entire dissertation (as defined above) should not exceed 15,000 words.

Full details on the required format and how to submit the dissertation can be found at: https://intranet.ouce.ox.ac.uk/msc/
4.4. Submission Deadlines

The deadlines for handing in assessed course work are as follows:

**Elective Module Essays:**
Michaelmas Term essay: 1st Monday of Hilary Term by 12 noon (Monday 19th January 2020)
Hilary Term essay: 1st Monday of Trinity Term by 12 noon (Monday 27th April 2020)

Note: There are no elective modules in Trinity Term.

**Research Dissertation:**
By 12 noon on first weekday of September (Tuesday 1st September 2020)

4.5. Good Academic Practice and Avoiding Plagiarism

Plagiarism is presenting someone else’s work or ideas as your own, with or without their consent, by incorporating it into your work without full acknowledgement. All published and unpublished material, whether in manuscript, printed or electronic form, is covered under this definition. Plagiarism may be intentional or reckless, or unintentional. Under the regulations for examinations, intentional or reckless plagiarism is a disciplinary offence. Please see the University guidelines: [http://www.ox.ac.uk/students/academic/guidance/skills/plagiarism](http://www.ox.ac.uk/students/academic/guidance/skills/plagiarism)

Oxford University imposes severe sanctions for cases of plagiarism. In the most extreme case, a student will be judged to have failed the course. These regulations are imposed by the University and if a student is suspected of plagiarism the matter is likely to pass to the Proctors who will rule on the matter independently of SoGE. We expect students enrolled at Oxford to exhibit the highest standards of academic integrity and not knowingly submit any work or intellectual ideas that have been adapted from or copied from a third-party source without appropriate recognition (see below). In addition, we expect all assessed work you submit to represent new and original writing conducted during your relevant terms in Oxford. It is not acceptable to re-package essays presented for degrees elsewhere (i.e. self-plagiarism). Students found suspected of plagiarism will be referred to the Proctors and if plagiarism is confirmed, the student may be failed. Any Proctoral investigation might delay the publication of a candidate’s results and graduation.

During Michaelmas term we will discuss these rules and expectations regarding plagiarism. You will be required to complete the University’s on-line course on the topic and sign a ‘plagiarism declaration’ form which accompanies each piece of submitted assessed work.

4.6. Course Governance and Student Representation

4.6.1. Graduate Teaching and Examinations Committee
Graduate Teaching and Examinations Committee (GTEC), chaired by the Director of Graduate Studies (Taught Programmes), defines the strategic direction of MSc provision in line with SoGE’s evolving academic strategy. It is responsible for coordinating academic programmes, staffing and timetabling across all four courses. It receives and considers the minutes of course team meetings, examiners reports and student assessments in preparation for
Divisional scrutiny. It discusses and proposes amendments to assessment regulations for approval by higher committees as appropriate.

4.6.2. Student Representation: Joint Consultative Committee
At the start of the course the WSPM student group elects two of their members to serve as representatives on the Joint Consultative Committee (JCC) which meets each term. If you have any comments or concerns you should pass these on to your representatives who will raise them with the Course Team at the JCC meeting.

4.6.3. Feedback and Concerns
Our courses are constantly being adjusted in response to changes in the discipline and student feedback. We welcome your constructive feedback and have a number of avenues through which you can contribute feedback. You can also use these avenues to raise any concerns that you might have; we will seek to resolve these as quickly as possible. You can:

- Provide feedback and ask questions during weekly class meetings;
- Speak with your Course Director or Academic Director during his/her weekly office hours;
- Provide feedback or raise concerns via your class representatives;
- Ensure that at the end of each term you complete the feedback on each module course as well as field-trips and workshops.

This feedback, along with any concerns, will be discussed at the termly Joint Consultative Committee (JCC) for your course. The minutes of the JCC and the module feedback are then considered by the relevant Course Team and by GTEC (on which there is student representation).

Students on full-time and part-time matriculated courses are surveyed once per year on all aspects of their course (learning, living, pastoral support, college) through the Student Barometer. Previous results can be viewed by students, staff and the general public at: https://www.ox.ac.uk/students/life/student-engagement?wssl=1

4.7. Complaints and Academic Appeals within SoGE

The University, the Social Sciences Division and the School of Geography and the Environment all hope that provision made for students at all stages of their course of study will result in no need for complaints (about that provision) or appeals (against the outcomes of any form of assessment).

Where such a need arises, an informal discussion with the person immediately responsible for the issue that you wish to complain about (and who may not be one of the individuals identified below) is often the simplest way to achieve a satisfactory resolution.

Many sources of advice are available from colleges, faculties/departments and bodies like the Counselling Service or the OUSU Student Advice Service, which have extensive experience in advising students. You may wish to take advice from one of those sources before pursuing your complaint.
General areas of concern about provision affecting students as a whole should be raised through Joint Consultative Committees or via student representation on the faculty/department’s committees.

4.7.1 Complaints
If your concern or complaint relates to teaching or other provision made by the faculty/department, then you should raise it with the Director of Graduate Studies, Dr Jamie Lorimer. Complaints about departmental facilities should be made to the Departmental Administrator, Richard Holden. If you feel unable to approach one of those individuals, you may contact the Head of School, Professor Gillian Rose. The officer concerned will attempt to resolve your concern/complaint informally.

If you are dissatisfied with the outcome, you may take your concern further by making a formal complaint to the Proctors under the University Student Complaints Procedure: https://www.ox.ac.uk/students/academic/complaints

If your concern or complaint relates to teaching or other provision made by your college, you should raise it either with your tutor or with one of the college officers, Senior Tutor, Tutor for Graduates. Your college will also be able to explain how to take your complaint further if you are dissatisfied with the outcome of its consideration.

4.7.2 Academic Appeals
An academic appeal is an appeal against the decision of an academic body (e.g. boards of examiners, transfer and confirmation decisions etc.), on grounds such as procedural error or evidence of bias. There is no right of appeal against academic judgement.

If you have any concerns about your assessment process or outcome it is advisable to discuss these first informally with your subject or college tutor, Senior Tutor, course director, director of studies, supervisor or college or departmental administrator as appropriate. They will be able to explain the assessment process that was undertaken and may be able to address your concerns. Queries must not be raised directly with the examiners.

If you still have concerns you can make a formal appeal to the Proctors who will consider appeals under the University Academic Appeals Procedure: https://www.ox.ac.uk/students/academic/complaints

4.8. If You Need Help
If you find yourself facing a problem during your course of study you can seek advice and support from various sources in the University. Generally, the department is best qualified to help you navigate problems relating to the academic content of the course and your college is best qualified to provide support and advice relating to health or personal problems.

Every college has their own systems of support for students, please refer to your College handbook or website for more information on who to contact and what support is available through your college. Details of the wide range of sources of support available more widely in the University are available from the Oxford Students website, including in relation to mental and physical health and disability: http://www.ox.ac.uk/students/welfare
4.9. Links to Key Documents and Resources

The following are some useful links:

**Department Intranet.** The department’s intranet pages contain much information on members of staff, Health & Safety, House Rules and so on. [https://intranet.ouce.ox.ac.uk/msc/index.html](https://intranet.ouce.ox.ac.uk/msc/index.html)

**Canvas.** This is our virtual learning environment and a key learning resource. Follow the link via the WSPM home page: [https://canvas.ox.ac.uk/](https://canvas.ox.ac.uk/)

**Past Exam Papers are available from OXAM:** [https://weblearn.ox.ac.uk/portal/site/oxam](https://weblearn.ox.ac.uk/portal/site/oxam)

**The Central University Research Ethics Committee web site** ([http://www.admin.ox.ac.uk/curec/](http://www.admin.ox.ac.uk/curec/)) provides essential information on the University’s policy concerning the ethical review of research projects involving human participants or personal data, undertaken by staff and students, or on University premises. The form you must complete and have approved before conducting such research is available at: [http://www.admin.ox.ac.uk/curec/oxonly/checklistsandapplicationform/](http://www.admin.ox.ac.uk/curec/oxonly/checklistsandapplicationform/)

**Field Work Behaviour and Safety.** The forms you must complete before leaving for field work are available on the School’s intranet at: [https://intranet.ouce.ox.ac.uk/safety/fieldwork.html](https://intranet.ouce.ox.ac.uk/safety/fieldwork.html)

4.10. Key Departmental Contacts

- Course Coordinator: Dr Faith Opio
- Course Director: Dr Jocelyne Hughes
- Academic Director: Professor Simon Dadson
- DGS (Taught Programmes): Dr Jamie Lorimer
- Academic Administrator: Dr Lorraine Wild
- Head of Administration and Finance: Richard Holden
- Disabilities Officer: Claire Hann

4.11. Key Dates

4.11.1. Term dates

<table>
<thead>
<tr>
<th>Induction field trip 2019</th>
<th>Thursday 3 October</th>
<th>Saturday, 5 October</th>
</tr>
</thead>
<tbody>
<tr>
<td>Michaelmas 2019</td>
<td>Sunday, 13 October</td>
<td>Saturday, 7 December</td>
</tr>
<tr>
<td>Hilary 2020</td>
<td>Sunday, 19 January</td>
<td>Saturday, 14 March</td>
</tr>
<tr>
<td>Ebro field trip 2020</td>
<td>Sunday, 15 March</td>
<td>Saturday, 21 March</td>
</tr>
<tr>
<td>Trinity 2020</td>
<td>Sunday, 26 April</td>
<td>Saturday, 20 June</td>
</tr>
</tbody>
</table>
4.11.2. Assessment Dates

- 1st elective submission: first Monday of Hilary Term
- 2nd elective submission: first Monday of Trinity Term
- Dissertation submission: 1st September 2020
- Provisional dates for examinations: Week 4 in Trinity Term
Appendix 1: TEACHING STAFF

Core Teaching Staff

**Professor David Bradley** is Ross Professor of Tropical Hygiene Emeritus at the London School of Hygiene and Tropical Medicine and a Distinguished Visiting Scholar at OUCE. He is a physician, communicable disease epidemiologist and zoologist. After studies at Cambridge and London he lived and worked in East Africa - Tanzania and Uganda - for ten years and has continued to carry out research there, also in India, Bangladesh, Philippines, Sierra Leone, Kenya, and the UK as well as making shorter working visits to many other countries. After initial work on community pathogenesis, epidemiology and the public health importance of schistosomiasis he worked on domestic water supply and health in East Africa, on *Mycobacterium ulcerans*, and the theoretical basis of tropical public health. He devised the now generally adopted functional classification of water-related diseases. His current work is on WASH in relation to health in Africa, small water bodies in the UK, and WASH policy. He has advised the WHO, DFID, the World Bank, and ICDDR,B on public health and research policy. He was President of the Royal Society of Tropical Medicine and Hygiene and has an Honorary DSc from the University of Leicester. Contact email: david.bradley@zoo.ox.ac.uk

**Dr Katrina Charles** is an Associate Professor and Senior Research Fellow in Water Security in SoGE. Her research encompasses a range of cross-disciplinary approaches to understanding and improving water security for the poor. She is active in research in Asia and Sub-Saharan Africa. Dr Charles is the co-director of the REACH Improving Water Security for the Poor programme, which addresses water security challenges in Kenya, Ethiopia and Bangladesh. Katrina trained as an Environmental Engineer in Australia, before undertaking her PhD on a risk-based approach to management of decentralised wastewater treatment systems in Sydney’s drinking water catchments.

**Professor Simon Dadson (Academic Director)** is Hydro-JULES Programme Leader at the Centre for Ecology and Hydrology and Professor of Hydrology at the University of Oxford. His research focuses on the processes that link climate, hydrology, and geomorphology. These links range from the potential impacts of future climate change on river flows, to the study of how continental-scale weather patterns have influenced the development of mountain topography over the past few million years. Simon has published widely in leading scientific journals such as Nature, Science, Geophysical Research Letters, Proceedings of the Royal Society, and Water Resources Research.

**Dr Dustin Garrick** is an Associate Professor and Departmental Research Lecturer in Environmental and Resource Management at the Smith School of Enterprise and the Environment. His work examines policies, institutions and incentives addressing water scarcity and climate variability in stressed river basins. In his recent book, Water Allocation in Rivers under Pressure, he advances theory and evidence on property rights and resource allocation, working across multiple research traditions, including the commons, political economy and risk science. He recently served on the Global Water Partnership / OECD task force on Water Security and Sustainable Growth and is active on a number of international and comparative water policy and economic projects. Prior to joining Oxford (July 2016), Dr Garrick was Philomathia Chair of Water Policy at McMaster University, Postdoctoral Research Fellow in Water Security at University of Oxford (2011-13) and a Fulbright Scholar (2010-11) in Australia, where he remains a Research Associate of the Centre for Water Economics, Environment and Policy at Australian National University.
Dr Helen Gavin MCIWEM, C.WEM, C.Env, C.Sci, is a water resources and sustainability professional, passionate about water resources and renewable energy. Following a PhD in wetland hydrology, Helen became a Chartered Environmental Scientist, and has more than 18 years of professional experience in quantitative environmental issues spanning water resources, hydro-ecology, greenhouse gas emissions, environmental management, and renewable energy. She has held a range of roles including technical specialist, water and energy auditor, and programme manager. Recently, she has been working with the Water Resources in the South East alliance; as a Principal Environmental Scientist for the engineering consulting firm, Atkins; and at the University of Oxford on a £2M multidisciplinary research programme evaluating the risk and impact of drought and water scarcity in the UK.

Professor David Grey has 35 years of experience in multi-sector water management and development and has worked in over 60 countries. He has been staff of the World Bank for 26 years, most recently as Senior Water Advisor, a role which included oversight of the Bank’s global water resources agenda and chairmanship of the Bank’s Water Resources Management Group. His current research interests are in: the roles that water insecurity plays in poverty, environmental degradation and dispute, and water security plays in growth and stability; the role that benefit sharing can play in resolving inter-jurisdictional disputes over water at all levels; and the risks that climate and other change mean for water security, livelihoods and environmental sustainability. He has a long-term interest in the institutional and incentive structures for improving the performance of water management and water service delivery.

Dr Neil Hart is a Departmental Lecturer in Physical Geography. Neil completed a PhD at the University of Cape Town before carrying out postdoctoral research at the University of Reading and University of Oxford on North Atlantic sting-jet wind storms and African climate extremes. This research is helping to answer the big question of whether the subtropics are likely to experience desertification in coming decades. Much of his current research is focused on southern Africa and involves collaborations with climatologists, oceanographers, and hydrologists in the UK and across Africa.

Professor Cameron Hepburn is Director of the Smith School and an expert in environmental, resource and energy economics. He is a Professor of Environmental Economics at the Smith School and at the Institute for New Economic Thinking at the Oxford Martin School, and is also Professorial Research Fellow at the Grantham Research Institute at the London School of Economics and a Fellow at New College, Oxford. He is involved in policy formation, including as a member of the DECC Secretary of State’s Economics Advisory Group; and had an entrepreneurial career, co-founding two successful businesses and investing in several other start-ups. Cameron graduated in law and chemical engineering from the University of Melbourne; and an MPhil and DPhil in economics from the University of Oxford.

Professor Rob Hope is Professor of Water Policy in SoGE, and the Director of the Smith School Water Programme and Programme Director of REACH (http://www.reachwater.org.uk/). He is a development economist whose research examines the relationship between water and development. His research focuses on understanding trade-offs, choices and outcomes in balancing water security, economic growth and human development. A portfolio of research projects are structured around two themes: 1) Water Security, Growth and Development, and 2) Smart Water Systems. The latter is a cross-departmental research group working on the design, testing and evaluation of novel applications of mobile communications technologies for water security and poverty reduction in developing countries.
Dr Jocelyne Hughes (Course Director) gained her first degree in geography from the University of Cambridge and was awarded a Commonwealth Scholarship to conduct her PhD on riverine plant ecology and hydrology at the University of Tasmania. Her current research is investigating plant-water relationships at Marley Fen in Wytham Woods; the ecological functionality of a floating reedbed at Farmoor Reservoir; and the geography of invasive non-native freshwater amphipods. She has edited *Freshwater Ecology & Conservation: Approaches & Techniques*, Oxford University Press, 2019. Jocelyne has conducted research on the ecology, hydrology and conservation of wetlands in Australia, Antarctica, Tunisia, Guatemala and the UK. She has held university lectureships at the University of Melbourne and University of Reading, and has worked in the Oxford University Department for Continuing Education where she directed an online postgraduate programme in Ecological Survey Techniques. She was joint holder of an Oxford IT Innovation Award in 2016-17 to develop the *Activity Browser* which showcases Oxford-created digital teaching resources; member of the 2017 student-led Oxford IT Innovation Award to develop *VESPA* (Virtual Environments Sampling Platform); and recipient of an OUSU Teaching Award in 2018.

Dr Stefania Innocenti is a Research Associate at the Smith School of Enterprise and the Environment (SSEE) at the University of Oxford. Her work clarifies the role of bounded rationality, self-views, and individual and collective learning as possible drivers of, or impediments to, institutional change and its impact on economic outcomes. Her interest includes behavioural economics, institutional economics, applied econometrics, development economics, mathematical and computational models of social interactions. Prior to joining SSEE, Stefania earned her Ph.D in economics from Maastricht University. She also worked at the European University Institute, University of Florence, UN International Labour Office in Geneva and at the Italian Ministry of Economics and Finance.

Dr David Johnstone has 50 years of practical experience in the water and wastewater sector in the UK and overseas in over 30 countries, particularly in Latin America, South East Asia and the Middle East. He originally trained as a chemist, with a PhD in Physical Chemistry. In his career he worked with Thames Water Authority, Sir William Halcrow and Partners, and the Water Research Centre before becoming an independent consultant. He has worked on the strengthening of the operational and managerial capacity of developing world water utilities. He served as Consultant to the United Nation’s Taskforce on Wastewater contributing to the establishment of a Sustainable Development Goal for Water to replace the Millennium Development Goal for Water and Sanitation which expired in 2015. Dr Johnstone is a Member of the Court of the “Worshipful Company of Water Conservators”.

Dr Johanna Koehler is Research Associate and Programme Manager of the Water Programme at the Smith School of Enterprise and the Environment, University of Oxford. Her research examines the interplay of water risks and institutional change in terms of political and institutional transformations in the water sector as well as new market-based water service delivery models emerging across sub-Saharan Africa. Specifically, Dr Koehler investigates how risks and responsibilities can be re-conceptualised and re-allocated in pluralist arrangements between the state, market, and communities. She has conducted extensive fieldwork in East Africa. Her work as part of the Smith School Water Programme has also contributed to developing a business model for maintaining drinking water infrastructure in marginalised areas of Kenya. She holds a DPhil in Geography and the Environment from the University of Oxford, an MSc in Water Science, Policy and Management from the University of Oxford and previously worked at the United Nations Office in Geneva. In 2018 she was joint winner as part of the Smart Water Systems group of the inaugural University of Oxford’s Vice Chancellor’s Innovation Award.
Bill Kingdom, Member of the Institution of Civil Engineers, has a 20-year career in the World Bank’s Water Global Practice where he was the Global Lead directing the Bank’s knowledge agenda for water supply and sanitation. Prior to joining the World Bank he spent 10 years as a management consultant and a similar period as a consulting engineer – working in the water sector in South and East Asia, the Middle East, UK, USA, Canada, and Southern Africa. Taken together this has provided him with a unique perspective on the theory and practice of delivering water and sanitation (WSS) services around the globe. He has led projects to improve the performance of public enterprises in developed & developing countries, supported regulators, provided policy advice to governments and developed a number of innovative PPP approaches. He has authored many papers including on the challenges of sector financing, improving governance and performance of public utilities, options for institutional and regulatory structures, and the role of the private sector in delivering and financing WSS services. Bill graduated from Cambridge University and holds an MSc from York University.

Dr Linus Mattauch is a lecturer in the Environmental Change Institute, and Deputy Director of the Economics of Sustainability Programme at the Institute for New Economic Thinking at the Oxford Martin School (INET). He is an economist with expertise on climate policy and economics, wealth inequality and welfare. Linus’ research centres around evaluating policy options for mitigating climate change and addressing wealth inequality. He also analyses what makes such policies popular with citizens. As an example, his work shows how a carbon tax can be supported by citizens and benefit poor households. Linus previously held a postdoctoral grant at the German Academic Exchange Service (2016–2018) at INET; worked at the Mercator Research Institute on Global Commons and Climate Change; and at the Technical University of Berlin where he completed his PhD thesis in 2015. Linus completed an MMathPhil from Oxford in mathematics and philosophy.

Dr Catherine MacKenzie is Dean of Degrees and Visiting Research Fellow of Green Templeton College. She is also Graduate Tutor, Director of Studies in Land Economy, and Bye-Fellow of Homerton College, Cambridge; Director of Studies in Law at Clare Hall, Cambridge; and a Barrister and Governing Bencher of Inner Temple Inn of Court for barristers. Elected Chairman of the Board of Scrutiny of Cambridge, she has coordinated International Environmental Law on the Cambridge LLM and taught International Law on the Oxford BCL. She has served as Chairman of Examiners of the Cambridge Master's in Sustainability Leadership and of the Oxford Master's in Diplomatic Studies. She is a member of the Bar of England and Wales and the High Court of Australia; previously employed by Allen & Overy, the World Bank, and the Asian Development Bank. She has held fellowships at the University of Tokyo, Vermont Law School and in Kazakhstan, served with the United Nations Mission in Liberia, and advised on women’s legal education in Saudi Arabia, Kuwait and Bahrain. She jointly edited Law, Tropical Forests and Carbon, Cambridge University Press (2013) and has written International Law and the Protection of Forests, Oxford University Press (forthcoming). Catherine has taught International Environmental Law at the School of Geography and the Environment since 2005.

Dr Christine McCulloch graduated in geography from KCL/LSE before gaining a Fulbright scholarship for study at Oberlin College, Ohio. Five years of lecturing in the University of London followed, first at Goldsmiths’ and then at Queen Mary Colleges, before she joined the senior management of the Natural Environment Research Council. Her first thesis (Masters) explored the history of ideas about rivers. During a long career break, she taught geography in secondary schools before joining the Economic and Social Research Council to lead research support in politics, economics and geography. Then she completed her Oxford DPhil in 2005 on the political ecology of dams in the UK.
before working on a multi-national, EU-funded research project on the sustainability of the Dead Sea region. Christine works on the politics of water resource decision-making as an OUCE Research Associate. She is a member of the British Dam Society and lives in a water tower on the bank of the River Thames.

**Dr Faith Opio** (MSc Course Coordinator) completed her PhD in mining engineering with specialisation in environmental geochemistry at the Queens University in Canada. She will contribute to the teaching of the water chemistry practical session in Hilary Term.

**Dr Homero Paltan** holds a DPhil from Christ Church, University of Oxford where he investigated the global implications of hydro-climatic variability. At present he works for the World Bank implementing tools, frameworks, and strategies to improve the resilience to climatic and non-climatic uncertainties of water resources investments. Homero is also affiliated to NASA’s Jet Propulsion Laboratory and Universidad San Francisco de Quito, Ecuador, where he supports research on climate modelling, hydrological extremes, and water security. Previously, he worked at the Inter-American Development Bank, the United Nations, and other private and public institutions in the water, energy, and transport sectors.

**Prof Edmund Penning-Rowsell OBE** is a geographer by discipline, taking his PhD from University College London. His research interests are the political economy of major hazards and how this affects decisions about investment in hazard mitigation. He has more than 40 years’ experience of research and teaching in the flood hazard field, analysing floods and investment in flood alleviation, river management, water planning, and landscape assessment. His focus is on the social impact of floods, and the policy response from regional, national and international organisations. Edmund founded the Flood Hazard Research Centre at Middlesex University in 1970. He was twice the Chair of the Defra/Environment Agency Advisory Group on Flood and Coastal Defense Research and Development (2004/5), and was awarded the O.B.E. by the Queen in May 2006 for services to flood risk management. Since 2012 he has had research papers published in *Environment and Planning ‘C’* (twice), the *Transactions of the Institute of British Geographers*, the *Geographical Journal*, *The International Journal of River Basin Management*, *Area*, *Foresight*, *Natural Hazards*, *Environmental Science & Policy* and *Climate Risk Management*.

**Michael Rouse CBE** works as an independent international consultant on institutional governance and regulation in a number of countries, including Ghana, China and Malaysia. He was Head of the Drinking Water Inspectorate in London during the period 1973-2003 with responsibility for the enforcement of drinking water quality standards, the investigation of incidents and independent reporting. As one of the three UK regulators he worked closely with his regulatory colleagues in OFWAT and the Environment Agency. He worked at the Water Research Centre (WRC) in the UK for nineteen years. He worked on policy and operational research aspects in a number of areas including lead service pipes, water distribution leakage control, sewage sludge disposal, investigation of the structural integrity of sewerage systems and hydraulic analysis of sewerage networks. He set up the Swindon Laboratory in 1982 initially working on the rehabilitation of water and sewerage systems. This led to the development of the concept of asset management planning for water systems. He was Managing Director of WRC from 1984-1993 and is the past President of the International Water Association.

**Dr Louise Slater** is an Associate Professor in Physical Geography in SoGE. Her research focuses on understanding and predicting changes in floods and fluvial systems in the context of contemporary shifts in both climate and land cover.
Louise’s approach is statistical and computational; she uses a variety of Big Data sources and data-driven methods to disentangle the different drivers of flooding and fluvial change across a variety of climates and land use types. Prior to joining the School of Geography and the Environment, Louise held university lectureships at Loughborough University and Queen Mary University of London, and conducted research at IIHR-Hydroscience & Engineering, USA. Louise is an alumna of the Ecole Normale Supérieure Lyon, France, and holds her PhD from the University of St Andrews, UK, in Earth and Environmental Sciences. She is Editor for the journal Hydrology and Earth System Sciences (HESS).

Dr Pauline Smedley is a hydrogeochemist at the British Geological Survey. Her research focuses on the processes controlling mobilisation and transport of trace elements of health concern in groundwaters, including arsenic, fluoride, molybdenum, uranium, and nickel; impacts of water-quality problems on drinking water in the UK and developing countries, and groundwater baselines. Her recent work includes monitoring groundwater chemistry in relation to shale gas development in northern England; characterising groundwater chemistry and geochemical controls in principal British aquifers; and assessment of the behavior of fluoride in groundwater in the Ethiopian Rift Valley.

Dr Troy Sternberg is a geographer researching desert environments and societies. His current focus is on how climate hazards impact landscapes and people across Asian drylands. Troy's DPhil on the changing pastoral environment in Mongolia formed the basis for pioneering research in the Gobi desert. His work investigates how climate, drought, extreme cold and environmental transition affect the physical landscape, human well-being and state policy in Mongolia and China. He is now integrating South Asian and Middle Eastern arid zones with the Gobi to develop a continent-wide perspective on climate, environmental and social change in Asian desert and dryland regions. Troy organised the 3rd Oxford Interdisciplinary Desert Conference, which was held at the School in April 2015.

Dr Abi Stone is a Lecturer at the University of Manchester. She completed her DPhil in the School of Geography and the Environment before taking up a post-doc in the School. Her research focuses on the dynamics of dryland systems, including environmental change, landscape dynamics and groundwater resources. She is interested in these processes and dynamics over a range of timescales from Quaternary glacial-interglacial cycles to recent decades. Her research addresses two broad themes: (i) late Quaternary (~250,000 years) landscape dynamics using geoproxies (including sand dunes, water-lain sediments and fluvial tufa and applying OSL and U-series dating), (ii) the use of chemical tracers as novel archives of groundwater recharge and palaeomire conditions in the unsaturated zone.

Dr David Thomas has over 25 years experience as a practicing water and wastewater engineer. Preferring to work more in the field than an office, his professional interests range from large scale wastewater upgrades in the UK, through to sanitation projects in Africa, and emergency relief work with the Red Cross and Oxfam. He graduated from the University of Cambridge, and did postgraduate degrees at Cranfield University and the Open University.

Dr Kevin Wheeler is a water resources engineer and Research Associate with the Environmental Change Institute at the University of Oxford. His work focuses on trans-boundary rivers and increasing water security through multi-stakeholder cooperation, specifically through collaborative risk-based modelling within negotiation contexts. As a consultant for 15+ years, Dr Wheeler has worked on a variety of water-related issues ranging from community-based
water development projects to addressing trans-boundary disputes, including negotiations on Colorado River. For the last 6 years, he has focused on the Nile River by exploring cooperation between Ethiopia, Sudan and Egypt. He holds an DPhil and MSc in Water Science, Management and Policy from the University of Oxford, as well as MSc in Water Resource Engineering, and BSc in Civil/Environmental Engineering from the University of Colorado.

Prof Paul Whitehead is Visiting Professor of Water Science. He has degrees from Loughborough, Manchester and Cambridge and has over 35 years of experience of hydrology, water quality and ecology with particular expertise in developing linked land and water models. He has been an advisor to EA, DEFRA and NERC on many research programmes and was on the Executive Committee of the EU research project Euro-limpacs which investigated impacts of climate change on ecosystems across Europe and North America. Since 2010, Paul has been the Director of the NERC’s Macronutrients Programme. He teaches water quality issues and environmental modelling.
Appendix 2: CORE MODULES

Climate and Catchment Processes

Module leader: Dr Louise Slater

Teaching staff: Dr Neil Hart (NH), Dr Abi Stone (AS), Dr Homero Paltan (HP) and Dr Kevin Wheeler (KW)

Michaelmas Term & Hilary Term

Module rationale
The aim of the module is to provide an understanding of basic processes affecting the catchment hydrological cycle and its variability: inputs, internal processes, and outputs.

The module begins with a series of four lectures in Michaelmas term covering the principal features of the climate system, including an account of the general circulation of the atmosphere, catchment-scale climate drivers including precipitation and evaporation, key modes of climate variability such as El Niño and the North Atlantic Oscillation, and anthropogenic climate change.

In Hilary Term, the focus switches to the physical hydrology of river catchments, including hillslope hydrology, channel hydrology, groundwater flows, and catchment flood management. The module includes two workshops that explore the ways in which models of climate and catchment processes can be used in decision making in the water sector, and the risk management of water systems.

Learning outcomes
On successful completion of this module, students will be able to demonstrate knowledge and understanding of the basic hydrological and climatological processes affecting the catchment hydrological cycle. Students will acquire the ability to:

- identify the climatic drivers of hydrological patterns and variability in river basins;
- recognize the different hydrological properties of river basins;
- manipulate and interpret a range of climatic and hydrological data from diverse sources;
- assess the drivers of hydrological changes over time;
- synthesize information graphically to produce a scientific poster;
- critically evaluate the response of river catchments to human impacts and management; and
- appreciate the role of models and risk management in decision making.

Teaching approach
The module will comprise lectures, practicals, group work and student presentations. Eight lectures (including practicals) of approximately two hours duration will be given, with discussion time included within each lecture, where appropriate.
A group-work program will run at the end of Michaelmas Term and students are expected to present results from this work in class in eighth week of Michaelmas. Two workshops in Hilary Term will draw together the themes of the module with specific reference to water security and risk management.

A preparatory reading list (below) provides key readings ahead of the lectures. Handouts of the lecture slides will be available electronically (via the Canvas webpage) in advance of each lecture, along with relevant lists of further reading.

Module outline (Michaelmas Term)

<table>
<thead>
<tr>
<th>CLASS</th>
<th>DESCRIPTION</th>
<th>LECTURER</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Precipitation and Evaporation</td>
<td>NH/HP</td>
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<tr>
<td></td>
<td>Atmospheric stability and instability, condensation and clouds, precipitation meteorology. Regional precipitation regimes. Evaporation from water, soil and vegetation. Approaches to the measurement and estimation of rainfall and evaporation. Visit to the Radcliffe Meteorological Station.</td>
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<tr>
<td>2</td>
<td>The General Circulation</td>
<td>NH/HP</td>
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<tr>
<td></td>
<td>The general circulation of the atmosphere. Climatology of the tropics, sub-tropics, mid-latitude and polar regions. Seasonal variations in climate. The influence of the general circulation on global and regional patterns of rainfall and evaporation. In the practical session students are introduced to a range of climate data sources that can be used to characterise hydrological patterns and variability in river basins.</td>
<td></td>
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<tr>
<td>3</td>
<td>Climate Variability</td>
<td>NH/HP</td>
</tr>
<tr>
<td></td>
<td>Ocean-atmosphere interactions. Major mechanisms driving variability in the general circulation (including ENSO and NAO). Regional examples and teleconnections. In the practical students will explore the key features of recent El Nino events and their impacts.</td>
<td></td>
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<tr>
<td>4</td>
<td>Climate Change for Water Managers</td>
<td>LS/HP</td>
</tr>
<tr>
<td></td>
<td>Introduction to the basic principles of climate prediction for water-related applications. Key achievements of climate models and evaluation of their performance. Key challenges for the next decade are discussed. In the practical session students will examine key features of climate model output for a region of their choice.</td>
<td></td>
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<tr>
<td>5</td>
<td>Student Presentations</td>
<td>LS/HP</td>
</tr>
<tr>
<td></td>
<td>Students will prepare (in groups) a poster summarising the climatic and hydrological properties of a river basin from the following list: Ebro, Thames, Nile, Ganges, Indus, Murray-Darling, Colorado.</td>
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</table>
# Module outline (Hilary Term)

<table>
<thead>
<tr>
<th>CLASS</th>
<th>DESCRIPTION</th>
<th>LECTURER</th>
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<tbody>
<tr>
<td>1</td>
<td><strong>Hydrogeology</strong>&lt;br&gt;The lecture will introduce the main principles of groundwater occurrence and flow; geological controls and porous media; groundwater flow and residence times; the water balance; seasonal response; and groundwater development. The Chalk aquifer will be used as a case study.</td>
<td>AS</td>
</tr>
<tr>
<td>2</td>
<td><strong>Hillslope Hydrology</strong>&lt;br&gt;This lecture will discuss the role of infiltration in hillslope hydrology; soil moisture and infiltration processes; overland flow; subsurface flow pathways and mechanisms; return flows; and dynamic contributing areas. In the practical session, students will perform a water balance study of a catchment undergoing land-use change.</td>
<td>LS/HP</td>
</tr>
<tr>
<td>3</td>
<td><strong>Channel Hydrology</strong>&lt;br&gt;Understanding the forces influencing the flow of water in channels is critical to any water resources or hazard management strategies. This lecture will introduce the forces at work and will discuss channel responses to management. In the practical session, students will learn to use seasonal forecasts of river flow produced by global forecasting systems.</td>
<td>LS/HP</td>
</tr>
<tr>
<td>4</td>
<td><strong>Catchment Flood Management</strong>&lt;br&gt;This final lecture will integrate and review the topics presented in the course so far and draw together some themes underlying recent developments in catchment-based flood management and climate. The practical session will introduce a range of recent approaches commonly used in natural flood management.</td>
<td>LS/HP</td>
</tr>
<tr>
<td>5</td>
<td><strong>WORKSHOP: Science for Policy and Management: Water Security</strong>&lt;br&gt;This workshop provides an introduction to modelling and the role of models in decision-making and negotiations, including an overview of different modelling approaches; the application of systems thinking; and exploration of uncertainty. The practical exercise will examine the use of models in decision-making and negotiations. A case study will be used to draw together different components discussed throughout the module and examine alternative management options from different stakeholder perspectives.</td>
<td>KW</td>
</tr>
<tr>
<td>6</td>
<td><strong>WORKSHOP: Risk Management of Water Systems</strong>&lt;br&gt;This workshop discusses the principles of decision scaling approaches to evaluate and manage climatic and non-climatic vulnerabilities and risks in water systems and infrastructure. It will introduce the assessment of frameworks, analytical methods, numerical models, and observations in decision making in the water resources sector. Students will learn to employ performance metrics such as resilience, robustness, and reliability. Case studies will be used to highlight strategies to manage uncertainties in hydropower, irrigation, flood control, and urban water supply systems.</td>
<td>HP</td>
</tr>
</tbody>
</table>
Recommended readings

There are numerous introductory climatology and hydrology books available in the University’s Social Science Library and in College libraries. Some examples are included below. Those new to hydrology will find that the book by Ward and Robinson provides an accessible overview of the basics and is as close as it is possible to get to a course textbook. The text by Barry and Chorley is aimed at students with no prior knowledge of meteorology or climatology and contains material relevant to lectures 1-4 of Michaelmas Term. Use this list (and further readings provided on the Canvas webpage for the module) to follow up on concepts that are mentioned in lectures and to investigate further. The most important papers and books are starred, but don’t forget to explore the literature and find your own material to read. We recommend using the first weeks of term before this module starts to complete the pre-course reading, especially if this material is new to you.

General Textbooks

Precipitation and Evaporation

The General Circulation

Climate Variability

Climate Change for Water Managers

MSc WSPM Course Book 2019–20 | 31
Hydrogeology


Hillslope Hydrology


Channel Hydrology


Catchment flood management


Economics of the Environment

Module Leaders: Dr Stefania Innocenti (SI) and Dr Linus Mattauch (LM)

Teaching staff: Prof. Cameron Hepburn (CH) and Prof Robert Hope (RH)

Michaelmas Term

Module rationale
Economics is critical for understanding contemporary environmental, natural resource and sustainable development challenges. Economic ideas, incentives and institutions are both a root cause of these challenges and a key feature of market-based responses to them, spanning from climate change, biodiversity loss to water scarcity and service delivery.

The Economics of the Environment module equips MSc students in SoGE with the foundational concepts, methods and analytical tools to examine the role and application of economic approaches to environmental and related policy issues across a range of contexts, scales and issues.

Module structure
The module will be organised in two phases, leveraging the interdisciplinary economic research and teaching across the School.

PHASE I - FOUNDATIONS (weeks 1-4) covers the foundations of economics and the environment, examining the economic analysis of and responses to environmental issues. It also provides a survey of economic approaches to environmental policy ranging from instrument choice to property rights.

PHASE II - APPLICATIONS (weeks 5-8) of the module shifts from foundations to applications, organising the students into specialised tracks for each MSc with interactive lectures and exercises. The specialised tracks in phase II are problem-based, fostering critical examination and application of economics to a range of contexts, scales and issues relevant to water policy and management.

In phase II students will cover water economics. This will include three specific topics: Valuing Water (week 6), Pricing Water (week 7) and Impact Evaluation (week 8).

Learning outcomes
This module will equip students to understand and apply economic frameworks, methods and tools to environmental and natural resource management, sustainable development and related policy challenges.

Students will identify the main trends and debates of economics in a logical and systematic way; acquire practical experience with methodologies for policy analysis, instrument design and evaluation; and learn to apply economics with other natural and social science frameworks, tools and methods for understanding and responding to current and future environmental, resource and sustainable development issues.
Teaching approach
The module will be taught through a series of lectures and discussion groups. The first four sessions (PHASE I, FOUNDATIONS) will introduce and illustrate the conceptual building blocks, history and evolution of natural resource and environmental economic theory and practice.

The three remaining sessions (PHASE II, APPLICATIONS) will include lectures and interactive discussions or exercises across a spectrum of problems relevant to each course.

Examination
Students in Water Science, Policy and Management (WSPM) programme will be examined in Trinity Term.

Module outline

<table>
<thead>
<tr>
<th>WEEK</th>
<th>DESCRIPTION</th>
<th>LECTURER</th>
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<tbody>
<tr>
<td>Week 1</td>
<td><strong>Economics of the Environment</strong></td>
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<tr>
<td>14th Oct</td>
<td>This session introduces the economic roots of contemporary environmental problems, ranging from biodiversity loss and climate change to water shortages and deforestation. It briefly defines economics along with some key concepts, before offering an overview of debates about the feasibility and desirability of continued economic growth.</td>
<td>CH</td>
</tr>
<tr>
<td>Week 2</td>
<td><strong>Markets and market failure</strong></td>
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<tr>
<td>21st Oct</td>
<td>This session examines how markets allocate scarce resources. It identifies the sources of market failures that contribute to environmental and resource management problems.</td>
<td>SI</td>
</tr>
<tr>
<td>Week 3</td>
<td><strong>Discussion Group</strong></td>
<td></td>
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<tr>
<td>TBD</td>
<td><strong>Governing the Commons</strong></td>
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</tr>
<tr>
<td>28th Oct</td>
<td>This session reviews the theory and evidence regarding collective action and the commons. It compares different approaches to resource allocation, including markets, states and communities. The session draws on concepts and tools in the fields of institutional economics and political economy, including game theory, property rights and transaction costs.</td>
<td>LM</td>
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<tr>
<td>Week 4</td>
<td><strong>Instrument choice: regulation and pricing</strong></td>
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<tr>
<td>4th Nov</td>
<td>This session examines how the government can intervene to improve market outcomes and explores the opportunities and limits of market-based instruments. It covers which policy instruments economists suggest to address pollution problems and how these instruments work in practice across diverse contexts.</td>
<td>LM</td>
</tr>
<tr>
<td>Week 5</td>
<td><strong>Discussion Group</strong></td>
<td></td>
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<tr>
<td>TBD</td>
<td><strong>From foundations to water related applications</strong></td>
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<tr>
<td></td>
<td>This discussion will bridge the two phases of the course. We will specifically shed light on how economic principles can inform the analysis of specific water applications.</td>
<td>RH &amp; SI</td>
</tr>
</tbody>
</table>
Valuing Water
Valuing water poses a set of identification and measurement issues bounded by space, time and social preferences. Key topics include the Total Economic Value framework; revealed preference and state preference methods; markets and payments for water ecosystems; case studies.

Pricing Water
Pricing water for drinking water or bulk water for irrigation requires different economic approaches and methods. Key topics include tariff design; payment behaviour; endowment effect; Natural Monopoly; opportunity cost; subsidies and targeting; non-volumetric pricing for irrigation; case studies.

Impact Evaluation
Attributing the impact of policy for people or the environment can be evaluated and estimated by a range of economic methods. Key topics include theory-based evaluation; randomised control trials; matching and double difference methods; selection bias; instrumental variable; case studies.

Reading Expectations
Each session in the Foundations (Phase I) will have two to three key readings, addressing the following elements:

- recommended readings for each week, examining the intersection of economics and the environment
- a supplementary reading list providing an in-depth application relevant for each MSc

Discussion group will convene students in weeks 3 to deepen inquiry and debate, as well as develop analytical skills; the discussion groups will be customised and coordinated separately for each MSc programme. Additionally, in week 5 Prof. Hope and Dr Innocenti will chair a discussion session to “bridge” Phase I to Phase II, i.e. the foundations to the water-related applications which will be investigated in the following weeks.

There are two required texts for the Phase I of the course.
1. Keohane and Olmstead (2nd edition, 2016; details below). Selected chapters are assigned in weeks 1-4, and the remaining chapters are suggested reading. Order your paperback early or purchase the e-book version.
Module Readings

PHASE I, FOUNDATIONS

Week 1: Economics of the Environment


Additional recommended readings for the WSPM students:

Week 2: Markets and Market Failure

Additional recommended reading for the WSPM students:

Week 3: Governing the Commons

Additional recommended reading for the WSPM students:


**Week 4: Instrument Choice**


**Additional recommended reading for WSPM students:**


**PHASE I, OTHER ADDITIONAL RECOMMENDED READINGS**


**PHASE II, APPLICATIONS**

**Week 6: Valuation and Choice**


**Additional optional resources:**

**Week 7: Water Pricing**

**Additional optional resources:**

Week 8: Impact Evaluation


Additional optional resources:


Institutional Governance and Regulation

Module Leader: Michael Rouse CBE

Teaching staff: Michael Rouse CBE (MCR) and Bill Kingdom (WDK)

Michaelmas Term

Module rationale
The objective of this module is to provide an understanding of the elements of institutional governance and regulation which are necessary for the delivery of effective, efficient and sustainable water supply and sanitation services. These same elements have to be in place for the achievement of Sustainable Development Goals 6.1 and 6.2. There is exploration of critical governance policy matters such as separation of policy and delivery functions, roles and responsibilities of stakeholders and centralisation/decentralisation issues. There is discussion on myths and barriers to progress such as the emotive arguments on public or private provision of services. The module shows various public and private structures all of which can succeed if essential elements are in place, and all can fail if those essential elements are missing. Emphasis is given to improving service provider performance and cost recovery through benchmarking, aggregation and other approaches. Water is a capital-intensive industry and approaches to financing major infrastructure development are considered. Examples of transparency and public involvement are given in the context of a participation structure with examples of community systems. Approaches to economic and quality regulation and regulatory bodies are considered, and how these evolve through water sector reform. Drinking water safety and regulation is explored, as is sanitation safety, with emphasis on the management of risk. Approaches and standards related to environmental water quality are given. The module draws on experience from around the world on what has worked well and what has contributed to failures. Generally, the elements and principles apply equally to developed and developing countries, but the module considers circumstances where the requirements are different.

Learning Outcomes
The students will have a good understanding of the elements necessary for the achievement of effective, efficient and sustainable water, sanitation and wastewater services. They will understand what works in practice and those factors leading to failures. They will see the links between policy, governance structures, regulation, public participation and the organisation of service delivery. Those students who take a deep interest in the module will be able to assess existing governance systems and offer solutions, based on root cause analysis, where there are shortfalls in effectiveness.

Teaching approach
The module will be delivered in eight 2 hour sessions during Michaelmas term. The first hour will be a lecture. There will be more lecture material provided in slides than will be presented in that hour. After a short break the remaining time will be split between a discussion on a specific topic and team working. Discussion topics will be chosen from issues related to the lecture of that day, or on a wider topic embracing several aspects. Students are encouraged at the beginning of the module to propose discussion topics. Students will be advised of each discussion topic ahead of each session together with associated reference material. Following the
discussion period teams of five will apply the module thinking on their case study – see below. The amount of time taken for the discussion, and the remaining time available for the team work, is a matter for student consensus preference. Institutional Governance and Regulation is a large subject, and it is important that students study the lecture material, and associated references, outside the session periods. For the module in general, the more pre-reading by students the greater the opportunity for discussing issues of interest.

In the first session students will form teams of five people each. Each team will identify countries or cities which they will then use as case studies to discuss and assess the implications of the teaching content of each session. The selected team study areas, where possible, will be the same as those in other relevant modules to provide for integrated thinking on water, sanitation and environmental water matters. Teams are expected to work on their case study projects between sessions. Each team will produce a plan, presented as a powerpoint presentation at the final session, recommending solutions to the identified problems and deficiencies.

Module outline

<table>
<thead>
<tr>
<th>Session</th>
<th>Description</th>
<th>Lecturer</th>
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<tbody>
<tr>
<td>1</td>
<td>Module Overview and Policy Issues, including Institutional Structures</td>
<td>MJR</td>
</tr>
<tr>
<td>1a</td>
<td>An overview of the elements of effective governance and a description of the range of private and public structures. Some key policy issues critical to governance including: (i) Structural options. (ii) Integration and consolidation. (iii) Types of regulatory structure; importance of separation from government. (iv) Water and sanitation as a human right (v) Charging policies. (vi) Provisions for the poor (vii) Licensing (viii) Specific policy challenges associated with rapid urbanization, and cities in decline. (Note: There is linkage between this session on policy and the Policy Module, which provides theory, methods and practice, with specific aspects covered in depth)</td>
<td></td>
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<tr>
<td>1b</td>
<td>Introducing team ‘projects’: Formation of teams. Selection of countries/cities for study. From initial information from students, some additional discussion on issues and problems. Discussion on work required on team projects before next session.</td>
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<tr>
<td>1c</td>
<td>Student proposals for Discussion Topics. Introduction of Discussion Topic for Session 2b</td>
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</tr>
<tr>
<td>2</td>
<td>Transparency, Public Participation and Community Systems</td>
<td>MJR</td>
</tr>
<tr>
<td>2b</td>
<td>Discussion Topic</td>
<td></td>
</tr>
<tr>
<td>2c</td>
<td>Work in project teams to consider policy aspects, and identify public participation shortcomings</td>
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</tr>
<tr>
<td>3</td>
<td>Economic Regulation, Planning and Finance</td>
<td>WDK</td>
</tr>
<tr>
<td>3a</td>
<td>(i) Some background theory to economic regulation. (ii) Approaches to finance and cost recovery. (iii) Strategic planning, delivery planning, business planning, some examples of planning processes</td>
<td></td>
</tr>
</tbody>
</table>
### 3b Discussion Topic

**3c** Work in project teams to investigate possible improved planning and oversight towards long term sustainability of service delivery and access to finance

### 4 Performance Measures, Benchmarking and Non-revenue Water

**4a** (i) Measurement, Audits, Enforcement and Benchmarking. (ii) The important question of non-revenue water including leakage, its measurement and a key performance indicator.

**4b** Discussion Topic

**4c** Work in project teams to develop regulation and planning, and consider performance measures and benchmarking

### 5 Water Quality Regulation


**5b** Discussion Topic

**5c** Work in project teams to continue on aspects in 2b, 3b and 4b

### 6 Public Sector Operations

**6a** (i) Benefits and limitations of municipal operations (ii) Corporatised public utility concept (iii) Aggregation and iv) improving public sector service delivery.

**6b** Discussion Topic

**6c** Work in project teams to consider how to further improve performance of public operations

### 7 Procurement and Private Equity Model

**7a** (i) Degrees of use of the private sector. (ii) Principles of successful procurement. (iii) Concession and other contracts. (iv) Partnering. (v) Successes and failures. (vi) The private equity model with examples of England and Chile

**7b** Discussion Topic

**7c** Work in project teams on all aspects of case studies and begin preparation of team presentations for final Session

### 8 Filling in Gaps and Team Presentations

**8a** General Discussion on gaps and issues highlighted during the earlier sessions with additional lecture material if required.

**8b** Project Team Presentations using Powerpoint

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**Readings**

The most important reference for the module is the Module Reference Book. That book provides references on each of the chapter subjects. The amount of pre-reading is a matter for individual students. Suggested reading is given for each of the module weeks. Post-lecture reading is equally important especially to consider the content of the lecture in the context of the project teams’ studies and other case scenarios.
Module Reference Book

Some General References on Governance, Policy and Management
Berg, S.V. Best practices in regulating state-owned and municipal water utilities: Economic Commission for Latin America and the Caribbean (ECLAC) LC/W.542 Copyright © United Nations, May 2013

History
Juuti, P.S. and Katko, T.S. Water, Time and European Cities. Available in PDF format [www.watertime.net]. [Valuable background to why various cities in Europe developed their water supply and sanitation systems in different ways, and a useful account of historical private sector involvement].

Weekly Readings
Module Reference Book chapters are recommended. Other reading is for consideration. It is recommended that students also do their own literature research.

Week 1. Module Overview and Policy Issues
Module Reference Book: Chapter 1, Parts 1 and 2

Week 2. Transparency, Public Participation and Community Systems
Module Reference Book: Chapter 5

Other Reading:
Week 3. Institutional Structures, Economic Regulation, Planning and Finance
Module Reference Book: Chapters 2 and 3

Other Reading:

Week 4. Performance Measures, Benchmarking and Non-Revenue Water
Module Reference Book: Chapter 6

Other Reading:

Week 5. Water Quality Regulation.
Module Reference Book: Chapter 4.

Other Reading:


Week 6. Public Sector Operations.
Module Reference Book: Chapter 7

Other Reading:
OECD Principles of Good Governance:

Australia reform:
https://openknowledge.worldbank.org/bitstream/handle/10986/27532/117112-WP-P157523-PUBLIC.pdf?sequence=1&isAllowed=y

Chan, E.S. Bringing Safe Water to Phnom Penh’s City International Journal of Water Resources Development:
http://www.informaworld.com/smpp/title?.content=t713426247; Online publication date: 18 November 2009


Week 7. Procurement and Private Equity Model
Module Reference Book: Chapters 8 and 9

Other Reading:


http://www.ksg.harvard.edu/taubmancenter/publications/papers.htm


Week 8. Filling in Gaps and Team Presentations
Module Reference Book. Chapter 10
Water Quality

Module Leader: Dr Jocelyne Hughes

Teaching staff: Dr Jocelyne Hughes (JH), Prof Paul Whitehead (PW), Dr Pauline Smedley (PS), Dr Helen Gavin (HG), Dr David Thomas (DT)

Hilary Term

Module rationale
The module will provide a basic understanding of the chemical, geochemical and biological processes taking place within the hydrological cycle; water-rock interactions, aquatic ecology and ecological functions. These relationships are all linked by water flows and reactions taking place at different rates within the water cycle. The human and societal impacts related to water quality and pollution will be discussed and evaluated.

Learning objectives
An understanding of the processes and reactions in natural water systems across a wide range of geographical and climatic regimes is a necessary foundation for understanding human impacts on the hydrological cycle. Throughout the module the relevance of the science as underpinning management and policy will be stressed. The first three lectures will introduce concepts in water quality and highlight human impacts on the natural physical and ecological cycles. Topics covered include diffuse and point source contamination including agricultural practices giving rise to eutrophication of surface waters, nitrate pollution which affect many groundwater sources, acidification from industrial emissions, and other pollution sources that are significant for both surface and groundwater. The module continues with lectures 4 and 5 on the influence of biogeochemical cycles on aquatic ecological processes, in rivers, lakes and wetlands, including topics on the impacts of invasive aquatic species, constructed wetlands for water quality management, water quality ecosystem services, and the link between water quality and environmental flows. Processes in surface waters and groundwater are closely linked and lectures 6 – 8 will stress the physicochemical and geochemical controls on the composition of natural waters.

Teaching approach
The main teaching will be through lectures, discussions or practicals within each session. It is expected that students should read the specific readings related to the lecture in advance of the session- see texts and resources shown below. The importance of field and practical work is also stressed and opportunities for these will be offered during the course, both locally around Oxford and further afield, and where possible these will be interconnected with laboratory activities (see Water Management module). Students are asked to maintain the field notebooks provided for observations and field notes during field or practical sessions.

The Dorset field trip provides the main introduction to several natural science elements of the course. This will include an introduction to hydrogeology and ground and surface water quality, including groundwater pollution and also freshwater biology. Opportunities to expand on these themes also exist with the visit from the Environment Agency to Oxford to demonstrate the ARC boat and water quality monitoring; and Pauline Smedley from the British Geological Survey will demonstrate key equipment and methods used in the field for groundwater research and monitoring during her lectures. The module will provide an overview of statutory water quality obligations and
biological monitoring of UK rivers. There will be an opportunity for a visit to Otmoor RSPB reserve in the upper Thames catchment (aquatic ecosystems and invertebrate sampling) in Trinity term.

Module outline

<table>
<thead>
<tr>
<th>CLASS</th>
<th>DESCRIPTION</th>
<th>LECTURER</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Surface Water Quality and Pollution</strong>&lt;br&gt;An outline of the main principles of water quality and pollution of surface waters. Determination of key concepts in water pollution; sources, pathways and impacts. Details of key surface water pollutants (organic, inorganic, toxins and heavy metals).&lt;br&gt;• Kummerer et al. 2018.&lt;br&gt;• Whitehead et al 2012.&lt;br&gt;• Jones 1997. Chapter 8</td>
<td>PW &amp; HG</td>
</tr>
<tr>
<td>2</td>
<td><strong>Acidification</strong>&lt;br&gt;Acidification causes, impacts and processes; international context and approaches to predict recovery and reverse acidification; case studies from across Europe, North America and China.&lt;br&gt;• Berner and Berner 2012. Chapter 3&lt;br&gt;• Whitehead et al. 1997.</td>
<td>PW &amp; HG</td>
</tr>
<tr>
<td>3</td>
<td><strong>Eutrophication</strong>&lt;br&gt;Causes and problems of eutrophication; Water Framework Directive and measures considered for restoration; estuarine eutrophication.&lt;br&gt;• Berner and Berner 2012. Chapters 5-7&lt;br&gt;• Chislock et al 2013.</td>
<td>PW</td>
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<tr>
<td>4</td>
<td><strong>Aquatic ecosystems</strong>&lt;br&gt;Introduction to biota, structure and function of aquatic ecosystems. Spatial and temporal changes in response to the dynamics of the physical environment. Aquatic ecosystem services and environmental flows&lt;br&gt;• Moss (2018) Chapters 2, 3, 17 and 18&lt;br&gt;• Tharme, R. et al. in Hughes (2018) Chapter 2</td>
<td>JH</td>
</tr>
<tr>
<td>5</td>
<td><strong>Wetlands and water quality</strong>&lt;br&gt;Introduction to the structure, function and productivity of wetlands; responses to spatial and temporal hydrological changes; nutrient cycling and carbon storage; wetland ecosystem services; constructed wetlands for wastewater treatment.&lt;br&gt;• Mitsch and Gosselink (2015) Choose a chapter or section that interests you&lt;br&gt;• ‘Wetland Functions &amp; Values- chapters 1-4’, four youtube videos by Connecticut Dept. of Energy &amp; Environmental Protection - <a href="https://www.youtube.com/watch?v=Z3WZDZFvTZQ">https://www.youtube.com/watch?v=Z3WZDZFvTZQ</a></td>
<td>JH &amp; DT</td>
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</tbody>
</table>
### Groundwater quality and the hydrological cycle

An overview of groundwater and the hydrological cycle from a geochemical perspective: from rainwater to groundwater, chemical reactions (dissolution/precipitation, ion exchange, sorption, redox), salinity, evolution along flow lines

- Hiscock and Bense 2016. Chapters 4, 8.
- Edmunds and Shand 2008. Chapters 1, 3, 5, 8.

#### Groundwater, geochemistry and impacts

Groundwater quality in relation to health; natural biogeochemical reactions and their impacts on water supply; case studies on arsenic and fluoride in groundwater.

- Edmunds and Smedley 2013.
- Fendorf et al. 2010.

#### Groundwater Baselines and Pollution

Groundwater baselines in space and time; establishing the baseline; departures from the baseline - nitrate in groundwater, pesticides, emerging contaminants, urban impacts; case studies on shale gas and groundwater quality.

- Vidic et al. 2013.

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**Introductory readings**


Water and Health

**Module Leaders: Prof David Bradley and Dr Katrina Charles**

**Teaching staff: Prof David Bradley and Dr Katrina Charles**

Michaelmas Term & Hilary Term

**Module rationale**

Water plays a key part in the causation, transmission and prevention of many diseases as well as being essential for life and health. The core module explains the scale and nature of the health risks related to water, including domestic water use, waste water and sanitation, hygiene behaviour and water resource development. Its emphasis is on communicable diseases and their prevention by good water management. The epidemiology of the major water-related diseases will be taught in relation to a functional classification of these diseases. Rural and urban domestic water supplies are considered, both in tropical and temperate climates and in poor and rich societies, and the health problems related to both water access and water quality. The health effects of a range of water improvements are considered, and the methods of measuring these benefits critically examined. Sanitation, the disposal of human wastes, and hygiene behaviour are also similarly considered. The range of diseases related to surface waters and water resource developments are examined, together with their vectors and intermediate hosts, along with health impact and opportunity assessments, and interactions with conservation, and their environmental control. Risk-related interventions, including water safety plans, will be covered, as will effects of climate and other environmental changes.

The module assumes no health background on the part of students. It therefore also teaches basic epidemiological principles (which are also of value beyond the health field), mainly through practical exercises in relation to water. Non-communicable diseases are introduced. Other aspects of water-related health are dealt with on the induction course, Otmoor, and WEDC field visits, and in relation to other modules and visits.

**Learning objectives**

By the end of the course, participants should have sufficient understanding of health issues in relation to water that they can ask appropriate questions on human health of any project they undertake, can critically read expert reports that they may commission; have a sense of the work involved in dealing with any health-related problem they encounter; and have a good basis for more specialized study if they wish to pursue health and water issues further.

**Teaching approach**

The core module comprises eight morning sessions which combine lectures with discussions, and practical afternoon sessions will take up epidemiological methodology, microbiology of pathogens and indicator micro-organisms and of water-related tropical parasites and their insect and other vectors, and exercises on water-related outbreak investigation and control and on health impact assessment for water resource developments. Teaching will be complemented by a field visit to Otmoor nature reserve in Trinity Term to illustrate the interaction of health preservation and nature conservation, site visits to water and sewage treatment works in Wessex and in Spain, and an optional visit the WEDC at Loughborough for low cost water technologies. Some disease-related work will be included in practicals for other modules.
# Module outline

<table>
<thead>
<tr>
<th>Term</th>
<th>CLASS</th>
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<th>LECTURER</th>
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<tbody>
<tr>
<td></td>
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<td>DB</td>
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*DB*
### Water-based, Zoonotic and Vectorborne Diseases related to Water


### Water Resource Development and Disease Control

Health consequences of water resource development. Life cycle of developments. Interactions with engineering, population, agriculture and conservation. Water management in disease control. Interdisciplinary aspects of health management. Ways to conceptualize the issues: population biology and genetics; behavioural and landscape epidemiology. Public health strategy and its relations to global development goals: MDGs, SDGs and JMP; disease control, disease eradication, health and wellbeing.


Environmental management for vector control World Health Organization [http://www.who.int/water_sanitation_health/publications/vectcont/en/](http://www.who.int/water_sanitation_health/publications/vectcont/en/) This will take you to part of the WHO web site and below the text are 3 (A-C) download buttons. The material is rather old but gives a sound account of methods relevant to water resources development, especially for irrigated agriculture.

| 5 | **Water Safety Plans & disease transmission dynamics**  
Over two sessions we will use a risk-based framework to explore drinking water management, drawing on case studies of outbreaks, incidents and health risk management in drinking water supplies, with a focus on developed countries. This first session addresses catchment management, wastewater treatment and the multiple barrier approach, including discussion of disease transmission dynamics.  
|---|---|
| 6 | **Water Safety Plans & risk modelling**  
Following on from the previous week, we will continue to explore risk-based approaches to drinking water management, focusing on water treatment, distribution systems, and the consumer, and the risk modelling approaches.  
| 7 | **Household drinking water treatment**  
Point of use drinking water treatment approaches offer an important tool for protecting health. However, there are limitations on when and where they will be effective. Through this session we will explore from a systems perspective on water supply how interventions relate to the system, and how this influences success or failure, and how research design informs our understanding of this. This will include: causes of poor household drinking water quality, and measurement; the difference between efficacy and effectiveness of POU treatment methods; and opportunities and risks for promotion of household drinking water treatment. |


Sanitation in low income settings
Sanitation is understood to be essential to achieving good health, however, how best to design it requires consideration of the socio-technical system. This session will focus on sanitation, from a systems perspective, in rural and urban low income communities, critically reviewing the narratives and evidence of health risks/benefits, and the major challenges to improving access to sanitation and achieving effective health gains.


What is the benefit of WASH for health?
In the wake of the SHINE and Wash Benefits trials, there is conflicting information on the benefits of WASH for health. This session is designed to help students develop their ability to critically assess research in this area, and the evidence to advocate for WASH investment.

Students will be assigned readings from the SHINE and WASH Benefits trials, and academic and policy discussions around these papers.

Introductory and Reference readings


Feachem RG, Bradley DJ, Garelick H and Mara DD. 1983. Sanitation and Disease: Health Aspects of Excreta and Wastewater Management. Chichester: John Wiley


Water Policy

Module Leaders: Professor Rob Hope and Dr Johanna Koehler

Teaching Staff: Professor Rob Hope (RH) and Johanna Koehler (JK)

Hilary Term

Module rationale
This module explores water policy providing an introduction to theory, methods and practice drawing upon case studies from around the world. After an introduction to water policy and the policy analysis exercise, three classes focus on water policy structure as defined by rights, institutions and decentralisation processes. The following three classes explore agency with regard to risk, choice and discourse. In the final class we discuss the policy analysis exercise (set in class 1), which complements the knowledge acquired in the module with a practical skillset for policy analysis. The overall learning outcome of the module is to provide students with the skills and knowledge to understand, interpret and evaluate policy from design to evaluation.

Teaching approach
The module will comprise lectures, discussions and group activities. Lectures of two hours duration will be given, with discussion time included within each lecture. Students will be given short preparatory reading lists prior to lectures. Students will have opportunities to engage more deeply with this material through activities in the Water Management module, including reading circles, policy debates, workshops and field trips.

Module outline

<table>
<thead>
<tr>
<th>Class</th>
<th>Description</th>
<th>Lecturer</th>
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<tbody>
<tr>
<td>1</td>
<td>Water Policy: Introduction and Policy Analysis Exercise</td>
<td>RH &amp; JK</td>
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<tr>
<td></td>
<td>Theory, methods and concepts that underpin the characteristics of water policy in the areas of water resources and water services will be introduced to inform the structure and logic of the module. The second half of the class will be used to introduce students to the policy analysis exercise as a practical component of the course.</td>
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<td>2</td>
<td>Rights</td>
<td>RH</td>
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<td></td>
<td>We examine policy and political debates on the nature, justification and execution of rights for drinking water services and, more recently, rivers. Legal, economic and policy perspectives and fault-lines are discussed drawing from historical debates re-imagined in contemporary policy narratives.</td>
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<tr>
<td>3</td>
<td>Institutions</td>
<td>JK</td>
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<td>An overview of institutional theory is provided to guide water policy analysis, including formal and informal institutions, and questions around institutional design, analysis, development as well as drivers of institutional change at different levels of governance. We discuss how the effectiveness and equity of water policy can be assessed, including for managing water commons.</td>
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</table>
Decentralisation

Decentralisation is a process of state reform transferring political authority, implementation responsibilities and/or budget decisions to lower levels of government. Decentralisation of water services and water resource management is a longstanding trend dating from the 1980s in both developing and developed countries.

<table>
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<th>4</th>
<th>Decentralisation</th>
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Risk

Water risks vary across temporal and spatial scales, and depend on economic, social, geographic, demographical, cultural, institutional, governance, and environmental factors. In this lecture we explore how risk perceptions are closely linked with the institutions designed to manage risks. We draw on concepts such as Beck’s risk society and Douglas’ cultural theory of risk.

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<th>Risk</th>
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Choice

We explore the extent to which policy reflects the choices of people. The nature of social choice mechanisms is examined through ‘Impossibility Theorem’, ‘information asymmetry’ and the ‘Principle-Agent Problem’. We question approaches to public participation in water policy drawing upon anthropological, sociological and economic perspectives.

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<th>Choice</th>
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Discourse

Epistemological perspectives will introduce theoretical approaches to water politics including practice, discourse, hegemony, political ecology and structuration. Case studies will illustrate how different theories manifest and influence policy.

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<th>7</th>
<th>Discourse</th>
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</table>

Policy Analysis Exercise

This session will be about applying the knowledge you have gained throughout the course and discussing the policy analysis exercise prepared over the term.

| 8 | Policy Analysis Exercise |

Introductory readings*

Fleck, J. (2016). Water is for fighting over...and other myths about Western Water. Island Press.

* For further reading, please consult the course syllabus.


*Disclaimer: Introductory readings are provided for background purposes. Readings will be updated before the Hilary Term.*
Water Management

Module Leaders: Dr Jocelyne Hughes & Prof Edmund Penning-Rowsell

Teaching Staff: Jocelyne Hughes (JH), David Grey (DG), Edmund Penning-Rowsell (EP-R), Christine McCulloch (ChM), Michael Rouse (MR), David Bradley (DB), David Johnstone (DJ), Homero Paltan (HP), Katrina Charles (KC), David Thomas (DT), Catherine Mackenzie (CaM), Troy Sternberg (TS) and others

Michaelmas, Hilary & Trinity Terms

Module rationale
Effective water management, whether it is of water supply, water resources or water security and risks, requires complex, interdisciplinary knowledge of water. It requires knowledge from the natural sciences of how water behaves, as precipitation, surface water, groundwater, and as a habitat for aquatic organisms. It requires knowledge from the social sciences of how people interact with water, and how policy is developed and implemented. But beyond these, effective water management also requires a critical understanding of the interaction of the natural and social sciences, and to go beyond the academic to understand how the water industry works in practice.

This module is designed to complement the other core modules, helping students to develop a more integrated understanding of the academic and practical aspects of water science and policy to support water management through a range of learning experiences. Students will develop an understanding of how evidence is produced, and how it can be used and communicated effectively to inform change, as well as an understanding of how trade-offs between water ‘sectors’ occur in practice, considering the political and practical aspects of decision making and policy implementation.

Intended learning outcomes

• Critical understanding of the interactions and trade-offs between water sectors and water management in academic and practitioner environments;
• The ability to formulate and communicate compelling arguments in water management, appropriate for different stakeholders.

Teaching approach

The module uses a combination of lectures, workshops, seminars, reading circles, online materials and field trips, from core staff as well as invited speakers. Sessions will be diverse to give students a range of learning experience and opportunities to engage with a broad range of researchers and practitioners. Lectures and seminars will be used to explore core module content in a practitioner focused setting. Formative assessments will provide the basis for students to develop argumentative writing and critical thinking skills. Field trips and interactive workshops will provide a forum to develop a deeper understanding of water management in practice and contextualise and synthesise material across the core modules. All confirmed sessions and pre-field trip briefings/lectures will be posted onto the course Google calendar.
Module outline
The content and timing of individual sessions may vary depending on speaker availability (for indoor sessions) and weather (for field trips).

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
<th>Leader</th>
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</table>
| MT   | **Induction Field Trip, Dorset**  
A residential fieldtrip to explore the scientific and policy aspects of water management around the Swanage area of Dorset. | JH |
|      | **Water Security part 1**  
Introduction to the water security challenges of the 21st century from a global perspective. | DG |
|      | **Jubilee River Field Trip: managing the river channel into London**  
Appraisal of a flood alleviation channel on the River Thames near to Windsor: all-day visit and on-site discussion. | EP-R |
|      | **Reading Circles part 1**  
Critical appraisal of significant books dealing with key water issues and management in a variety of geographical regions. Formatively assessed book review. | ChM |
|      | **Water Security part 2: Turbulent Waters – Managing International Rivers**  
Interactive session on the special policy and political challenges associated with international watercourses. | DG |
|      | **Farmoor Field Trip: managing the supply of drinking water**  
Visit to Thames Water’s Farmoor Reservoir and water treatment works, supplying the Oxford region with drinking water. Hosted by Thames Water- half day site visit and indoor discussion/lecture. | DJ/EP-R/DT |
|      | **Policy controversies: memo and debate**  
A two-part exercise to debate major water policy controversies. Students prepare memos independently (part 1) to generate evidence for their position/s. Memos serve as preparation for team-debates (part 2) on competing ‘sides’ of policy controversies. | JH |
|      | **International Water Law & Management**  
Introduces students to the role of international law in the management of water issues and explores a number of water management case studies using legal resources. All day workshop, presentations and group work. | CaM |
| HT   | **Water and Gender**  
Exploration of gender issues in the management of water: half-day session with presentations and discussions | KC |
|      | **Reading Circles part 2**  
Critical appraisal of significant books dealing with key water issues and management in a variety of geographical regions. Formatively assessed book review. | ChM |
|      | **Wessex Field Trip: managing effluent and water quality**  
Visit to Wessex Water’s Avonmouth plant for wastewater and sewage treatment (near to Bristol). All-day visit hosted by Wessex Water- indoor lecture/discussion and site visit. | DJ/DT |
### Dams, reservoirs and water storage
A two-part session on the political ecology of long-term water storage; and the Grand Ethiopian Renaissance Dam (GERD).

**KW/Ch M**

### Water Security part 3
Crosscutting case studies at different scales, ranging from basins and aquifers, to dry lands and the Tropics. These case studies are designed to connect multiple course sessions and activities across a range of geographic contexts.

**DG/TS**

### City Water
Presentations by core staff and student-led discussions to consider the challenges of urban water, sanitation, wastewater and flooding, plus associated governance and management issues. Half-day workshop and discussion.

**MR**

### Environment Agency Field Demonstration
Half-day demo in Oxford with the EA - the statutory organisation managing and monitoring surface water (quantity and quality) in the UK.

**JH**

### Evenlode River Field Trip: water management through a catchment partnership
Half-day field trip to the Evenlode catchment in the Upper Thames, to meet stakeholders and discuss key issues.

**EP-R/JH**

### Ebro field trip: integrated water management
A residential fieldtrip to explore scientific and policy aspects of water management in the Ebro river basin in Spain.

**JH/HP**

### Otmoor Field Trip: management and assessment of a created wetland
Macroinvertebrate surveys for water quality assessment in a created wetland in the upper River Thames catchment. Practical field work followed by a guided visit by the reserve manager to understand the water management context of the wetland creation scheme.

**DB/JH**

### Indicative readings (also see field trip handbooks and session hand-outs)

Research Design and Skills

Module Leader: Dr Jocelyne Hughes

Michaelmas, Hilary & Trinity Term

Module rationale
Conceptualizing, designing and executing research that generates new knowledge is a fundamental process and skill for postgraduate students to learn. This programme will support students to develop their ideas into successful research projects.

Learning outcomes
- Conceptualize and articulate research questions appropriate for a 3-month MSc dissertation;
- Write a critical evaluation and analysis of the literature, rather than a summary;
- Professionally plan and execute primary research with appropriate ethical standards and risk assessment;
- Acquire foundational knowledge and use key geographic research methods and skills.

Teaching approach
This module will use a combination of workshops, seminars, demonstrations and hands-on experiences throughout the three terms to guide students through the research design process and give them an opportunity to engage with key geographic research methods. Workshops and seminars with DPhil students and alumni will provide opportunities for students to engage with peers across different disciplines to learn about their experiences in undertaking their first independent research project. Students will present their dissertation research design to the class and a panel of faculty staff for evaluation and feedback.

Module outline

<table>
<thead>
<tr>
<th>Week</th>
<th>Michaelmas</th>
<th>Hilary</th>
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<tbody>
<tr>
<td>1</td>
<td>Research design introduction</td>
<td>Dissertation planning</td>
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<tr>
<td>2</td>
<td>Epistemology</td>
<td>Student Presentations</td>
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<td>3</td>
<td>Methodology</td>
<td>Ethics &amp; risk assessment</td>
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<td>4</td>
<td>Presenting Arguments</td>
<td>Funding and project proposal</td>
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<tr>
<td>5</td>
<td>Fieldwork Planning</td>
<td>Skills sessions (separate timetable)</td>
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<tr>
<td>6</td>
<td>Topic Selection</td>
<td>Skills sessions</td>
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<tr>
<td>7</td>
<td>Aim and research questions</td>
<td>Writing a dissertation</td>
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<tr>
<td>8</td>
<td>Literature Analysis</td>
<td>Exam practice and skills</td>
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</tbody>
</table>

Research Skills workshops will be delivered by a range of lecturers from across the department on topics including focus group discussions, key informant interviews, GIS, data analysis, modelling, water chemistry analysis.
Indicative readings


Kanbur, R. (2003) Q-Squared. Qualitative and Quantitative Methods of Poverty Appraisal. Permanent Black: Delhi (Also, see Cornell University webpages)


Marsland et al. (2001) Combining qualitative (informal) and quantitative (formal) research methods. SSC: Reading.


MSc/MPhil WATER SCIENCE, POLICY AND MANAGEMENT

Academic Director: Professor Simon Dadson
Course Director: Dr Jocelyne Hughes
CONTACTS:
Tel: +44 (0)1865 285120
Email: msc-coordinator-ecm-wspm@ouce.ox.ac.uk