

# Handbook WM 2012-2014

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## **1 UNESCO-IHE**

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### **1.1 Introduction**

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UNESCO-IHE continues the work that was started in 1957 when IHE first offered a postgraduate diploma course in hydraulic engineering to practicing professionals from developing countries. Over the years, IHE has developed into an international education institute providing a host of postgraduate courses and tailor-made training programmes in the fields of water, environment and infrastructure; conducting applied research, implementing institutional capacity building and human resources development programmes, participating in policy development, and offering advisory services world-wide.

The Institute has gradually expanded its academic base to include disciplines such as sociology, economics, and environmental and management sciences. The range of activities has broadened accordingly, from identifying solutions to engineering problems to designing holistic and integrated approaches in the development and management of water and environmental resources, and urban infrastructure systems. The services of the Institute now also include integrated water resources management, effective service delivery and institutional reform, all of which aim to enhance full stakeholder involvement, equity, accountability and efficiency in water sector development and management.

In November 2001, UNESCO's 31<sup>st</sup> General Conference decided to make IHE an integral part of the Organisation. By March 2003, the necessary treaties and agreements between the IHE Delft Foundation, UNESCO and the Netherlands Government were signed, allowing for the entry into operation of the new UNESCO-IHE Institute for Water Education. UNESCO-IHE is governed by a thirteen-member Governing Board appointed by the Director General, and is managed by a Director and Deputy Director. The IHE Delft Foundation provides all other staff and facilities to UNESCO-IHE.

The mission of the Institute is to contribute to the education and training of professionals and to build the capacity of sector organisations, knowledge centres and other institutions active in the fields of water, the environment and infrastructure, in developing countries and countries in transition.

UNESCO-IHE is located in Delft, an internationally renowned centre of excellence in civil engineering and in water related sciences. The Delft University of Technology, the laboratories of WL/Delft Hydraulics, GeoDelft, and The Netherlands Organisation for Applied Scientific Research are situated nearby. UNESCO-IHE maintains intensive relations with national and international institutions to ensure a continuous exchange of knowledge and experience.

### **1.2 MSc Degree Programmes**

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The backbone of the Institute are the postgraduate programmes in the fields of:

- ∞ Environmental Science
- ∞ Municipal Water and Infrastructure
- ∞ Water Management
- ∞ Water Science and Engineering

Each year, these programmes are attended by hundreds of engineers, chemists, biologists, earth scientists, and other professionals from all over the world. The graduates are awarded a Master of Science degree. The programmes are subject to accreditation under Dutch law.

### **1.3 Research and PhD Programmes**

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UNESCO-IHE carries out scientific research, often in co-operation with universities and research institutes in developing countries. A number of positions are available for PhD research. The PhD programme has a nominal duration of 4 years and can be carried out either in Delft or in a sandwich

construction. The PhD degrees are awarded by UNESCO-IHE together with a Dutch university. Candidates should preferably hold a UNESCO-IHE MSc degree, but an equivalent degree from another reputed university may also be acceptable.

## **1.4 Organisation**

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The Rectorate of the Institute consists of a Rector, a vice rector Academic Affairs and a Business Director. The organisation is structured into departments, which are further subdivided into various sections. Within the organisation structure, three academic departments are distinguished:

- z Water Science and Engineering
- z Environmental Engineering and Water Technology
- z Integrated Water Systems and Governance

These departments have one or more academic cores in the major fields, each with a leading professor, who is assisted by academic staff and research fellows. Process management support units and a education bureau provide administrative support.

Besides the academic staff of UNESCO-IHE, education is provided by selected guest lecturers, who are experts employed by universities, research institutes, government agencies, consulting firms, international organisations, etc. in the Netherlands and abroad.

## **2 Programme framework**

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### **2.1 Introduction**

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#### **The Master of Science Degree Programmes**

The Institute provides the following Master of Science degree programmes:

- z the master programme in Environmental Science;
- z the master programme in Municipal Water and Infrastructure;
- z the master programme in Water Management; and
- z the master programme in Water Science and Engineering.

These programmes have a nominal duration of 18 months and are leading towards a Master of Science (MSc) degree in the respective field upon successful completion. Each programme has several distinct specialisations, in which students follow a programme curriculum best suited to their preference.

The minimum study load of the programmes is 106 credit points, expressed in units defined by the European Credit Transfer and Accumulation System (ECTS).

## 2.2 Academic Regulations

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The *Education and Examination Regulations* (separately included in this handbook) provide the basic data of the programme, including the major rules around the examinations and the rights of students to inspect the results of the examination assessment.

The regulations describe the precise details of how examinations are assessed and marked, the procedures and rules for re-examinations, procedures for appeal, and which results are required for awarding the Master of Science degree.

Students are strongly advised to familiarise themselves with these procedures at an early stage during their study.

## 2.3 Structure of the Programmes

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The programmes are conducted over a period of 18 months during two academic years. The general planning structure is shown in the *Academic Calendar*.

In the first year, the calendar is divided into 14 periods of three weeks, in which the components of the curriculum are presented as modules. After each second module, a separate week is reserved during which the examinations for the two modules take place. The first six months of the second year are reserved for completion of the MSc thesis research work.

Within each programme, the following generic components are distinguished:

- z ten taught modules of 5 credit points each;
- z fieldtrips and groupwork, total 10 credit points;
- z a special/research topics module of 3 credit points;
- z the thesis proposal preparation of 7 credit points;
- z the thesis research and examination, 36 credit points.

## 2.4 Curriculum Information

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All components of the programme curriculum are described by a syllabus (summary) in the programme-specific part of the handbook providing the following information, which is further detailed in the sections below:

- z the name and code of the subject;
- z the learning objectives;
- z the pre-requisite knowledge or skills;
- z the study load hours and credit points;
- z the lecture, exercise and examination contact hours;
- z the nature and weights of the examination parts;
- z the responsible lecturers/examiners;
- z a concise description of the contents and working methods; and
- z the required and recommended literature, and other materials.

## 2.5 Learning Objectives

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Each programme specialisation has a set of learning objectives that state the knowledge, insight and skills achieved by students who successfully complete the programme. A distinction is made between discipline-specific learning objectives, which are required by the field of study, and general academic skills, which are expected from university education graduates. The programme objectives for each specialisation are provided in the programme-specific part of the handbook.

Similarly, each component of the curriculum has a set of learning objectives, which detail the specific outcomes if the student completes that part of the programme. The individual subjects usually aim to achieve a further detailed subset of the overall learning objectives.

## 2.6 Working Methods

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The programmes are conducted using a combination of lectures, exercises, assignments and examinations. The latter are described separately in the next section.

Lectures serve one or more of the following functions:

- z to impart information;
- z to introduce and explore a topic;
- z to build-up complex structures step-by-step;
- z to clarify and illustrate concepts and ideas detailed in the literature or lecture notes; and
- z to provide a framework for further independent study and reading.

An exercise takes one of the following forms:

- z a design or practical exercise;
- z a computer or other workshop;
- z a laboratory session;
- z a fieldwork or fieldtrip; and
- z a groupwork discussion.

Assignments are carried out independently by the students and consist of all required activity to:

- z study or practice the lecture material;
- z prepare a report, thesis or presentation;
- z work out the results of an exercise;
- z conduct an experiment or test;
- z prepare for an examination; and
- z conduct a research or other study.

## 2.7 Examinations

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Examinations serve to test if students have achieved the learning objectives for a specific component of the programme, and ultimately those of the programme itself. The examination for a component may be composed of multiple parts. For example, a combination of a written or oral test and one or more assignments to handed in separately. Examination work can also be produced by (small) groups of students working together on an assignment, e.g. the groupwork report.

Assessment of examination material is carried out by appropriate examiners, which are usually the involved lecturers. Students who successfully complete a component of the programme will be granted the credit points for that component. Fieldtrips may require active participation instead of an examination in order to receive the credit points.

For each examination, students are informed about the assessment results via e-mail. When all examinations have been passed, the student has successfully completed the so-called programme examination and will be awarded the degree.

## **2.8 Study Load**

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All scheduled education activity taking place in the presence of a lecturer or an assistant is designated as contact time. All other time spent by students in relation to the study programme is designated as independent study time.

The study load for (a part of) a programme is the cumulative contact time and independent study time that is nominally required to successfully complete that (part of the) programme. Study load is expressed in whole ECTS credit points, where one ECTS credit point is equivalent to 28 working hours.

The study load credits for a curricular activity indicate the notional time spent by an average learner to achieve the required outcomes for that activity, as specified by the learning objectives. The nominal time expenditure for a 5 ECTS credit points module is therefore 140 hours.

Where study load involves scheduled class-based activity, one lecture period is taken equal to two hours of contact time.

## **2.9 Planning and Scheduling**

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Lectures and exercises taking place inside the Institute are, in principle, scheduled into 'periods' of two hours each, for which the following times are available:

Period 1 08:45 – 09:30 and 09:45 – 10:30

Period 2 10:45 – 11:30 and 11:45 – 12:30

Period 3 13:45 – 14:30 and 14:45 – 15:30

Period 4 15:45 – 16:30 and 16:45 – 17:30

Throughout the academic year, the student will receive the following information and materials:

- ⌘ schedules of the educational activities;
- ⌘ required lecture notes, textbooks and other course-related material;
- ⌘ announcements of examination planning details; and
- ⌘ statements on examination results and study progress.

## **2.10 Participation**

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Active participation and attendance by students is required for all curricular activities on the schedule. Students have to inform their programme coordinator as early as possible when they are not able to attend a scheduled programme activity.

## **2.11 Evaluation of the Programme by Students**

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As part of the quality assurance procedures of the Institute the programmes are routinely evaluated in order to obtain feedback from the students regarding the quality of the content and the performance of the lecturers. The evaluations are based on a module questionnaire, which the students complete in separate class sessions.

The questionnaire asks the students to provide a rating for achievement of the learning objectives, the study load feasibility, the contents of the subject matter, the balance between the various working and examination methods, the quality of the lecture materials, and the presentation by the lecturers. Furthermore, additional written comments and an overall rating for the module may be provided.

The module evaluations are carried after the examination, but before the results have been announced. Students can also request to address specific programme related issues in a group or individual discussion with the involved coordinator or lecturers.

Feedback on the programmes from the students is much appreciated. The Institute uses the results of the evaluations to improve the academic programmes where necessary, in order to maintain high standards of education.

## **3 Regulations**

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### **3.1 Exam regulations**

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Click here for the separate document:

[Education and examination regulation cohort 2012-2014 \(pdf\)](#)

### **3.2 Library regulations**

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#### **Fair use of on-line information resources at the UNESCO-IHE Library**

The UNESCO-IHE Library Services provides access to a large number of on-line information resources and databases. Access to these resources is provided to all computer users within the premises at Westvest and through remote authentication via the UNESCO-IHE portal.

By using these on-line resources you agree with the following conditions:

1) Systematic downloading of electronic journals articles using manual means is permitted only within reasonable amounts; no more than 50 downloads per user within 24 hours.

2) Programmatic downloading / 'web crawling' are not allowed. In addition to systematic downloading of files manually, the use of a spider (web crawler), the intention of which is to programmatically download data within a specific website, is prohibited.

3) Copyright/reproduction. It is prohibited to reproduce entire or parts of publications in your own publication without the consent of the publisher. You are obliged to provide a correct source reference of all of the material at all times.

4) Selling and providing material to third parties is strictly forbidden. The re-sale of material purchased subject to license to third parties is prohibited; this applies both within and outside of the Institute for which the materials have been purchased.

5) Permanent archiving. Large-scale archiving is not permitted on the local servers or your hostel personal computer nor is the continued use of these servers as an archive, in collaboration with third parties or otherwise. The temporary storage of archive material for personal use is permitted for a period not longer than 120 days.



6) Making changes to an original work. Infringing upon an original work by merging various original texts into a document or by amending original texts is prohibited. Processing materials in such a way is an infringement upon the copyright that is held by the publisher or the author him/herself.

**Infringement of one or all of the above mentioned stipulations will be considered as academic misconduct and will result in disciplinary measures, which will be proportionate to the seriousness of the infraction. The Rector will decide upon the disciplinary measures which will be taken. These measures may include temporary or permanent suspension from attending class.**

### **3.3 Code of conduct**

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#### **THE RECTORATE OF UNESCO-IHE**

In consideration of the need for rules and regulations concerning the safety and the proper use of the buildings, grounds and facilities of UNESCO-IHE by students and visitors;

In accordance with article 7.57h and article 9.2, first paragraph, of the Higher Education and Scientific Research Act of the Netherlands;

Having heard the Student Association Board;

#### **RESOLVES**

To establish the following Regulations:

##### **Article 1 Definitions**

##### **1.1 WHW**

Higher Education and Scientific Research Act of the Netherlands (Staatsblad Bulletin of Acts and Decrees 1992, 593);

##### **1.2 the Director**

The director of UNESCO-IHE

##### **1.3 the Rectorate**

The director and the deputy director

##### **1.4 Central services department**

The central services department of UNESCO-IHE

##### **1.5 Facilities**

The institute buildings, the interior and equipments as well as rented office and accommodation facilities

##### **1.6 Buildings**

The buildings of UNESCO-IHE, located at Westvest 7, Delft

##### **1.7 Student**

Anyone who is enrolled at UNESCO-IHE for the purpose of education provided by UNESCO-IHE

and who uses the educational and examination facilities of UNESCO-IHE for this purpose;

## 1.8 Visitor

Anyone who is not a student nor is employed by IHE-Delft as referred to in article 1.1 of the Collective Labour Agreement (CAO) for Dutch Universities.

### Article 2 Compliance requirement for rules, guidelines and instructions

2.1 Any student or visitor making use of the grounds, buildings or facilities of UNESCO-IHE is required to comply with all rules, instructions and/or directions issued by the Rectorate and delegated staff with regard to maintaining order and proper social conventions of the host country within the buildings and on the grounds. According to the in the institutes code of undesirable behaviour the following is considered to be undesirable behaviour: sexual harassment, aggression, or violence, both verbal and non-verbal towards course participants, staff, visitors or contracted staff. Furthermore all participants, staff, visitors and contracted staff are to observe and comply with the rules and regulations with regard to appropriate and legitimate use of the facilities of UNESCO-IHE scrupulously and without delay, and is required to deport him or herself such that:

a. he or she does not cause direct or indirect damage to UNESCO-IHE or to other persons who are present on the grounds or in the buildings of UNESCO-IHE or who make use of the facilities of UNESCO-IHE, nor that he or she causes nuisance or annoyance;

b. he or she does not infringe on the rights of UNESCO-IHE or of other persons who are present on the grounds or in the buildings of UNESCO-IHE or who make use of the facilities of UNESCO-IHE;

c. he or she does not act contrary to statutory obligations;

d. he or she does not act contrary to appropriate and proper social conventions with regard to people or property.

2.2 It is prohibited to wear clothing that covers the face or to wear other clothing and/or accessories that severely interfere with communication between teaching staff and students or between students themselves or between members of the teaching staff. When sitting an examination it is prohibited to wear clothing that covers the face or to wear other clothing and/or accessories that severely limit the ability to establish the identity of the person in question.

2.3 The Head of the Central Services department may, on behalf of the Rectorate, issue instructions and directions for the purpose of ensuring the smooth and proper use and functioning of buildings and grounds of UNESCO-IHE entrusted to him/her.

### **Article 3 Disciplinary Measures**

The Rectorate may take the following measures against any student or visitor who fails to comply with the contents of these Regulations, with due observance of the procedure described in these Regulations:

- a. excluding the student or visitor from the buildings and grounds of UNESCO-IHE or from one or more parts of UNESCO-IHE, with the provision that a student may only be excluded from buildings or grounds in whole or in part for a period not to exceed one year;
- b. excluding the student or visitor from the use of the facilities of UNESCO-IHE;
- c. fining the student if such fine has been agreed on or follows from the statute;
- d. issuing a written reprimand;
- e. retribution for damages to properties and or facilities.

### **Article 4 Exclusion Order by the Rectorate**

4.1 The Rectorate may immediately issue an exclusion order for the buildings or grounds, or for parts of those buildings or grounds, to a student or visitor who commits an infringement on these Regulations or the rules referred to in article 2, or it may issue an exclusion order for the institute facilities.

4.2 Anyone who is subjected to measures as referred to in the first paragraph will be given the opportunity for a subsequent hearing as soon as possible by or on behalf of the Rectorate if this was not previously possible due to the urgent nature of the matter at hand.

4.3 The exclusion order will contain at least the following:

- a. an indication of the buildings and/or grounds or the parts of the buildings and/or grounds of UNESCO-IHE and/or the facilities or use of the facilities of UNESCO-IHE to which the exclusion order applies;
- b. the duration of the exclusion order;
- c. the reasons for the exclusion order;
- d. any conditions which will result in the effectuation of the exclusion order in case of non-compliance.

### **Article 5 Termination of the exclusion order**

5.1 The Rectorate may, of its own accord or in response to a request by a person who is subject to a disciplinary measure in the form of an exclusion order as referred to in these Regulations, choose to terminate the exclusion order or alter its scope before it has elapsed if there is sound reason to do so according to the judgement of the Rectorate.

5.2 The Rectorate may attach special conditions to the termination or alteration of the exclusion order.

5.3 If in the judgment of the Rectorate the person subject to the exclusion order, and on behalf of whom a proposal to terminate said order has been forwarded, has not met the special conditions set by the Rectorate, then the original exclusion order will once again be put into force; the period of time that has passed since the termination or alteration of the exclusion order will not be deducted from the originally specified period in this case.

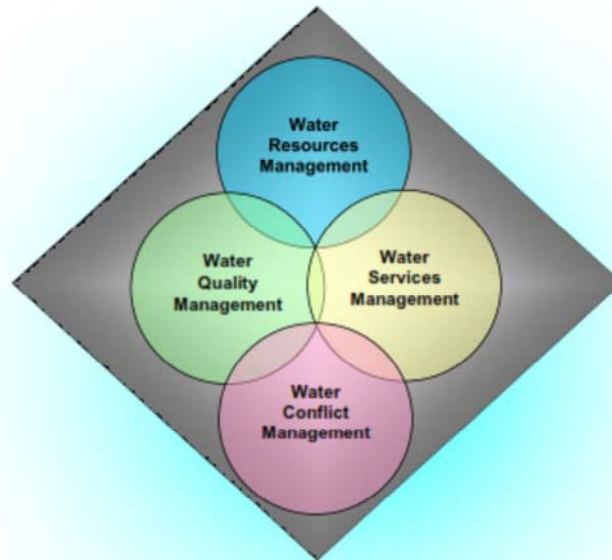
### **Article 6 Entry into force**

These Regulations enter into force on October 1st 2007

**Article 7 Method of Citation**

These Regulations may be cited as “Regulations for the use of buildings, grounds and facilities by students and visitors of UNESCO-IHE”.

Approved in the rectorate meeting of September 25<sup>th</sup> 2007



INTERNATIONAL MASTER'S PROGRAMME IN

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# Water Management

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Handbook 2012 - 2014

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## 4.1 Introduction to WM Programme

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The International Masters program in Water Management (**WM**) builds on the recognition that:

- ∴ *Water plays a key role in the natural and human environment.*
- ∴ *Decisions by water resource planners and developers can have far reaching consequences for society and the environment.*
- ∴ *Efficiency, equity and ecological integrity of natural resources use can only be achieved through an integrated approach involving engineering, law, policies, institutional development and management.*

**WM** covers an interdisciplinary field that combines an understanding of water availability in terms of quality and quantity and hence of key biophysical and hydrological processes with a critical understanding of legal, institutional, economic and other arrangements that regulate access, allocation, treatment, use and discharge of water. The programme aims at imparting to students the knowledge, insight and skills that are required to develop, implement and evaluate water management policies and strategies in order to promote the wise use of water and achieve effective governance of water resources, and to be appropriate candidates for further study towards a research career.

Management implies policy development, planning and design of strategies for sustainable development, allocation of scarce resources, implementation of strategies, and the operation of agencies and utilities. The management approach requires an understanding of problems, causes and an integrated approach to dealing with such problems. Consequently, the objectives of the programme in Water Management consist of three types of aspects:

1. technical aspects that enhance the understanding of physical, biological and other technical processes;
2. non-technical aspects that enhance the understanding of legal, social, economic, financial, institutional and managerial aspects; and
3. integrative aspects that enhance the understanding of the interplay between technical and non-technical aspects.

As such the **WM** programme responds to the concepts of integrated management for sustainable use of resources, as emphasised by the 1992 International Conference on Water and Environment in Dublin and the 1992 Earth Summit in Rio and affirmed by the 2000 World Water Forum in the Hague, the 2002 Johannesburg declaration and the 2003 World Summit on Water in Kyoto.

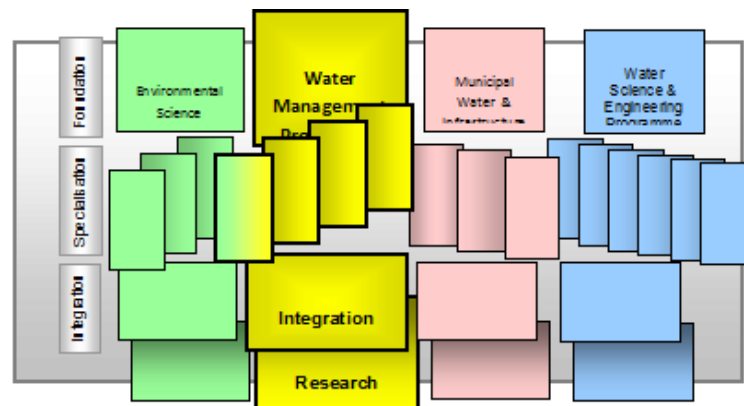
The **WM** programme exposes students to an academic level of thinking and to new developments in the field of study and prepares them to conduct academic research. Furthermore, the approach of UNESCO-IHE is case and solution oriented with an important focus on developing countries. This means that the value of the achieved knowledge and skills is measured in terms of applicability of the science, technology, engineering, planning and policies to water and environmental management. As the concept of sustainable development needs its own unique elaboration in contexts where living conditions of large populations are in a critical stage and environmental protection is sometimes seen as a luxury, the **WM** programme, with specialisations in Water Resources Management (**WRM**), Water Quality Management (**WQM**), Water Conflict Management (**WCM**) and Water Services Management (**WSM**), provides approaches and knowledge that are relevant to these challenging conditions.

In water management education, the development of knowledge together with skills is essential. In the UNESCO-IHE approach, lectures by experts in the field are complemented by assignments, exercises, laboratory and fieldwork and group-work. Innovative distance learning and electronic interactive educational tools support the programme, while further innovations and developments to link up with UNESCO-IHE's global network are ongoing. In addition to increasing accessibility to academic programme elements for interested individuals and professional groups on an ad hoc basis, UNESCO-IHE has introduced a modular structure to stimulate participation by professionals who cannot follow the full-time programme. A module is a three-week concentration of courses around a

specific theme and generally opens to external participants. Short-term participants may thus accumulate credits towards the UNESCO-IHE Master's Degree.

### *Structure of WM Programme*

Water Management is one of four UNESCO-IHE Master's programmes. It is offered as an 18-month Master's of Science (MSc) programme. The first year of the programme are taught modules and is followed by a six-month research period resulting in a thesis. The first year starts with four general modules followed by four modules in three specialisations and another three common modules. One of the specialisations is also carried by another IHE programme: Water Quality Management by the Environmental Science (ES) programme. Participants of the ES programmes will follow the common introductory and concluding modules within their own programme, but combine with the **WM** participants in the **WQM** specialisation.



*Figure 1 Sharing Specialisations between UNESCO-IHE Master's Programmes*

The programme follows a modular structure – each module having duration of three weeks – and consists of three distinct phases:

1. **Foundation** : a common basis at the start of the programme, where candidates of the WRM, WQM, WCM and WSM specialisations follow four common modules.

2. **Specialisation** : four modules in four different specialisations, allowing the participants to broaden, but especially deepen their understanding of specific management issues and learn to apply the necessary tools with regard to water resources, conflict, quality and services management. In addition, participants can select two elective modules, either to further deepen or further broaden their knowledge and skills.

3. **Integration** : participants of the three specialisations come together to test the knowledge, insight and skills acquired in the preceding modules in a multi-disciplinary, problem-solving environment, consisting of a two-week international field trip, facing contemporary water management issues in Europe and a four-week group work seeking management solutions for a simulated river basin in a development context. The **WM** programme culminates in a research proposal development & summer courses period followed by a 6-month research period, dedicated to integrating and applying individual knowledge through applied research in a field directly pertaining to the participant's professional experience, interest and context, integrated with the existing UNESCO-IHE research lines.

The modular structure of the programme allows for sharing of selected modules between specialisations. To a limited extent participants will be allowed to take a module offered under another specialisation or even another programme. However, if a module has not been designated as an elective subject, this will be possible only after prior consultation with and approval of the programme coordinator.

## 4.2 Final Qualifications WM Programme

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### **Knowledge & understanding**

1. Knowledge of current theory and contemporary developments in Water Management.
2. The ability to describe the rationale for an integrated and interdisciplinary approach for managing water systems.
3. Knowledge of biological, physical and chemical principles of water systems.
4. Knowledge of economic, institutional and legal principles, approaches and instruments in water management.
5. Understanding the broader scientific, engineering and socio-economic context and the role of other disciplines required for Water Management.

### **Applying knowledge and understanding**

6. The ability to apply the knowledge and academic capabilities acquired, in management and engineering contexts.
7. The ability to contribute to managing water systems and organisations and to the development of institutional arrangements.
8. The ability to collect, analyse and organise relevant information and to draw sound conclusions.
9. The ability to prepare and implement a scientific research plan.
10. The ability to contribute to theoretical, methodological or applied developments within the field of study.

### **Making judgements**

11. The ability to decide between different ideas and approaches independently, based on available information, and assesses the potential for application, integration and further development.
12. The ability to select and apply a variety of techniques, tools and procedures in order to evaluate the consequences of different development and intervention scenarios.
13. The ability to reflect critically on how different activities impact on the wise use of water.

### **Communication**

14. The ability to report and communicate results clearly, and to explain and defend the reasoning, knowledge and assumptions to a variety of audiences.
15. The ability to function effectively in a multi-disciplinary team.
16. The capability to assess interests among different stakeholders and to facilitate decision-making processes.

### **Learning skills**

17. The ability to extend and enhance one's own knowledge, insight and skills in a largely autonomous manner.



## 4.3 Specializations

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### Specialization

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The Water Management Programme has four Specializations consisting of four modules each to allow participants to deepen their understanding of specific management issues and learn to apply the necessary tools relevant for their Specialization. In addition, participants can choose two elective modules from a wide range of topics to further deepen and/or broaden their knowledge and skills.

The following Specializations are offered within the Water Management Programme:

- z Water Resources Management (WRM)
- z Water Services Management (WSM)
- z Water Conflict Management (WCM)
- z Water Quality Management (WQM)

For more information on the content of each specific Specialization and its learning objectives, please consult the next sections.

## 4.4 Water Resources Management

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The Water Resources Management specialisation studies the ways in which water availability and use are matched, and develops alternative land use and water allocation policies and models and legal and institutional arrangements from the local watersheds to the basin scale and beyond. The specialisation starts with the module *Negotiation and Mediation for Water Conflict Management I* which addresses the issues potential for conflict and for cooperation when sharing water resources. And, the module *Water Systems Modelling*, which provides a broad introduction to the basics of hydrological, hydraulic and systems modelling; acquiring an understanding of operational concepts through transparent spreadsheet models, the participant develops an intuitive ability to interact with more advanced modelling approaches. Tested and innovative approaches for effective water resources planning, strategy formulation, economic theory and impact assessment and multi-criteria evaluation of management options at the national and international river basin level provide the learning environment in the module *Water Resources Planning*.

The module *Water and Environmental Law* allows participants to place water and environmental resources management in a policy, law and institutional context. Even in a conducive external law and institutional environment, management is unlikely to be successful unless the participant is able to embed them in a functional organisational framework. The participants can then choose between *Managing Water Organisations* and *Advanced Water Systems Modelling*. The module *Managing Water Organisations* will provide participants keen insight into what makes and keeps an organisation and its managers effective in addressing changing demands on its services. *Advanced Water System Modelling* introduces optimisation tools and catchment balances based on remote sensing and GIS. Concluding the specialisation, the participant selects the module *Watershed and River Basin Management* or the module *Public-Private Partnerships (PPP)*. *Watershed and River Basin Management* allows the participant the opportunity to assess land and water resources in their natural and anthropogenic interactions at the detailed watershed level, but without losing sight of the potential effects on the larger river basin scale. *PPP* provides a good understanding of arguments and practices of contemporary institutional arrangements in the water services sector and their implications on regulation, labour and economics.

The learning objectives of the WRM specialization are as follows:

### ***Knowledge & theory***

1. Be able to describe and predict for a given water resources system the main hydrological, hydraulic, chemical and ecological processes and how these processes are dynamically linked with human activities, including land and water use.

2. Be able to describe and explain the main concepts and instruments for analysing and influencing formal and informal arrangements over water, including policies, laws and institutions, and by adopting a historical perspective.
3. Be able to explain the key concepts for integrated, multi-disciplinary and interdisciplinary analyses of water systems and describe the challenges of such approaches.
4. Be able to describe different concepts to determine the value of water for various uses and users in (amongst others) economic and social terms and explain how these concepts can be used in water resources planning at various spatial and temporal scales

### **Methods, techniques & tools**

5. Be able to model processes of the water system (rainfall-runoff, flooding, water allocation, water accounting), validate models, critically interpret model outcomes in order to derive insight in trends, causes and effects, and define and explain model limitations.
6. Be able to formulate and critically evaluate governance frameworks related to water resources management, apply tools for policy analysis with emphasis on social inclusion and sustainability.
7. Be able to combine different types of method and through a process of triangulation synthesize outcomes in a coherent manner.

### **Analysis, synthesis & integration**

8. Be able to define a given water resources system, and compose the water flows across time and space, including the various water uses, and describe the interdependencies these create between the various water users.
9. Be able to critically evaluate technical and/or institutional water resources interventions (projects/ programmes/ policies/ agreements) through analysis of implications for the water resources system, its users and their interrelations at various spatial and temporal scales.

### **Research**

10. Be able to conduct, independently or in a multidisciplinary team, research including the formulation of research questions and hypotheses, the selection and application of adequate research methodologies and techniques and the formulation of well-founded conclusions, recommendations and limitations.

### **General academic skills**

11. Be able to clearly and systematically communicate, argue and defend findings in oral and written presentations to a variety of audiences.
12. Think in multidisciplinary, integrated dimensions. Be able to distinguish main issues from side issues.
13. Have the academic attitude and learning skills to enhance and keep up-to-date the acquired knowledge and application skills in a largely independent manner.

## **4.5 Water Quality Management**

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The Water Quality Management specialisation studies the water quality impacts of human activities on aquatic ecosystems, as well as alternative remedial actions, under different levels of environmental stress and in different socio-economic contexts. The specialisation starts with the module *Water Quality Assessment*, in which the participant re-acquaints her-/himself with common and critical water pollution parameters, their indicators, sources, causes and effects. Appropriate monitoring, modelling and risk assessment techniques are demonstrated, discussed, applied in case study and simulated settings.

The elective module *Wetlands for Water Quality* combines the use of electronic learning and video-conferencing with hands-on field visits, guest lectures and seminars. The participant realises that in addition to wetlands conservation and safeguarding biodiversity, wetlands have all the ingredients to

play a potentially crucial role in wastewater treatment. The third and fourth Water Quality Management specialisation modules are shared with the Water Resources Management specialisation: *Environmental Planning and Implementation*, where the participant will learn to apply sustainable development concepts to policy analysis techniques, as environmental impact assessment and natural resource valuation. And the *Water and Environmental Law* module as described under the previous specialisation.

In the module *Aquatic Ecosystems* the participant is encouraged to grapple with environmental issues related to the use of and impacts on freshwater ecosystems. This module immerses the participant in practical field measurements of a small catchment, combined with laboratory experiments based on samples taken, GIS and computer modelling. Concluding the specialisation, the participant selects either the module *Watershed and River Basin Management* or the module *Public-Private Partnerships* (described above).

The the learning objectives of the WQM specialization are as follows:

### ***Knowledge and theory***

1. Be able to describe and predict for a given water resources system the main hydrological, hydraulic, chemical and biological processes and how these processes are dynamically linked with aquatic ecosystems as well as with human activities such as land and water use and pollution.
2. Be able to describe and explain the main concepts and instruments for analysing and influencing formal and informal arrangements for water quality management, including policies, laws and institutions, and by adopting a historical perspective.
3. Be able to explain the key concepts for integrated, multi-disciplinary and interdisciplinary analyses of aquatic ecosystems and describe the challenges of such approaches.
4. Be able to describe concepts to determine the value of water for various uses and users in (amongst others) economic and ecological terms and explain how these concepts can be used in water resources planning at various spatial and temporal scales.

### ***Methods, techniques and tools***

5. Be able to interpret, design and optimize water quality assessment and monitoring programmes by applying experimental, statistical and modelling tools.
6. Be able to formulate and critically evaluate governance frameworks related to water quality management and apply tools for policy analysis with the emphasis on social inclusion and sustainability.
7. Be able to combine different types of method and through a process of triangulation synthesize outcomes in a coherent manner.

### ***Analysis, synthesis and integration***

8. Be able to define a given water resources system, and compose the water and pollution flows across time and space, including the various water uses, and describe the interdependencies these create between the various water users.
9. Be able to critically evaluate technical and/or institutional interventions focused on water quality (projects/ programmes/ policies/ agreements) through analysis of implications for the water resources system, its users and their interrelations at various spatial and temporal scales.

### ***Research***

10. Be able to conduct, independently or in a multidisciplinary team, research including the formulation of research questions and hypotheses, the selection and application of adequate research

methodologies and techniques and the formulation of well-founded conclusions, recommendations and limitations.

### ***General academic skills***

11. Be able to clearly and systematically communicate, argue and defend findings in oral and written presentations to a variety of audiences.
12. Think in multidisciplinary and integrated dimensions and be able to distinguish main issues from side issues.
13. Have the academic attitude and learning skills to enhance and keep up-to-date the acquired knowledge and application skills in a largely independent manner.

## **4.6 Water Services Management**

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The Water Services Management specialisation studies the provision of water and sanitation services and the management of related infrastructure, and designs new institutional and financial instruments and business models for different socio-economic contexts. Technical and engineering options, standards and developments are unearthed in the module *Water Supply and Sanitation Systems*. The participant matches water supply and sanitation technology to a wide range of local conditions to ensure sustainable performance and technical reliability. In the second module of the specialisation, *Institutional Analysis*, the participant confirms the primary and supporting objectives and activities for service delivery. The participants re-think sectoral and organisational vision, mission, goals and objectives and evaluate business processes in light of suitable institutional arrangements. The module *Financial Management in the Water Sector* allows the participant to demythologise the finance issue at the level of the utility and suggests different ways of financing water companies and cost-recovery for sanitation and wastewater treatment. The module *Managing Water Organisations* will provide WSM participants profound understanding into what makes and keeps an organisation and its managers effective in addressing changing demands on its services. Concluding the specialisation, the participant selects a module in line with her or his professional interests from *Watershed and River Basin Management* or *Public-Private Partnerships* (described above).

The learning objectives of the WSM specialization are as follows:

### ***Knowledge and theory***

1. Be able to describe for a given water resources system the interplay between the main biophysical processes and social dynamics, in analyzing service delivery modalities.
2. Be able to describe and explain the main concepts and instruments for analysing and influencing formal and informal arrangements concerning water supply and sanitation services, including policies, laws and institutions, and by adopting a historical perspective.
3. Be able to explain the key concepts for integrated, multi-disciplinary and interdisciplinary analyses of water services management and describe challenges of providing water supply and sanitation services at different levels (from global to local).
4. Be able to summarize the current debates relevant for water supply and sanitation services, using institutional and management theories from different academic disciplines (e.g. economics, public administration, sociology, political science, law).

### ***Methods, techniques and tools***

5. Design and apply analytical tools to research issues of water services management and describe, modify and apply management tools (e.g. with the benchmarking, cost benefit analysis, management information systems) with the aim of improving water supply and sanitation provision.

6. Be able to formulate and critically evaluate governance frameworks related to water services management and apply tools for policy analysis with the emphasis on social inclusion and sustainability.

7. Be able to combine different types of method and through a process of triangulation synthesize outcomes in a coherent manner.

### ***Analysis, synthesis and integration***

8. Be able to analyze and evaluate governance processes and utility management arrangements in the water services sector, integrating technical, legal administrative, social and financial components.

9. Be able to critically evaluate technical and/or institutional interventions (projects/ programmes/ policies/ agreements) through analysis of implications for water supply and sanitation services, its users and their interrelations at various spatial and temporal scales.

### ***Research***

10. Be able to conduct, independently or in a multidisciplinary team, research including the formulation of research questions and hypotheses, the selection and application of adequate research methodologies and techniques and the formulation of well-founded conclusions, recommendations and limitations.

### **General academic skills**

11. Be able to clearly and systematically communicate, argue and defend findings in oral and written presentations to a variety of audiences.

12. Think in multidisciplinary and integrated dimensions and be able to distinguish main issues from side issues.

13. Have the academic attitude and learning skills to enhance and keep up-to-date the acquired knowledge and application skills in a largely independent manner.

## **4.7 Water Conflict Management**

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Water Conflict Management studies the management of conflicts over water resources. It focuses on negotiation, mediation and decision-making processes, in order to prevent, manage and resolve conflicts concerning water. The specialisation starts with the module Negotiation and Mediation for Water Conflict Management I which addresses the issues potential for conflict and for cooperation when sharing water resources. During the second module, Negotiation and Mediation for Water Conflict Management II, the participant will be able to design and facilitate inclusive consultation, negotiation, mediation and decision-making processes between various water users, water managers, politicians and other decision makers. Tested and innovative approaches for effective water resources planning, strategy formulation, economic theory and impact assessment and multi-criteria evaluation of management options at the national and international river basin level provide the learning environment in the module Water Resources Planning. The content of the Water and Environmental Law module is described earlier. Part of the WCM participants will go to Dundee for modules on International Law of Water Resources, National Water Law and Regulation and Governance in Public and Private Services Provision. The participants remaining in Delft will follow Managing Water Organisations and choose between Watershed and River Basin Management or Public Private Partnerships (all described above).

The learning objectives of the WCM specialization are as follows:

### **Knowledge & theory**

1. Be able to describe for a given water resources system the interplay between the main

biophysical processes and social dynamics, in analyzing, anticipating, preventing and managing conflicts.

2. Be able to describe and explain the main concepts and instruments for analysing and influencing formal and informal arrangements over water for collaboration, including policies, laws and institutions, and by adopting a historical perspective.
3. Be able to explain the key concepts for integrated, multi-disciplinary and interdisciplinary analyses of water systems and describe the challenges of such approaches at sector, intersectoral and transboundary levels.
4. Be able to name and critically discuss theories, concepts and tools of conflict management and cooperation building techniques in the context of natural resources and water in particular.

#### **Methods, techniques & tools**

5. Be able to design and facilitate inclusive consultation and conflict management processes, such as consensus building, public participation, negotiation and mediation between actors at different levels.
6. Be able to formulate and critically evaluate governance frameworks related to water conflict management and apply tools for policy analysis with the emphasis on social inclusion and sustainability.
7. Be able to do combine different types of method and through a process of triangulation synthesize outcomes in a coherent manner.

#### **Analysis, synthesis & integration**

8. Be able to define a given water resources system, assess the different functions of the water resources system and the often competing interests of water using sectors and actors, describe the interdependencies between these, and finally assess the possibilities and limitations of cooperation.
9. Be able to critically evaluate technical and/or institutional interventions focused on conflict management (projects/ programmes/ policies/ agreements) through analysis of implications for the water resources system, its users and their interrelations at various spatial and temporal scales.

#### **Research**

10. Be able to conduct, independently or in a multidisciplinary team, research including the formulation of research questions and hypotheses, the selection and application of adequate research methodologies and techniques and the formulation of well-founded conclusions, recommendations and limitations.

#### **General academic skills**

11. Be able to clearly and systematically communicate, argue and defend findings in oral and written presentations to a variety of audiences.
12. Think in multidisciplinary and integrated dimensions and be able to distinguish main issues from side issues.
13. Have the academic attitude and learning skills to enhance and keep up-to-date the acquired knowledge and application skills in a largely independent manner.

## **4.8 Academic Staff**

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### **Programme committee**

Prof. P. van der Zaag, PhD; Chair, Head WRM & WCM Specialization

J. Kemerink, MSc; Secretary, Programme Coordinator

M. Rusca, PhD; Member, MSc Research coordinator

Prof. M.P. van Dijk, PhD; Member, Head WSM Specialization

M.L. Mul, PhD; Member, Coordinator WRM

P. Kelderman, PhD; Member, Coordinator WQM

P. Libaudiere, MA; Member, Coordinator WSM

Z. Shubber, LL.M; Member, Coordinator WCM

S.J. van Andel, PhD; Member representative WSE

J.H. Koster, MSc; Senior Education Advisor

### **Module coordinators**

**WM1** J. Kemerink

**WM2** I. Masih

**WM3** M. Rusca & J. Kemerink

**WM4** Y. Jiang

**WRM5** Y. Mohamed

**WCM5** Z. Shubber

**WQM5** P. Kelderman

**WSM5** S. Seyoum

**WRM6** M. Mul

**WSM6** M. Blokland

**WQM6** H. van Bruggen

**WCM6** Z. Shubber

**WRM7** I. Masih

**WQM7** M. Hamdard

**WSM7** P. Libaudière

**WM8** F. Jaspers

**WM9** S. Graas & N. van Couwenberg

**WQM10** G.M. Gettel

**WSM10** M.P. van Dijk

**WM10** K. Schwartz & J. Kemerink

**WQM11** Y. Jiang & M. Hamdard

**WSM11** M. Kooy & M. Rusca

**WM12** K. Schwartz & S. Graas

**WM13 & WM15** M. Rusca

**Academic Staff in Water Management Programme**

M.W. Blokland, Associate Professor of Water Services Management

J.J.A. van Bruggen, Senior Lecturer in Microbiology

R.A.M. de Bruijn, Head of Financial Department

J.P. Buiteman, Senior Lecturer in Sanitary Engineering

R.W. Camies, Producer Video and Multimedia

A. Crosato, Senior Lecturer in River Morphology and River Engineering

A.A. van Dam, Senior Lecturer in Ecological & Environmental Modelling

L.P. Darvis, Librarian

M.P. van Dijk, Professor of Water Services Management

W.J.A.M. Douven, Senior Lecturer Environmental Systems Analysis

S. Graas, Senior Lecturer in Water Systems Modelling

A.B.K. van Griensven, Lecturer in Environmental Hydroinformatics

J. Gupta, Professor of Policy Law of Water Resources and Environment

G. Gettel, Lecturer in Aquatic Biogeochemistry

E.M.A. Hes, Lecturer in Environmental Science

M. Hamdard, Lecturer in Environmental Planning and Management

J.C. Heun, Associate Professor of Water Resources Management

H. Helbron, Lecturer in Environmental Planning and Management

M. Hofstra, Senior Advisor Policy Analysis and Water Governance

F.G.W. Jaspers, Associate Professor in Water Resources Management



Y. Jiang, Lecturer in Water Economics

P. Kelderman, Senior Lecturer in Environmental Chemistry

J.S. Kemerink, Lecturer in Water Governance

M. Kooy, Lecturer in Water Governance

F. Kruis, Head of Environmental Laboratory

J. Leentvaar, Professor Environmental Policy Making

P. Libaudière, Lecturer in Water Economics

S. Maskey, Senior Lecturer in Hydrology

Y. Mohamed, Senior Lecturer in Water Resources Management

S. Mugisha, Lecturer in Water Services Management

M.L. Mul, Senior Lecturer in Water Resources Management

J.C. Nonner, Associate Professor of Geohydrology

I.P. Popescu, Senior Lecturer in Hydroinformatics

M. Rusca , Lecturer in Water Governance

M. Ronteltap, Lecturer in Water Supply

E. de Ruyter, Senior Lecturer Aquatic and Marine Ecology

L. Salame, Lecturer in Water Conflict Management

K.H. Schwartz, Senior Lecturer Institutional Development

S.K. Sharma, Senior Lecturer in Water Supply

Z. Shubber, Lecturer in Water Conflict Management

A. Szöllösi-Nagy, Rector UNESCO-IHE Institute for Water Education

W.J. Sturrock, Lecturer in English Communication Skills

S. Uhlenbrook, Professor of Hydrology

N. van Cauwenbergh, Lecturer in Water Resources Management

P. van der Zaag, Professor in Integrated Water Resources Management

J. Wenninger, Senior Lecturer in Hydrology

**Guest Lecturers in Water Management Programme**

Ph. Barret GEYSER Association

W.G.M. Bastiaanssen, PhD Professor ITC

R. Beltman ICSB

M. Bijlsma Private consultant

A. Bolding, PhD Wageningen University

G. van Boven, MSc Netherlands Commission for Environmental assessment (MER)

R. Brouwer VU Amsterdam

F. Cleaver, PhD University of Bradford

P. Droogers, PhD Future Water

E. Harlé SUEZ

P. Hellegers Wageningen University

S. Hendry Dundee University

A.Y. Hoekstra, PhD Professor Twente University

A. Janssen HKV Consultants

F. Kansiime, PhD Makerere University

G.J. Klaassen Private consultant

K. Komives ISS

J. Kowarsky Israeli Centre for Negotiation and Mediation

H.A.M. de Kruijf, PhD Eco Assistance

A. Kolhoff, MSc Netherlands Commission for Environmental assessment (MER)

W. van der Krogt Deltares

J. Kuylenstierna UN Water

J. Labre SUEZ

P. Meerts Netherlands Institute of International Relations 'Clingendael'

E. Mostert Delft University of Technology

E. Meijers Deltares

T. Perianu SUEZ

J. Pokorny, PhD ENKI Trebon

E. Rap, PhD Wageningen University

H.H.G. Savenije, PhD Professor TU Delft

B. Schijf, MSc Netherlands Commission for Environmental assessment (MER )

A. Schuurmans PSO

F. Smits Waternet, research and engineering

A. Tilmant, PhD Professor Laval University

J.M. Trondalen Compass and UNESCO-PCCP

T. Van Heijzen Vitens

N. Veldkamp WMD

J. Vera Delgado, MSc Wageningen University

M. Vis, PhD Delft Hydraulics

J. Vymazal, PhD ENKI Trebo

A. Wolf Oregon State University

## **5 Facilities**

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### **5.1 Location**

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The UNESCO-IHE buildings and facilities are located on a single compound at the Westvest 7 in the centre of Delft. The buildings provide a pleasant and efficient atmosphere for optimal learning and creativity, direct communication with lecturers and other staff, as well as meeting with fellow students. The building is open during the following times:

Monday to Friday 07:30 – 20:00

Saturday 08:00 – 12:30

### **5.2 Student Affairs (office)**

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The Student Affairs office provides non-academic support to students. The SA office takes care of student applications and student registration. The new students are also assisted with formalities such as applications for residence permits, insurance, bank accounts, and fellowship issues. Housing arrangements in one of the hostels are being made immediately upon arrival.

Throughout their study period, students can contact the staff during office hours for information or questions related to health, religion or other issues related to the student's well being. Personal matters can be discussed with the student counsellor and will be dealt with strictly confidential.

During the entire academic year, SA organizes a number of social and cultural activities including the weekly movie night, social evenings and the annual Christmas dinner. Other activities include cultural excursions to interesting cities and places in the Netherlands and other countries in Europe.

Furthermore, the students are given opportunity to actively practice sports on a regular basis. From October to May, the Institute arranges accommodation in Delft for such sports as soccer, volleyball, basketball and badminton. The SA office organizes sports events and tournaments, in which the teams can compete internally, but also against players from other international institutes.

### **5.3 Student Association Board**

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The Student Association Board (SAB) is composed of representatives who are elected by the students in annual elections that take place some four weeks after the opening of the academic year.

The SAB provides a forum through which students can share their experiences, problems and general issues on study-related matters. If necessary, the SAB will bring these matters forward in discussions with the executive levels of the Institute. The board can be contacted directly via its members or the general e-mail address [sab@unesco-ihe.org](mailto:sab@unesco-ihe.org).

The SAB closely co-operates with the Student Affairs office in organizing social and sporting events. The board also publishes its own magazine *The Informer*, in which the rich variety of contributions are entirely derived from, and produced by, the student community.

### **5.4 ICT services**

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UNESCO-IHE provides modern computing (IT) facilities for education and research. A local wired- and wireless network is available in UNESCO-IHE's building. Through UNESCO-IHE's networks all computers have access to a fast Internet connection. Besides that, participants have unlimited access to Internet in all hostels provided by UNESCO-IHE.

All UNESCO-IHE desktop and laptop PCs are Intel based with Microsoft Windows operating system. The UNESCO-IHE laptop PC will be provided in order to get access to the IT-facilities. The laptop is on loan for use during studying at UNESCO-IHE. At the end of the study, UNESCO-IHE offers the possibility to buy the laptop. The contract given clearly states the terms and conditions for

borrowing the laptop. Bringing one's own laptop is allowed; however, laptops other than the UNESCO-IHE laptop might not give access to all the required IT-facilities and might not be supported by IT-service desk.

A wide range of software packages is available, ranging from standard PC-software, like Microsoft Office (Word, Excel, etc.) to special modelling software used for the educational programmes. All participants will get a free UNESCO-IHE web-based e-mail box. A web-based E-learning and collaborative system is accessible for all participants to exchange learning information and documents.

For specific applications during the thesis study, it may be possible to use specialist software packages on the laptop PCs. This is, however, dependent on the particular type of licence agreement that the Institute has with the supplier. Enquiries for specific software should be made at the computer helpdesk.

## **5.5 General Facilities in the Building**

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In the reception area of the building, students have their own locker for the distribution of schedules, lecture notes and other study-related papers, and private mail. Last-minute changes in schedules are indicated on the announcement board near the entrance. Two monitor screens opposite the reception desk are regularly updated with news or information on events taking place at UNESCO-IHE.

Private telephone calls can be made from card-operated phone booths located next to the reception desk. Photocopy services are available to students. There is also a facility to recharge chip-cards, which students receive from the bank to pay for small purchases without using cash. Furthermore, the building contains a meditation room, which is located on the third floor.

The restaurant provides a wide variety of reasonable-priced multicultural meals and beverages during lunchtime. The meals can be paid using the chip-card or cash. Coffee, tea and soft drinks can be obtained from machines throughout the day.

The building houses a number of fully-equipped lecture rooms and theatres, which can accommodate groups of all sizes from 15 to 300 persons. Rooms for facilitating computer classes and workshops are present and can be used freely by students outside class hours. Furthermore, the Institute has its own printing and reproduction facilities and also contains an in-house distance learning and video conferencing centre. The library, computer facilities and laboratory are described in detail below.

## **5.6 UNESCO-IHE Library and Information Services**

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UNESCO-IHE's Library provides access to over 35,000 printed titles, among which the complete collection of UNESCO-IHE Master thesis and PHD dissertations. Furthermore the collection contains over 8.000 online journals. The online journals collection is accessible on the network at the Westvest premises or through remote authentication through the UNESCO-IHE portal. For more information please visit the Library's Internet page <http://www.unesco-ihe.org/library>

The library is open to all UNESCO-IHE participants and staff, and to visitors by appointment. The services provided by the library include lending out books, requesting articles and other materials through the inter-library loan system and providing assistance in searching the electronic catalogue.

### **Membership**

Upon registration UNESCO-IHE participants receive a registration card which can also be used to borrow items from the library collection.

### **The catalogue**

The library collection is accessible through an electronic catalogue, which is searchable by author,

title (word) and subject, as well as by Boolean operators. Please visit <http://www.unesco-ihe.org/library> for more information.

### Borrowing library items

A maximum of ten items may be borrowed from the library at any one time. The maximum loan period is 21 days, renewable up to a maximum of 42 days. Renewals can be made online, <http://www.unesco-ihe.org/library> by using the borrower information function within the catalogue or by email ([library@unesco-ihe.org](mailto:library@unesco-ihe.org)). Please note that the loan period can be extended only if the items have not already been reserved by another person.

Reference works, M.Sc theses, bound and non-bound periodicals and materials bearing a green sticker may not be borrowed. By using their library card to borrow items from the library, borrowers agree to be responsible for those items, including the cost of replacing lost or damaged items.

### Opening Hours

Monday 09:00–18.30

Tuesday-Friday 09:00–19.00

Saturday 09:30–12:30

Please note that the Library opening hours are subject to change. Visit the Library webpage for regular updates.

From July 2011 until December 2011, the Library spaces are being renovated. Most of the printed collections and the reference desk have been relocated to A2 a/b on the first floor and on account of missing the reading room, the opening hours have been changed to Monday-Friday 09-15-17.30

For further information please contact the library reference desk.

Email: [library@unesco-ihe.org](mailto:library@unesco-ihe.org)

Tel: +31 (0)15 215 1714

Fax: +31 (0)15 212 2921

## 5.7 Laboratories

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Modern educational and research laboratories are available in the fields of chemistry, process technology, microbiology, aquatic ecology and soil science. A wide range of standard analytical tests can be performed for chemical, physical and microbiological water, air and soil quality analyses.

Elemental analyses, various kinds of microscopy and analytical techniques such as spectrophotometry, gas- and ion chromatography, and atomic absorption can be carried out. A wide range of laboratory and bench-scale reactors, temperature and light controlled growth chambers, and various constant temperature rooms are available for research in one of the departmental research programs, including waste water management using aquatic macrophytes and wetlands, the adsorption and/or (an-)aerobic degradation of micropollutants, self-purification in drains and filtration. Through close co-operation with the Delft University of Technology and other educational and research institutions, research possibilities are quite extensive.

In addition to the in-house facilities, the laboratory has a range of instrumentation and equipment available for field instruction and for conducting hydrological or environmental field experiments and measurements.

## 5.8 Study Materials

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Study materials such as textbooks, lecture notes and hand-outs are provided by the Institute. Students receive the lecture notes in their personal locker before the start of the involved lecture series. Additional material can be provided by the lecturers in the form of hand-outs. Reference works are available from the Institute library or the library of the Delft University of Technology (see above).

A number of supporting materials, such as for example PowerPoint presentations or exercise materials used by the lecturers, can be accessed or downloaded from the electronic repository. Students can login to the electronic repository from any location via the Internet web page located at <http://km.ihe.nl>.

Students are expected to provide other materials, such as stationary, electronic calculators and language dictionaries on their own account.

## 5.9 English support courses

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### Introduction

A variety of academic writing courses are offered to students during the first 12 months of study. Students are allocated a place on these courses according to their language level, not their specialization. Writing courses are available from 'lower-intermediate' to 'advanced' level, consisting of about 20 hours contact time. These courses run parallel to scheduled lectures, and are not limited to one programme specialization or module.

### Placement Test for everyone

**Every student must take the English Placement Test. Based on the result, the student may be required to follow an academic writing course.**

Placement tests are held in October and January. Participants with weakest English skills are strongly advised to take the test in October, as they will receive support courses first. All remaining participants will be tested in January. Places on writing courses are allocated according to the student's placement test score. A student cannot join a writing course unless s/he has taken the placement test.

Students whose test score is at A1, A2 or B1 level CEFR (The Council of Europe's *Common*

*European Framework of Reference (CEFR) for Languages* is a basis for recognising language qualifications. A1-A2 = Basic; B1-B2 = Intermediate; C1-C2 = Advanced), are obliged to attend a support course: attendance is required. Students whose test score is B2 are strongly recommended to attend a course. If students who score B2 choose to take a support course, regular attendance is required. Those with score levels C1 and C2 are exempt from academic writing courses.

### **Scheduling and attendance**

Academic Writing courses are given throughout the year, with the first courses starting in October and the last courses ending in August/September. Students are assigned a course based on their Placement Test performance.

English support courses usually consist of about 20 hours contact time, approximately 13 or 14 lectures. English support courses are always scheduled at the following times:

- ⌘ Tuesdays 3.45pm-5.30pm
- ⌘ Thursdays 8.45am-10.30am

Occasionally classes are given on Saturday mornings. In special cases, evening classes may be necessary.

A Certificate of Attendance will be provided on completion of an academic writing course, provided attendance requirements have been met.

If a student does not turn up for the allocated course without giving notification of absence, s/he forfeits their place on the course. An alternative course is not provided.

### **Summary descriptions of writing courses**

#### ***First Steps in Academic Writing: lower intermediate***

based on textbook '*First Steps in Academic Writing*', Longman

This course provides low-intermediate students with essential tools to master basic academic writing. It focuses on paragraph organization, sentence structure, and grammar. Students are guided through the writing process to produce well-organized, clearly developed paragraphs. Simple explanations are supported by clear examples to help students through typical rough spots, and numerous practices help students assimilate each skill.

#### ***New Headway Academic Skills: intermediate***

Based on textbook '*New Headway Academic Skills*', Oxford University Press

This course combines reading, writing, and study skills, and is suited to those who have reasonable English but have not studied for a while. It aims to refresh and consolidate existing language through practice, as well as to learn new language. There is guided writing practice and relevant grammatical structures are explained. In addition, skills and strategies which develop good vocabulary learning and recording are included.

#### ***Academic Writing: upper intermediate***

based on textbook '*Focus on Academic Skills for IELTS*', Pearson-Longman

- Focuses on academic writing skills
- Includes vocabulary building and reading techniques relevant to research.
- Specific writing skills include: collocations; useful phrases and language of research; the language of change (increase, decrease, etc); interpreting and comparing information from diagrams;



presenting arguments and opinions; justifying solutions (modal verbs, conditionals) and much more to improve academic writing.

· Life-long learning. This textbook offers systematic preparation for the IELTS exam, hence it can help any student who wishes to gain this internationally-recognised certificate, or improve their existing score.

***Advanced Academic Writing: advanced***

based on textbook '*Academic Writing, A Handbook for International Students*' Routledge

- ⌘ Specifically aimed at improving key academic writing skills, this is a very practical and thorough course.
- ⌘ Three main areas are covered: The Writing Process – from making an outline to proof-reading; Elements of Writing – writing skills such as making comparisons, describing results and paraphrasing; Accuracy in Writing – to improve common problems, eg articles, passives, prepositions.

The above courses follow a workshop approach and are designed to provide maximum hands-on practice. There is a strong emphasis on collaborative writing activities for students, with the lecturer adopting the role of facilitator.

***MSc Thesis Writing: for all participants.*** A reader is provided.

In August/September a series of lectures is given, open to all MSc participants, on thesis writing. The lectures aim to make participants aware of the conventions and structures used to write a proposal, literature review and thesis, and how to present their judgements in a persuasive and reasoned argument. Topics will include proposal writing, literature review, thesis chapters, argument structure, paragraph writing, editing skills, etc.

## **6 Academic Calendar**

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# WATER MANAGEMENT

## MASTERS PROGRAMME

Academic Year: 2012-2014  
Specialization: Core Programme  
Module Coordinator: J. Kemerink

### Module Sheet

Module Name		Module Code	Credits
Week 1 + principles of integrated water resources management		WM01	5
<b>Target Group</b> Young and mid-career professionals, engineers and (mid-level) decision makers interested in a basic and broad understanding of main issues in the water management context.	<b>Prerequisites</b> Preferably a relevant water science or management related BSc degree; some experience in the water sector; good command of the English language (reading, writing, speaking).		

### Learning Objectives

*Upon completion of the module participants will be able to..*

- Summarize the latest insights, context and concepts in integrated water management that are under debate in international and regional forums.
- Explain the main arguments for an integrated approach in the field of water management.
- Describe the major natural functions and human uses of river systems.
- Summarize the basics of GIS and Remote Sensing, and apply the techniques for typical applications in water management.
- Explain what science is and what scientific research entails including distinguishing the main methodological approaches.

### Topics and Learning Activities

#### Introduction to the Module

#### Integrated Water Resources Management

Context, developments, perspectives, issues and debates in Integrated Water Resources Management. Water Resources: green water vs. blue water; catchment yield. Water Demand: demand projections; demand management; elasticity of water demand; the value of water. Water allocation. Water governance.

#### Introduction to GIS and Remote Sensing

Basics of GIS and Remote Sensing. Vector-based geographic data processing with Arc-View GIS. GIS analysis and visualization. Grid data analysis and overlays including DEM and hydrological applications. Supervised and un-supervised classification.

#### Research and Academic Skills Development

What is Science?; Different Approaches to Scientific Methodology; Referencing; Plagiarism; Critical Reading.

#### Lecturing Material

- Water Resources Management, UNESCO-IHE Lecture Notes.
- Introduction to GIS and RS, Reader on GIS. UNESCO-IHE Lecture Notes.
- Other handouts and relevant articles.

#### Assessment

- 50%: Written Exam (closed book)
- 25%: Assignment
- 25%: Assignment

**2012/2014-WM01: Week 1 + principles of integrated water resources management**

Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: study/load hours	Lecturer(s)
<b>1</b>	<b>IWRM Principles - Concepts and Definitions</b>									
1.1	Water Resources	4						4	12	Van der Zaag
1.2	Water Demand	4						4	12	Van der Zaag
1.3	Water Allocation	4						4	12	Van der Zaag
1.4	Water Governance	4						4	12	Van der Zaag
1.5	Emerging Issues	4						4	12	Van der Zaag
	<b>GIS &amp; Remote Sensing</b>									
<b>2</b>	<b>Introduction GIS</b>	<b>2</b>						<b>2</b>	<b>6</b>	Mohamed
2.1	Vector data analysis			4				4	4	Mohamed
2.2	Raster data analysis			4				4	4	Mohamed
2.3	Image data analysis			4				4	4	Mohamed
2.4	Remote sensing			4				4	4	Mohamed
2.5	Application of GIS and Remote Sensing to WM		4						4	Mohamed
<b>3</b>	<b>Philosophy of Science</b>									
3.1	What is Science?	4						4	12	Irvine
3.2	Different Approaches to Scientific Methodology	4						4	12	Wehn de Montalvo
3.3	Critical reading				4			4	8	Wehn de Montalvo & Kemerink
3.4	Referencing & Plagiarism	2		2				4	8	Darvis
3.5	Annotated Bibliography assignment		15						15	
	<b>Exam</b>		<b>3</b>						<b>3</b>	
	<b>Total</b>	<b>32</b>	<b>22</b>	<b>18</b>	<b>4</b>			<b>54</b>	<b>144</b>	

**MSc module - UNESCO-IHE**

# WATER MANAGEMENT

## MASTERS PROGRAMME

Academic Year: 2012-2014  
 Specialization: Core Programme  
 Module Coordinator: I. Masih

### Module Sheet

Module Name The water resources system		Module Code WM02	Credits 5
<b>Target Group</b> Young and mid-career professionals, engineers and (mid-level) decision makers interested in understanding the bio-physical system as a sound basis for water management.	<b>Prerequisites</b> Preferably a relevant water science or management related BSc degree; some experience in the water sector; good command of the English language. Basic knowledge of integrated water resources management is essential.		

### Learning Objectives

*Upon completion of the module participants will be able to..*

- Describe how the physical water resources system works, and illustrate the interaction between quantity and quality (chemical, biological, ecological), between surface water, soil water and groundwater, between stocks and fluxes. Explain major natural functions and human use of water resources systems focusing on river systems including groundwater, wetlands, lakes/reservoirs and estuaries.
- Identify basic components to characterise the quantitative and qualitative nature of a water resources system and able to analyse the hydrology of a water resources systems.
- Discuss the main issues of debate in an integrated water resources system underpinned by description of the biophysical, chemical and hydrological processes and their interactions, natural functions and human use of a water resources system.

### Topics and Learning Activities

#### Water Resources System:

Basic concepts in defining a water resources system, systems approach in water resources management, functions of the water resources systems, characteristics of the natural resources system, introduction to rivers, lakes and reservoirs, wetlands and estuaries as distinct as well as integrated (or interdependent) water resources systems. Understanding of natural system processes and interactions including the biophysical, hydrological, ecological and water quality processes and their interactions along with their natural functions, human uses and major problems.

#### **Learning Activities:**

*The learning activities include lectures and exercises.*

*The lectures are accompanied by PowerPoint presentations, available to the participants for self study.*

#### Hydrology of Water Resources Systems:

Hydrological cycle and water balance. Precipitation and evaporation. Principles of hydrology of surface and groundwater systems, hydrology of lakes and reservoirs including introduction to reservoir water balance and operations. Workshop on Hydrology: Analysis of hydro-climatic data (e.g. precipitation, river flows), discharge rating curve and reservoir operation.

#### **Learning Activities:**

*The learning activities include lectures, workshops, and exercises.*

*The lectures are accompanied by PowerPoint presentations, available to the participants for self study. Special effort is geared towards quantitative analysis of water resources systems.*

#### Water Quality:

Basics on water chemistry; chemical reactions; acids, bases, buffers in natural waters; precipitation and dissolution; redox reactions in the environment. Photosynthesis. Water quality issues related to aquatic ecosystems including eutrophication.

#### **Learning Activities:**

*The learning activities include lectures, workshops, exercises and laboratory work.*

*The lectures are accompanied by PowerPoint presentations.*

### Lecturing Material

- D. P. Loucks, E. van Beek, J. R. Stedinger, J. P. M. Dijkman, and M. T. Villars. 2005. Water Resources Systems Planning and Management: An Introduction to Methods, Models and Applications. UNESCO Publishing, Paris.
- Loucks, D., and E. van Beek (2005), Water resources systems planning and management, UNESCO Publishing, Paris, France. (Selected annex- A and E)

- P.J.M. de Laat, Y.A. Mohamed. M.L. Mul, and J.W. Wenninger. 2010. Hydrology: An introductory course. UNESCO-IHE Lecture Notes.

- Y. Mohamed, P.J.M. de Laat, and L. Kewzi. Workshop Hydrology. 2010. UNESCO-IHE Lecture Notes.
- J.C. Nonner. 2006. Introduction to Hydrogeology. UNESCO-IHE Lecture Notes Series. Taylor and Francis, Leiden.
- Water Chemistry and Biology, Kelderman. UNESCO-IHE Lecture Notes.
- Lectures-Power point presentations.
- Pre-Lecture material on Basics of Chemistry, Kelderman, UNESCO-IHE lecture notes.

### Assessment

- **65%: Written Exam (closed book)**
- **35%: Assignment**

2012/2014-WM02: The water resources system													
Nr	Course/Topic	Lecture	Assignment	Workshop Case study	Role play	Exercise	Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: study/load hours	Lecturer(s)
<b>1</b>	<b>Water Resources System</b>												
1.1	Introduction to module	1									1	3	I. Masih
1.2	Introduction to Water Resources System	3									3	9	I. Masih
1.3	River Systems	6									6	18	K. Irvine
1.4	Lakes, wetlands and estuaries	4									4	12	K. Irvine
<b>2</b>	<b>Hydrology of Water Resources System</b>												Å
2.1	Concepts of hydrology, hydrological cycle, water balance	2		2							4	8	Y. Mohamed and I. Masih
2.2	Precipitation	2		4							6	10	Y. Mohamed and I. Masih
2.3	Evaporation and Transpiration	2		4							6	10	Y. Mohamed and I. Masih
2.4	Surface water resources	2							2		4	12	Y. Mohamed and I. Masih
2.5	Groundwater resources	4		2							6	14	J. Nonner
2.6	Reservoir water balance and operation	2									2	6	Y. Mohamed
<b>3</b>	<b>Water Quality</b>												
3.1	Water Chemistry	4		4							8	16	P. Kelderman
3.2	Aquatic ecosystem and water quality issues	6									6	18	P. Kelderman
3.3	Laboratory session			4							4	4	F. Kruis
<b>4</b>	<b>Exam</b>			3							3	3	
	<b>Total</b>	<b>38</b>		<b>23</b>					<b>2</b>	<b>63</b>	<b>143</b>		
<b>MSc module - UNESCO-IHE</b>													



# WATER MANAGEMENT

## MASTERS PROGRAMME

Academic Year: 2012-2014  
Specialization: Core Programme  
Module Coordinator: J.Kemerink, M. Rusca

### Module Sheet

Module Name Water governance	Module Code WM03	Credits 5
<b>Target Group</b> Young mid-career professionals who are 1) working at middle and upper level in an organization in the water sector, 2) employed in policy making institutions in the water sector or 3) working for organizations engaged in management of water resources and water services.	<b>Prerequisites</b> Preferably a relevant bachelors degree or equivalent; basic PC-computer knowledge (MS-Windows, MS-Office); good English command.	

### Learning Objectives

*Upon completion of the module participants will be able to..*

- Identify and analyse actors and decision making processes related to water governance
- Distinguish and explain main discourses and theories on water governance
- Identify context, purpose, perspective and arguments of scientific papers on water governance
- Compare and contrast different scientific papers, case studies and theories on dynamic and political nature of water governance

### Topics and Learning Activities

#### Introduction to water governance

Discussing and analysing various definitions on water governance.  
Analysing concepts related to water governance (e.g institutions, policies, organizations).  
Discussing different modes of governance and analysing shifts in governance.  
Deconstructing the notion on 'good governance'.

#### **Learning Activities:**

*Lectures, tutorials, debate, self-study*

#### Politics of Water Governance

Defining politics and analyzing the political nature of water governance processes.  
Identifying actors in decision-making processes and discussing the concept of participation.  
Discussing and analysing water governance processes at three political levels:  
Everyday politics, Politics of policy & Global politics.

#### **Learning Activities:**

*Lectures, case studies, tutorials, debate, film, self-study*

#### Research methodology

Critical reading of scientific articles

#### **Learning Activities:**

*Lectures, workshop, exercise*

### Lecturing Material

- Scientific articles
- Books
- Power Point Presentations

### Assessment

- 50%: Written Exam (open book)
- 20%: Assignment
- 30%: Assignment

**2012/2014-WM03: Water governance**

Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: study/load hours	Lecturer(s)
<b>1</b>	<b>Concepts of Water Governance</b>									
1.1	Introduction to the Module	1						1	3	Kemerink/Rusca
1.2	Water governance: an introduction	4						4	12	Rusca
1.3	Modes of Governance	4						4	12	Kemerink/Schwartz
1.4	Debate: Good Governance?			2				2	2	Ahlers/Kemerink
1.5	Shifts in Governance	4						4	12	Kemerink/Kooy
1.6	Research methodology	4		2				6	14	Ahlers/Kemerink
<b>2</b>	<b>Politics of Governance</b>									
2.1	Politics: an introduction	4						4	12	Rusca
2.2	Concept of participation	2		2				4	8	Kemerink
2.3	Everyday politics	2						2	6	Kemerink
2.5	Politics of policy: promotion of policy models	2						2	6	Rap
2.6	Global politics	4						4	12	Ahlers/Rusca
2.7	Film: Life and Debt			1				1	1	Rusca
2.8	Debate: notions on development			2				2	2	Rusca
<b>3</b>	<b>Tutorials</b>			<b>10</b>				<b>10</b>	<b>10</b>	Kemerink/Rusca
<b>4</b>	<b>Assignment</b>		<b>28</b>						<b>28</b>	Kemerink/Rusca
<b>5</b>	<b>Exam</b>		<b>3</b>						<b>3</b>	Kemerink/Rusca
	<b>Total</b>	<b>31</b>	<b>31</b>	<b>19</b>				<b>50</b>	<b>143</b>	

**MSc module - UNESCO-IHE**

# WATER MANAGEMENT

## MASTERS PROGRAMME

Academic Year: 2012-2014  
 Specialization: Core Programme  
 Module Coordinator: Y. Jiang

### Module Sheet

Module Name Water economics		Module Code WM04	Credits 5
<b>Target Group</b> Young and mid-career professionals, engineers and (mid-level) decision makers interested in water (resources) economics.		<b>Prerequisites</b> Preferably a relevant water science or management related BSc degree; Some experience in the water sector; Good command of the English language.	

### Learning Objectives

Upon completion of the module participants will be able to..

- Explain the cause of water resource issues and the relevance of economics
- Describe the principle of economic method to manage water resources
- Identify economic instruments for water resource management
- Describe economic approaches to estimating the value of water in different use
- Apply economic theory and method to analyze issues of water resource management

### Topics and Learning Activities

#### 1. Introduction to water economics

This section introduces water economics by addressing why economics is relevant to water management. It uses simple examples and/or case studies to highlight the role and potential of economics to improve water management under emerging water crisis while stimulating interests and economic thinking.

##### **Learning Activities:**

*Lecture, group exercise/workshop*

#### 2. Economic foundation of water resource management

This section provides economic foundation for water resource management, covering the economic nature of water resources, the cause of water resource issues, economic principle for resource allocation and market mechanism, and basic economic concepts and analytical/decision tools relevant to water resource management

##### **Learning Activities:**

*Lecture, group exercise/workshop*

#### 3. Economic approaches to water resource management

This section synthesizes economic approaches to managing water, including price and quantity based policy instruments such as water pricing and tradable water rights, and their principles plus advantages and limitations. Institutional role and recent progress in market-based approaches such as payment for ecosystem services are also introduced.

##### **Learning Activities:**

*Lecture, group exercise/workshop*

#### 4. The economic value of water

This section explains the economic value of water and relevance to water management, introduces different approaches to valuing water in different use, and presents case studies valuing water.

##### **Learning Activities:**

*Lecture, group exercise/workshop*

#### 5. Ravilla roleplay

Roleplaying game, students will represent different stakeholders in a RBO and will need to negotiate.

##### **Learning Activities:**

*Exercises*

#### 6. Fieldtrip

Destination to be announced.

##### **Learning Activities:**

*Exercises*

### Lecturing Material

- Lecture notes by Prof. M.P. van Dijk and Dr. Y. Jiang
- Economics in the SWITCH-project. M.P. van Dijk. Unpublished paper.
- Water Resource Economics: The Analysis of Scarcity, Policies, and Projects. Griffin, R. C. (2006). MIT Press, Cambridge, MA, USA.

- Principles of Economics (6th edition). Mankiw, N.G. (2012). South-Western Gengage Learning, United Kingdom.
- Environmental & Natural Resource Economics (9th edition). Tietenberg, T., Lewis, L. (2012). Pearson, Amsterdam, the Netherlands.

### Assessment

- **20%: Assignment**
- **50%: Written exam (closed book)**
- **30%: Presentation**

2012/2014-WM04: Water economics										
Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: studyload hours	Lecturer(s)
1	<b>Introduction to water economics</b>	2		1				3	7	van Dijk
2	<b>Economic foundations of water (resources) management</b>									Jiang
2.1	The economic nature of water resource	1						1	3	
2.2	The cause of water resource issues: An economic perspective	2						2	6	
2.3	Economics and resource allocation	2						2	6	
2.4	Economic concepts and marginal analysis	3		1				4	10	
2.5	Demand, supply, and government policies	4		1				5	13	
3	<b>Economic approaches to water (resources) management</b>									van Dijk
3.1	Water pricing	1		1				2	4	
3.2	Tradable water rights and water markets	1		1				2	4	
3.3	Institutional role in water management	2						2	6	
3.4	Applying market-based approaches: practice and issues	5						5	15	
4	<b>The economic value of water</b>									Jiang and Guest Lecturer
4.1	The nature of economic value	1						1	3	
4.2	The economic value of water and its role in decision making	2						2	6	
4.3	Economic approaches to value water and practical issues	3		2				5	11	
4.4	Case studies of water valuation	2		2				4	8	
5	<b>Ravilla role play</b>			22				22	22	Heun & Jiang
	<b>Individual assignment</b>		14						14	
	<b>Exam</b>		3						3	
	<b>Total</b>	<b>31</b>	<b>17</b>	<b>31</b>				<b>62</b>	<b>141</b>	

MSc module - UNESCO-IHE

# WATER MANAGEMENT

## MASTERS PROGRAMME

Academic Year: 2012-2014  
 Specialization: Core Programme  
 Module Coordinator: Zaki Shubber

### Module Sheet

Module Name Mediation for water conflict management		Module Code WCM05	Credits 5
<b>Target Group</b> Current and future water managers, decision-makers and others involved in water management. Students need to have a first degree in a relevant subject (economics, social sciences, law, engineering, biology etc.) and preferably several years of relevant working experience.	<b>Prerequisites</b> Knowledge and appreciation of the principles of integrated water resources management, the water resources system and water governance.		

### Learning Objectives

*Upon completion of the module participants will be able to..*

- Discuss and analyze, from a conflict and cooperation perspective, cases of water sharing and use among different actors at different levels and from different sectors.
- Assess the impact of human activities on water systems and the repercussion on water conflict and cooperation.
- Explain, discuss and analyze the basic concepts of conflicts related to water and of conflict management.
- Identify, explain and analyze the elements of a negotiation process applied to the management of a water conflict.
- Prepare, organize, engage in negotiation processes related to shared water resources with different stakeholders.
- Apply a set of skills and tools needed for water conflict management through a negotiation process.

### Topics and Learning Activities

#### Alternative dispute resolution approaches

A lecture presents the spectrum of alternative dispute resolution approaches, focusing on negotiation techniques and styles. The various components of a negotiation process (trust, interests, alternatives, options, criteria & standards, communication, relationship, agreement) will be studied and key skills for successful conflict resolution (active listening, open ended questions, identification of positions and interests, the use of standards).

#### **Learning Activities:**

*Exercises and a role play will be used to help the participants practice the skills they learn. The skills of the students will be evaluated for the first time during Role play I.*

#### International Negotiation Processes

International negotiation processes, Multilateral negotiations between ten parties, Debrief of multilateral negotiations, Minilateral bargaining on a water problem, Cultural aspects and personal behavior in negotiation.

#### **Learning Activities:**

*Managing international negotiation processes on water issues is a vital skill for those who have to represent and defend the interests of their organization. Knowing how to go from A to B in a cooperative process is as important as being a specialist on water issues and other dossiers. This four day lecture intends to confront theory and practice of bargaining, help students to get a better understanding in handling procedures/processes & people/parties & positions/products, while not forgetting about power/perception and some other factors in negotiation such as the context in which negotiations are undertaken, for example. On the first day, the phenomenon of negotiation will be defined, while bilateral negotiation will be practiced. On the second day strategy and tactics will be dealt with. Various aspects related to the behavior of a negotiator (skills, styles and cultural aspects) will also be covered. On the third day, multilateral negotiations will be studied. Role plays will be organized and will be concluded on the fourth day. A single text on disaster relief issues will be drafted and debriefed. The objective of this exercise will be for the students to get as close to reality as possible. By using Clingendael's Workbook, students will be provided with exercises and negotiation literature. Participants will have to be aware of the fact that there will be some homework for day two and three, handed out on day one.*

#### Summary of concepts

Review of key concepts.

#### **Learning Activities:**

*The key concepts introduced in the previous lectures will be summarised and reviewed in a dynamic way.*

#### Negotiation strategies and confidence-building measures

Development of negotiation strategy, Lessons learned (common errors etc.), confidence building measures.

#### **Learning Activities:**

*This lecture aims to enhance a more in-depth understanding of prevention and resolution of international water*

disputes - as well as the role participants could play in such processes. Following aspects will be dealt with:

- Various types of water conflicts
- Common errors and success-factors in negotiations
- Preparing for negotiations
- Conducting a `reality` negotiation role-play (with post-assessment)
- The notion of adaptive negotiator, including how to make right decisions under pressure
- Development of negotiation strategy
- Confidence building initiatives, and some specific lesson learned.

#### Cases of transboundary water conflicts or cooperation

Presentation of in-depth case studies on transboundary water conflicts or cooperation.

##### Learning Activities:

Relevant in-depth case studies will be presented by experts and discussed in class.

#### Final roleplay

In this role play participants simulate a conflict on an transboundary water body.

##### Learning Activities:

Participants simulate a conflict on an transboundary water body. The participants will be assigned roles in the delegations of different stakeholders concerned with the management of this water body (governments,NGO representatives,professional networks,local governments,etc). Different negotiation rounds will be simulated. Feedback will be provided at the end by teachers and participants themselves. The skills of the students will be re-evaluated for the second time during this role play. Assessments will be compared, skills learning inferred.

#### Annotated bibliography

The students will develop an annotated bibliography on a topic of their choice and submit it at the end of the module. The annotated bibliography can be a stepping stone for the Essay assignment of the WCM II module.

#### Lecturing Material

- Alternative Dispute Resolution, a focus on a negotiation technique; by Ms. Lena Salame.
- Workbook on International Negotiation; by Prof Paul Meerts.
- Sourcebook Enhanced Negotiation Skills, Dispute Resolution of International Water Resources; J.M. Trondalen.
- R. Fisher and W. Ury, 1991. Getting to Yes. Random House, London.

#### Assessment

- 40%: Written Exam (closed book)
- 20%: Skills assessment
- 40%: Assignment

2012/2014-WCM05: Mediation for water conflict management														
Nr	Course/Topic	Lecture	Assignment	Workshop	Case study	Role play	Exercise	Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM:		Lecturer(s)
												contact hours	studyload hours	
1	Introduction	2										2	6	Salame & van der Zaag
2	Alternative dispute resolution approaches	6		12								18	30	Salame
3	International Negotiation Processes	6		12								18	30	Perlot & Meerts
4	Summary of concepts	2										2	6	Salame
5	Negotiation strategies and confidence-building measures	6		12								18	30	To be announced
6	Cases of transboundary water conflicts or cooperation			6								6	6	Szollosi-Nagy
7	Final role play			8								8	8	Smidt
8	Annotated bibliography	1	22									1	25	Salame
	Exam		3										3	
Total		23	25	50								73	144	
<b>MSc module - UNESCO-IHE</b>														

# WATER MANAGEMENT

## MASTERS PROGRAMME

Academic Year: 2012-2014  
 Specialization: Water Management  
 Module Coordinator: Y.Mohamed

### Module Sheet

Module Name Water resources assessment		Module Code WRM05	Credits 5
<b>Target Group</b> Young and mid-career professionals, managers, engineers and technicians dealing with or interested in various aspects of water resources management, and in particular the assessment of quantity and quality of water resources.		<b>Prerequisites</b> Successful completion of WM1, WM2 or equivalent is strongly recommended. Affinity with quantitative approaches is required. Good command of English	

### Learning Objectives

*Upon completion of the module participants will be able to..*

- Describe different types of water resources data, generated from ground and RS measurements.
- Apply diverse methods of data processing and data validation for water resources assessment.
- Quantify the different components of the water resources spectrum (rainfall, river flow, groundwater), an assess availability and access at different scales.
- Describe and apply different methods of water quality monitoring and assessment.
- Analyse and quantify multiples uses of water for: agriculture, hydropower, domestic, environment and other uses
- Apply water accounting techniques as a quick method for assessing water resources, water use, and water productivity in a river basin context.

### Topics and Learning Activities

#### Water resources assessment

Water Resources data: Different types of water resources data, monitoring, validation, archiving, and dissemination, and a review of a WRA case study. Surface water resources assessment: time series analysis of WR data, including: flow duration curves, statistical distribution and trend analysis, extreme value analysis (floods and droughts). Groundwater resources assessment: assessment of aquifer hydraulic properties and areal extent, recharge and discharge, sustainable yield, and groundwater abstraction. Water quality monitoring and assessment: requirements for WQ assessment; WQ parameters; WQ monitoring program; Pollution; WQ assessment. Estimation of water resources data in un-gauged basins and regionalization.

#### **Learning Activities:**

*The learning activities include lectures and workshops in class, as well as exercises and a field visit to the WaterNet (Amsterdam).*

#### Water using activities

Agricultural water demand, crop water requirement, net irrigation requirement, yield analysis, domestic water use, hydropower water demand, environmental water requirement.

#### **Learning Activities:**

*The learning activities include lectures and workshops in class, as well as exercises.*

#### Water accounting

Introduction to remote sensing data for water resources applications; Satellite image processing; Catchment water balance in GIS environment; Water productivity and water valuation; Water accounting.

#### **Learning Activities:**

*The learning activities include lectures and workshops in class, as well as exercises.*

### Lecturing Material

- Guide to Hydrological Practices: Volume I - Hydrology "From Measurement to Hydrological Information, WMO No 168, 2008.
- Water Resources Assessment Hand Book for review of national capabilities, 1997 (WMO, UNESCO)
- Water accounting at river basin scale, Mohamed, 2012. UNESCO-IHE lecture notes.
- Lectures-Power point presentations
- Molden, D., 1997. Accounting for Water Use and Productivity, SWIM Paper 1, International Irrigation Management Institute, 1 Colombo, Sri Lanka.

## Assessment

- 65%: Written Exam (closed book)
- 35%: Assignment

2012/2014-WRM05: Water resources assessment										
Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: studyload hours	Lecturer(s)
1	Introduction to WRA	2						2	6	Mohamed
2	Water Resources Assessment									
2.1	Water resources data (case study)	2		2				4	8	Masih
2.2	Surface water resources assessment	4	2	2				6	16	Mohamed
2.3	Groundwater resources assessment	4	2	2				6	16	Nonner
2.4	Water quality assessment	6						6	18	Kelderman
2.5	Water quality indicators for flow measurements	2						2	6	Wenninger
2.6	Water resources assessment in un-gauged basins	1		3				4	6	Masih
3	Water use activities	4		2				6	14	Graas
4	Water accounting									Mohamed/Bastiaanssen
4.1	GIS/RS applications in WRA	2		2				4	8	
4.2	Processing of spatial data (Land use, precipitation, evapotranspiration, runoff)	4	2	2				6	16	
4.3	Computation of catchment water balance	2	2	2				4	10	
4.4	Water accounting at different scales	2	2	2				4	10	
5	Field visit WaterNet					6		6	6	
6	Exam					3		3	3	
	<b>Total</b>	<b>35</b>	<b>10</b>	<b>19</b>		<b>9</b>		<b>63</b>	<b>143</b>	

MSc module - UNESCO-IHE



# WATER MANAGEMENT

## MASTERS PROGRAMME

Academic Year: 2012-2014  
Specialization: WM - WSM  
Module Coordinator: S. Seyoum

### Module Sheet

Module Name Water supply and sanitation systems		Module Code WSM05	Credits 5
<b>Target Group</b> Mid-career professionals dealing with planning and management aspects of water supply and sanitation infrastructure, working for municipalities, ministries, water and sewerage agencies or consulting firms.	<b>Prerequisites</b> Preferably a relevant water science or engineering related bachelor's degree or equivalent and some relevant experience.		

### Learning Objectives

*Upon completion of the module participants will be able to..*

- Discuss and provide a general overview of the technical and engineering aspects of water supply and sanitation infrastructure.
- Describe different types of water supply and sanitation systems and their suitability of application under different conditions
- Discuss treatment processes, structural components, function and performance of water supply and sanitation systems
- Discuss and apply the technical/design aspects of system level planning and operation and maintenance of the associated facilities.

### Topics and Learning Activities

#### Introduction to water supply and sanitation systems

##### **Learning Activities:**

*Lectures*

#### Water treatment

##### **Learning Activities:**

*Lectures, Design Assignment*

#### Water transport and distribution

##### **Learning Activities:**

*Lectures, workshop*

#### Ecological Sanitation

##### **Learning Activities:**

*Lectures, workshop*

#### Sewerage and drainage systems

##### **Learning Activities:**

*Lectures, assignment*

#### Wastewater treatment processes and plants

##### **Learning Activities:**

*Lectures, assignment, field visit*

### Lecturing Material

- Power point presentations.
- Field visits.

### Assessment

- 70%: Written Exam (closed book)
- 30%: Assignment

**2012/2014-WSM05: Water supply and sanitation systems**

Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: study/load hours		Lecturer(s)
								SUM: contact hours	SUM: study/load hours	
1	Introduction to water supply and sanitation systems	1						1	3	Seyoum
2	Raw water and drinking water aspects	4						4	12	Buiteman
3	Conventional water treatment methods	6	4					6	22	Buiteman
4	Raw water abstraction, pre-treatment and storage	2						2	6	Buiteman
5	Water treatment processes and plants	4	4				4	8	28	Buiteman
6	Water transport and distribution	4		4				8	16	Trifunovic
7	Ecological Sanitation	4		2				6	14	Ronteltap
8	Sewerage and drainage systems	5	3					5	18	Pathirana
9	Wastewater treatment processes and plants	6	3					6	21	Carlos Lopez Vazquez
	Exam		3						3	
	<b>Total</b>	<b>36</b>	<b>17</b>	<b>6</b>			<b>4</b>	<b>46</b>	<b>143</b>	

**MSc module - UNESCO-IHE**

# ENVIRONMENTAL SCIENCE

## MASTERS PROGRAMME

Academic Year: 2012-2014  
 Specialization: Water quality management  
 Module Coordinator: P. Kelderman, PhD, MSc

### Module Sheet

Module Name Water quality assessment		Module Code ES05W	Credits 5
<b>Target Group</b> Young and mid-career professionals (scientists, consultants, decision makers) with a background in Water management or Environmental science.	<b>Prerequisites</b> Preferably a bachelor's degree in chemistry, chemical engineering, biology, environmental science, hydrology, geography or equivalent. Basic knowledge in computer operations (MS-Windows; Office). Good command of English.		

### Learning Objectives

*Upon completion of the module participants will be able to..*

- Describe the different water pollutant groups and their risks and fates
- Describe and apply the different criteria for succesful monitoring of lakes, rivers and groundwaters
- Describe and apply a number of water quality models as a tool in Water management
- Design sustainable water quality monitoring programmes for river and lake basins

### Topics and Learning Activities

#### Water quality and monitoring

Water quality parameters. Natural water quality and pollution parameters. The monitoring cycle. Items of the monitoring programme: why, what, where, how, how often. Fieldwork and sampling. Physico-chemical and biological water quality assessment. Monitoring in the EU Water Framework Directive.

Case study: design of a sustainable water quality monitoring programme in an African river basin.

Practical field&lab work: sampling, preservation, field analyses; Quality control in the laboratory.

Groundwater monitoring: principles and case studies. Data reporting and presentation.

#### **Learning Activities:**

*Lectures, exercises, groupwork, lab and fieldwork*

#### Data analysis and presentation

Use of statistics in water quality monitoring. Statistical tests: t-test, confidence intervals, Q-test etc.; regression analysis.

Applications: minimum sampling frequency; significant differences between two data sets, etc.

Introduction to more advanced techniques such as ANOVA and FACTOR analysis.

Hands-on computer exercises

#### **Learning Activities:**

*Lectures, exercises*

#### Aquatic Ecotoxicology

Ecotoxicological tests. Environmental characteristics of pollutants. Sources, transport and fate of micropollutants.

Modelling and monitoring. Risk assessment and evaluation.

#### **Learning Activities:**

*Lectures*

#### Water quality modelling

Mathematical concepts; water and mass balances. Types and construction of water quality models. Simple In/Out

lake models: set up and exact solutions. Finite-difference approximations. BOD-DO modelling in a river system.

Modelling of micropollutants. Example: the Rhine and Danube alarm models. Good modelling practice.

Hands-on exercises with mass balances, and with the SOBEK model, for BOD-DO modelling.

#### **Learning Activities:**

*Lectures, exercises*

#### Fieldtrips

(Liable to changes, e.g. due to constraints at the side of the hosts): half-whole day visits are planned to water quality monitoring and modelling Institutions.

#### **Learning Activities:**

*Excursions*

## Lecturing Material

- P. Kelderman (2011) - Water quality and monitoring. UIHE lecture notes LN5/11/1.
- G.F. Kruis and P. Kelderman - Handout Fieldwork water quality monitoring and Laboratory QA/QC. Febr. 2011.
- P. Kelderman, H.A.M. de Kruijf and M. Mul (2011). Handout - Case study Water Quality Monitoring Network for the Inkomati River Basin in Mozambique. Febr. 2011.
- P. Kelderman (2010) - Handout data handling and presentation. Febr. 2010.
- H.A.M de Kruijf (2011). Handout Aquatic Ecotoxicology. Febr. 2011.
- E.M. Meyers (2011). Handout Water quality modelling. Febr 2011.
- E.M. Meyers and R.S. Penailillo Burgos (2009). Water quality modelling: Introduction SOBEK Exercise.
- Compiled powerpoint slides on Groundwater monitoring; powerpoint slides on all above topics; additional materials: relevant info, fieldtrips materials, etc.

## Assessment

- **70%: Written Exam (closed book)**
- **20%: Assignment**
- **10%: Lab Report**

2012/2014-ES05W: Water quality assessment												
Nr	Course/Topic	Lecture	Assignment	Workshop Case study	Role play Exercise	Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: studyload hours	Lecturer(s)
<b>1</b>	<b>Water Quality and Monitoring</b>											
1.1.	Introduction on Water quality	2								2	6	Kelderman
1.2.	Water quality monitoring and assessment	6								6	18	Kelderman, Kruis
1.3.	Case study water quality monitoring			3						3	3	De Kruijf, Kelderman
	<b>Å</b>											
<b>2</b>	<b>Data analysis and presentation</b>	<b>6</b>	<b>6</b>							<b>6</b>	<b>24</b>	Kelderman, van Dam
<b>3</b>	<b>Aquatic Ecotoxicology</b>											
3.1.	Principles of Aquatic Ecotoxicology	4								4	12	De Kruijf
3.2.	Environmental fate of micropollutants	4								4	12	De Kruijf
3.3.	Monitoring, modelling and risk assessment	4								4	12	De Kruijf
<b>4</b>	<b>Water quality modelling</b>	<b>8</b>	<b>6</b>							<b>8</b>	<b>30</b>	Meijers
<b>5</b>	<b>Lab/fieldwork water quality monitoring</b>		<b>4</b>	<b>8</b>						<b>8</b>	<b>12</b>	Kruis
6.	Fieldtrip							8		8	8	Kelderman
	<b>Exam</b>		<b>3</b>								<b>3</b>	
	<b>Total</b>	<b>34</b>	<b>19</b>		<b>11</b>			<b>8</b>		<b>53</b>	<b>140</b>	
<b>MSc module - UNESCO-IHE</b>												

# WATER MANAGEMENT

## MASTERS PROGRAMME

Academic Year: 2012-2014  
 Specialization: Water Conflict Management  
 Module Coordinator: Zaki Shubber

### Module Sheet

Module Name Advanced mediation for water conflict management		Module Code WCM06	Credits 5
<b>Target Group</b> Current and future water managers, decision-makers and others involved in water management. Students need to have a first degree in a relevant subject (economics, social sciences, law, engineering, biology etc.) and preferably several years of relevant working experience.	<b>Prerequisites</b> Knowledge and appreciation of the principles of integrated water resources management, the water resources system and water governance.		

### Learning Objectives

*Upon completion of the module participants will be able to..*

- Critically analyze cases of water sharing and use among different actors at different levels and from different sectors, from a conflict and cooperation perspective.
- Identify pertinent cooperative frameworks that apply to specific conflict situations and assess their efficiency.
- Apply management skills in conflict transformation, strategic planning, water governance and economic development.
- Explain and discuss the advantages of mediation processes, and prepare, organize and engage in them as a party and as a mediator for the resolution of shared water disputes.
- Explain, discuss and assess other consultation and cooperative processes (e.g. consensus building, public participation), and be able to prepare, organize and engage in them.

### Topics and Learning Activities

#### Introduction

This module focuses on various processes of conflict resolution. It teaches the students how to design and manage a mediation process as well as other processes that can be used in transboundary water management. It ends with a role play in which the students design and manage the processes they were taught, using the skills they have acquired. The module also presents relevant case studies. Students are also required to write an essay on a relevant topic.

#### **Learning Activities:**

*During the first half of the day, the module, its structure and objectives will be introduced to the students.*

*The expectations of the students will be collected and discussed.*

*The profiles of the various trainers and visiting lecturers will be presented.*

#### **Mediation techniques applied to water issues**

Environmental and water conflicts often involve more than two parties and are multi-layered in content, therefore it is crucial to suit the process to the conflict at hand (Negotiation, Mediation, Public participation, Facilitation, Consensus Building, or any combination thereof). Mediation is among the processes, well suited for two or more parties and multi-issues, which are involved in environmental and water conflicts when engaging in the attempt to resolve local, regional and international conflicts. It is important that the parties in dispute over water enter the suitable process voluntarily, knowing that if they reach an agreement, they will be accountable for its implementation.

Mediation plays an important role in national and international conflicts.

#### **Learning Activities:**

*The lecture will focus both on theory of negotiation and mediation and the analytic tools necessary to become a successful negotiator and mediator.*

*The mediator has to learn to assess the conflict, identify the interests of the parties, identify other stake holders (other countries, international organizations, etc.), write and ratify the written agreement.*

#### **Design and implement conflict resolution processes**

This lecture provides an opportunity to learn about current and leading-edge ways to work effectively in contentious water situations. It offers a place to practice new skills that are applicable from the individual level to the societal level and across a range of real-life situations.

Successful multi-party negotiations require profound transformations in the way participants conceptualize the issues at hand. Those involved can often point to the precise moment when thinking altered dramatically - the 'aha!' moment - where emphasis shifted from individuals thinking only in terms of their own agenda to also

understanding the needs of the other. Traditional conflict resolution models define these moments in rational terms - 'people come to agreement when it is in their interest to agree.' Even overlooking the tautological nature of this argument, 'rationality' simply often does not hold sway if the conflict involves even a modicum of real emotion.

To really understand the process of transformation, and the settings most conducive to inducing these shifts, then, one may do well to look outside of the field of conflict resolution as defined in modern, academic terms. When one thinks of the situations most analogous to settings conducive to transformative thinking, the world of spiritual transformation rises as potentially the most appropriate. Every spiritual tradition in the world, after all, is devoted to precisely this process of transformation: to aid individuals in moving from a focus on their own immediate wants and desires, to addressing more their obligations to society, humanity, and to the divine.

**Learning Activities:**

*This lecture, then, explores the relationship between political conflict and cooperation, and approaches and techniques from the realm of spiritual transformation, in our case as might be applied in international water resources negotiations.*

*This lecture will also present cooperative trends in several basins around the world. It will touch upon specific themes (eg. the evolution of the concept of equitable distribution of benefits, or how negotiations tend to evolve from rights to needs to equity), bringing in several cases that the participants are familiar with.*

*The skills of the students will be evaluated the final role play of this lecture.*

**Summary of concepts**

A recap of all concepts presented during the module will take place with a Q/A session to prepare for the final role play of this module.

**Learning Activities:**

*A review of all concepts presented.*

**Cases of transboundary water conflicts or cooperation**

Presentation of in-depth case studies on transboundary water conflicts or cooperation.

**Learning Activities:**

*Relevant in-depth case studies will be presented by experts and discussed in class.*

**Final role play**

The purposes of the game are to make participants aware of

- o The various aspects (technical, managerial, political) related to the management (transboundary) waters
- o The complexity of applying integrated and participatory approaches in decision making
- o The complexity of managerial, technical and human aspects of negotiations, consensus building, stakeholder participation and dialogue processes in relation to the management of water resources.

**Learning Activities:**

*The actors in the game have personal and confidential instructions outlining their goals and, partly, how they relate to other actors. The instructions also contain strategic information, regarding available means, goals to be achieved, alliances to be created etc. Consensus building is the key and will require strong focus on confidence and relationship building and strategies to deal with conflicting goals. The creativity of each actor to seek innovative solutions will be essential. Debriefing will take place immediately after the formal negotiations.*

**Essay**

The students will be required to develop an essay on a topic of their choice. They will have to submit it at the end of the module. For the students who followed WCM I, the essay can be based on their work for the annotated bibliography.

The students will be asked to prepare an essay on a topic of their choice, based on a review of relevant scientific literature. They will have to:

- o Introduction: Introduce the topic, defining a precise problem statement, research question or hypothesis
- o Review: Present the main ideas and issues on the debate, i.e. outline the different positions or view points and interests at stake.
- o Discussion: Give their own point of view on the topic and relate the topic in question to their own situation and experience.
- o Conclusion: Draw conclusions.
- o Reference list/bibliography: Provide a reference list or an annotated bibliography.

**Learning Activities:**

*To formulate a relevant and well-defined topic for an essay, and a related well-defined objective.*

*To identify, select, read, process, and analyse relevant research papers and scientific literature on a selected topic.*

*To write a well-structured and coherent scientific text, and present a summary to fellow students and staff.*

**Lecturing Material**

- Negotiation and Mediation, Theory and Skill. Workbook. The Israel Center for Negotiation and Mediation, Haifa.
- Designing and implementing conflict resolution processes (transformation and spirituality). Lecture Note by Professor Aaron Wolf, Oregon State University.

**Assessment**

- 40%: Written Exam (closed book)
- 20%: Skills assessment
- 40%: Assignment

2012/2014-WCM06: Advanced mediation for water conflict management														
Nr	Course/Topic	Lecture	Assignment	Workshop	Case study	Role play	Exercise	Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM:		Lecturer(s)
												contact hours	studyload hours	
1	Introduction	2										2	6	Salame & van der Zaag
2	Mediation techniques applied to water issues	6			12							18	30	Kowarsky
3	Design and implement conflict resolution processes	12			20							32	56	Wolf
4	Summary of concepts	2										2	6	Salame & van der Zaag
5	Cases of transboundary water conflicts or cooperation				6							6	6	Gupta
6	Final roleplay				12							12	12	Kuylenstierna
	Essay				24							24	24	Salame & van der Zaag
	Exam		3										3	
<b>Total</b>		<b>22</b>	<b>3</b>		<b>74</b>							<b>96</b>	<b>143</b>	
<b>MSc module - UNESCO-IHE</b>														

# WATER MANAGEMENT

## MASTERS PROGRAMME

Academic Year: 2012-2014  
 Specialization: Water Resources Management  
 Module Coordinator: Susan Graas

### Module Sheet

Module Name Water systems modelling		Module Code WRM06	Credits 5
<b>Target Group</b> Young and mid-career professionals, managers, engineers and technicians dealing with or interested in various aspects of water resources modelling.		<b>Prerequisites</b> Affinity with quantitative approaches is required. Good command of English.	

### Learning Objectives

Upon completion of the module participants will be able to..

- Describe the procedure of the modelling protocol.
- Name and explain type of models used in different case studies.
- Build water resources models that simulate river basin processes.
- Clearly present the results of the water system models.
- Critically analyse model outcomes.

### Topics and Learning Activities

#### Water system modelling - Concepts

Introduction to water system modelling concepts, including procedure in the modelling protocol, different types of models (prescriptive vs descriptive, stochastic vs conceptual, lumped vs distributed), calibration and validation procedures, performance indicators and available software packages.

#### Learning Activities:

Lectures supported by ppt and book chapters.

#### Water system modelling - Practice

Application of 3 different models. A hydrological model (HBV); a water allocation model (Waflex) and a hydraulic model (Mike-11) will be build and tested after which the output will be analysed and interpreted. The developed models will increase the understanding of the participants in the possible applications of water system modelling within the concept of integrated river basin management. One of the models has to be chosen to be presented and critically discussed during an oral exam.

#### Learning Activities:

Interactive computer workshops.

#### Paper discussion

Read two journal articles on the topic (selected by the lecturers) which are discussed during a session. The discussion will focus on the relevance of the modelling theory applied to the article in question, to appreciate the advantages of modelling for water resources management and to be able to understand, analyse and interpret model results.

#### Learning Activities:

Discussion.

#### Fieldtrip

A relevant organisation will be visited where the use of quantative data, monitoring and models for their work will be illustrated.

#### Learning Activities:

Excursion.

#### Case studies

Several guest lecturers will come and share their experience with respect to modelling water systems.

#### Learning Activities:

Lectures supported by ppt (and hand-outs).

### Lecturing Material

- Loucks, D.P. and Van Beek, E. 2005. Water Resources Systems Planning and Management, UNESCO-publishing. To be studied: Chapter 2,3,9 and 11.
- Mul, M.L. – Spreadsheet modelling, UNESCO-IHE Lecture Notes.
- Other handouts: Selected background reading.
- Software applications: HBV, WAFLEX (MS Excel), MIKE 11, DUFLOW.



## Assessment

- 60%: Written Exam (open book)
- 40%: Presentation

2012/2014-WRM06: Water systems modelling										
Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: studyload hours	Lecturer(s)
<b>1</b>	<b>Water system modelling - Concepts</b>									
1.1	Why model	2						2	6	Graas
1.2	Modelling process	2						2	6	Mul
1.3	Calibration & Validation	2						2	6	Mul
1.4	Types of models	2						2	6	Graas
1.5	Optimisation vs Simulation	2						2	6	Mul
1.6	Examples of Software Packages for Water Systems Modelling	2						2	6	Graas, Popescu
<b>2</b>	<b>River Basin Simulations - Practice</b>		<b>36</b>						<b>36</b>	
2.1	HBV (rainfall-runoff)			12				12	12	Mul
2.2	Waflex (water allocation)			12				12	12	Graas
2.3	Mike 11 (flood)			12				12	12	Popescu
<b>3</b>	<b>Paper discussion</b>	<b>4</b>						<b>4</b>	<b>12</b>	Graas, Mul
<b>4</b>	<b>Field trip</b>					<b>8</b>		<b>8</b>	<b>8</b>	Graas, Smits
<b>5</b>	<b>Case studies</b>									
5.1	DSM Gist, Delft			4				4	4	Smits
5.2	New data sources for modelling	2						2	6	Alfonso
<b>6</b>	<b>Exam</b>		<b>3</b>						<b>3</b>	
	<b>Total</b>	<b>18</b>	<b>39</b>	<b>40</b>		<b>8</b>		<b>66</b>	<b>141</b>	
<b>MSc module - UNESCO-IHE</b>										

# WATER MANAGEMENT

## MASTERS PROGRAMME

Academic Year: 2012-2014  
Specialization: Core Programme  
Module Coordinator: M.W. Blokland, MSc

### Module Sheet

Module Name Managing water organisations		Module Code WSM06	Credits 5
<b>Target Group</b> Young and mid-career professionals with an interest in strategic and operational management of water organisations.	<b>Prerequisites</b> Preferably experience in the water sector. A bachelor's degree or equivalent. Basic PC-computer knowledge. Good command of English language.		

### Learning Objectives

*Upon completion of the module participants will be able to..*

- Explain the position and strategy of a water organisation in relation to its institutional environment.
- Summarize the scope, scale, structure and key work processes of organisations
- Analyze the management and decision-making processes in water organisations, including the management of change.
- Plan the use of performance analysis and benchmarking in the regulation and management of water organisations.
- Assess the processes of human resources, health and safety, management for integrity and sustainability, asset management and customer management.

### Topics and Learning Activities

#### Water Organizations in Context

Mandate and structure, scale and scope of operations, ethics, integrity, sustainability, climate change, and reform.

#### Water Organisations at Work

Environment and strategy, performance and benchmarking, human resources management, health and safety, asset management, customer management.

### Lecturing Material

- Reading materials.
- Discussions.
- Exercises.
- Case studies.
- Power-point presentations.
- Two field trips; one to a water supply company and one to a river basin organisation.

### Assessment

- **100%: Assignment**

**2012/2014-WSM06: Managing water organisations**

Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: study/load hours	Lecturer(s)
<b>1</b>	<b>Introduction</b>									
1.1	Course and Fieldtrip Introductions			2				2	2	Blokland
1.2	Managing a Water Utility			8				8	8	To be announced
<b>2</b>	<b>Water Organisations in Context</b>									
2.1	Organisations Undergoing Reform			6				6	6	Schwartz
2.2	Mandate and Structure of RBO's			6				6	6	Mostert
2.3	Environment and Strategy			6				6	6	Schouten
2.4	Scale and Scope of Operations			8				8	8	Douven
<b>3</b>	<b>Water Organisations at Work</b>									
3.1	Effective Organisations			6				6	6	Schuurmans
3.2	Performance and Benchmarking			10				10	10	Blokland
3.3	Integrity, Sustainability			6				6	6	Mairesse, Fahsi
3.4	Health and Safety			6				6	6	Harle
3.5	Asset Management			8				8	8	van Dijk
3.6	Customer Management			6				6	6	Beltman
3.7	Human Resources Management			6				6	6	van Heijzen
<b>4</b>	<b>Fieldtrip</b>					<b>16</b>		<b>16</b>	<b>16</b>	Waternet Amsterdam & Drinking water utility WMD
<b>5</b>	<b>Assignment</b>		<b>43</b>						<b>43</b>	
	<b>Total</b>		<b>43</b>	<b>84</b>		<b>16</b>		<b>100</b>	<b>143</b>	

**MSc module - UNESCO-IHE**

# ENVIRONMENTAL SCIENCE

## MASTERS PROGRAMME

Academic Year: 2012-2014  
Specialization: Core Programme  
Module Coordinator: H.J. Lubberding, PhD, MSc

### Module Sheet

Module Name Environmental engineering		Module Code ES06T	Credits 5
Target Group Programme target group	Prerequisites Programme prerequisites		

### Learning Objectives

Upon completion of the module participants will be able to..

- Describe the basic chemical and biological processes and their engineering in water and wastewater treatment;
- Evaluate different approaches to wastewater treatment and select the best option for local conditions.

### Topics and Learning Activities

#### Water treatment

Water is playing an essential role in relation with the environment and in this module it is shown, how man can actively intervene in its pollution. Man is using several simple and advanced techniques to produce reliable drinking water from groundwater and surface water

#### **Learning Activities:**

*Lectures, workshop, fieldtrip*

#### Wastewater treatment

To limit environmental pollution wastewater has to be treated; an overview of basic processes available for the treatment of domestic and industrial wastewater, with special emphasis on natural processes and systems that can be applied, is given in wastewater treatment

#### **Learning Activities:**

*Lectures, laboratory.*

#### Environmental Process Technology

For a better understanding of water and wastewater treatment the principles of mass balances, reaction kinetics and reactor design are discussed in environmental process technology

#### **Learning Activities:**

*Lectures, workshop*

#### Lecturing Material

- Lecture notes Water treatment
- Lecture notes + laboratory notes wastewater treatment
- Lecture notes EPT

#### Assessment

- 50%: Written Exam (closed book)
- 25%: Assignment
- 25%: Assignment

**2012/2014-ES06T: Environmental engineering**

Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: study/load hours	Lecturer(s)
	<b>Water treatment</b>		<b>20</b>	<b>8</b>				<b>8</b>	<b>28</b>	Buiteman
	<b>Wastewater treatment, natural processes</b>	<b>16</b>		<b>16</b>				<b>32</b>	<b>64</b>	van Bruggen, van der Steen, Lubberding, Kelderman
	<b>Environmental process technology</b>		<b>20</b>	<b>16</b>				<b>16</b>	<b>36</b>	Bijlsma
	<b>Fieldtrip</b>						<b>4</b>	<b>4</b>	<b>12</b>	Å
	<b>Exam</b>		<b>2</b>						<b>2</b>	
	<b>Total</b>	<b>16</b>	<b>42</b>	<b>40</b>			<b>4</b>	<b>60</b>	<b>142</b>	
<b>MSc module - UNESCO-IHE</b>										

# ENVIRONMENTAL SCIENCE

## MASTERS PROGRAMME

Academic Year: 2012-2014  
Specialization: Core Programme  
Module Coordinator: J.J.A. van Bruggen, PhD, MSc

### Module Sheet

Module Name Wetlands for water quality		Module Code ES06W	Credits 5
Target Group Programme target group	Prerequisites Programme prerequisites		

### Learning Objectives

Upon completion of the module participants will be able to..

- assess the value of wetlands and explain the use of natural and constructed wetlands for the treatment of wastewater;
- describe the concept of wastewater treatment by wetlands;
- design and operate a wetland treatment system.

### Topics and Learning Activities

#### Introduction on natural wetlands

what are wetlands, where are wetlands, wetland ecology, biodiversity, economics. The role of wetlands in the catchment: general aspects, hydrological aspects, wetlands as buffers and the role in relation to climate.

#### **Learning Activities:**

*lectures, and video presentations.*

#### Natural wetlands for wastewater treatment

the basic principles, the advantages and disadvantages, the risks. Examples in a temperate climate and examples in the tropics.

#### **Learning Activities:**

*lectures, and video presentations.*

#### Constructed wetlands for wastewater treatment

the different types, the design and criteria for design. Advantages and disadvantages. Constructed wetlands in The Netherlands, the tropics and the rest of the world.

#### **Learning Activities:**

*lectures, and video presentations, field trip*

#### Integrated wetland production systems

theory, examples, advantages, disadvantages, economics, nutrient flows. Modelling of integrated production systems.

Field visits.

#### **Learning Activities:**

*lectures, and video presentations, assignment*

### Lecturing Material

- Lecture notes and case studies

### Assessment

- 60%: Written Exam (closed book)
- 40%: Assignment

**2012/2014-ES06W: Wetlands for water quality**

Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM:		Lecturer(s)
								contact hours	study/load hours	
1	Introduction into the module	1						1	3	
2	Wetlands	8	2					8	26	
3	Wastewater treatment aspects	6						6	18	
4	Natural wetlands for water treatment	4						4	12	
5	Constructed wetlands	14						14	42	
6	Integrated production systems	6						6	18	
7	Fieldtrip					16		16	16	
8	Exam		3						3	
	<b>Total</b>	<b>39</b>	<b>5</b>			<b>16</b>		<b>55</b>	<b>138</b>	
<b>MSc module - UNESCO-IHE</b>										

# WATER MANAGEMENT

## MASTERS PROGRAMME

Academic Year: 2012-2014

Specialization: Water Resources Management and Water Conflict Management

Module Coordinator: I. Masih

### Module Sheet

Module Name Water resources planning		Module Code WRM07	Credits 5
<b>Target Group</b> Young and mid-career professionals, managers, engineers and technicians who have the ambition to judge, participate in and guide multi-disciplinary water resources planning studies.	<b>Prerequisites</b> Understanding of the water resources physical system. Understanding of water use for agriculture, water supply, hydropower and environment. Understanding of water governance. Computer literacy. Good command of English.		

### Learning Objectives

*Upon completion of the module participants will be able to..*

- Distinguish the spatiotemporal scales and river basin development phases in a water resources planning process.
- Describe major steps in the participatory and integrated water resources planning process.
- Identify and apply planning tools, such as stakeholder integration, methods for environmental impact assessment and decision support systems, while engaging in water resources planning activities.
- Develop alternative water management strategies.
- Evaluate alternative water management strategies by applying multi-criteria analysis.
- Formulate and evaluate integrated water resources plans in a participatory context.

### Topics and Learning Activities

#### Framework of Analysis for water Resources Planning:

Principles of integrated water resources planning. Planning scales and approaches. Analysis of the trajectory and stages of river basin development (e.g. Open basin, closing basin, closed basin) and corresponding management strategies. Comprehension of different frameworks used in water resources planning with focus on key steps in the planning process, such as situation and function analysis including multi-level water sector analysis, planning objectives and criteria, scenario and strategy development, role of modelling in water resources planning and multi-criteria analysis.

#### **Learning Activities:**

*The learning activities include lectures, exercises, assignments and role play simulation game using LIBRA model.*

*There will be a field trip to a relevant Institution in the field of water resources planning.*

#### Stakeholder Participation in Water Resources Planning:

Importance of stakeholder participation in the planning process, opportunities and limitations. Stakeholder analysis. Tools and methods for stakeholder participation in key steps of the planning process including participatory decision support systems. Negotiation and compensation in group decision making. Plan implementation and evaluation. The evolution of and experience with participatory and integrated planning methods will be demonstrated through case study examples.

#### **Learning Activities:**

*The learning activities include lectures, exercises and assignments, interactive (computer) workshops, use of decision support system (Altaguax DSS).*

#### Environmental Assessment:

Environmental impacts of water resources development projects, principles and methods of environmental impact assessment, Applications of environmental impact assessment (EIA) and strategic environmental assessment (SEA) in water resources/environmental planning and management.

#### **Learning Activities:**

*The learning activities include lectures, exercises and assignments and group discussions.*

### Lecturing Material

- D. P. Loucks, E. van Beek, J. R. Stedinger, J. P. M. Dijkman, and M. T. Villars. 2005. Water Resources Systems Planning and Management: An Introduction to Methods, Models and Applications. UNESCO Publishing, Paris.
- J.C. Heun and N. Van Cauwenbergh – Participatory Integrated Water Resources Planning: Framework for Analysis and Stakeholder integration, UNESCO-IHE Lecture Notes.
- L. C. Beevers and H. Clouting - Environmental Assessment: Environmental Impact Assessment (EIA) & Strategic Environmental Assessment (SEA), UNESCO-IHE Lecture Notes.



- Other Handouts: Examples of case studies, Selected background reading.
- Software: LIBRA River Basin Planning Simulation, Excel Spreadsheets, Altiguax DSS, Expert Choice (MCA).

### Assessment

- 65%: Written Exam (closed book)
- 35%: Assignment

2012/2014-WRM07: Water resources planning											
Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: studyload hours	Lecturer(s)	
1	Introduction to Module and Water Resources Planning (WRP)	4						4	12	Masih	
2	Framework of Analysis for WRP	8		4			4	16	40	Heun & Masih	
3	Stakeholder Participation in WRP	10		10				20	40	van Cauwenbergh	
4	Environmental Impact Assessment and Strategic Environmental Assessment	10		8				18	38	Clouting & Hamdard & Vis	
5	Field Trip					8		8	8	Hamdard & Hofstra	
	Exam		3						3		
	<b>Total</b>	<b>32</b>	<b>3</b>	<b>22</b>		<b>8</b>	<b>4</b>	<b>66</b>	<b>141</b>		
MSc module - UNESCO-IHE											

# WATER MANAGEMENT

## MASTERS PROGRAMME

Academic Year: 2012-2014  
Specialization: Core Programme  
Module Coordinator: P.J.M. Libaudiere, MSc

### Module Sheet

Module Name Financial management in the water sector		Module Code WSM07	Credits 5
<b>Target Group</b> Staff from water organisations and other related sector institutions, who are interested in financial management of water related enterprises.	<b>Prerequisites</b> Preferably a relevant water science, economics or finance related bachelor degree; Some experience in the water sector; Good command of the English language.		

### Learning Objectives

*Upon completion of the module participants will be able to..*

- Recognize the need for commercial accounting and identify the components of standard financial statements in water organisations.
- Analyze the financial position of a water organisation through an analysis of financial statements.
- Compute a Social Cost-Benefit Analysis for water and sanitation related projects.
- Apply simple financial and economic modelling to optimize production and improve financial performance.
- Employ demand assessments and discuss the fundamentals of water pricing.
- Recognize and implement basic customer protection and marketing techniques in water organisations.

### Topics and Learning Activities

1. Introduction to Financial Management.
2. Finance and accounts management.
3. Demand assessment, water pricing and cost recovery.
4. Cost-Benefit Analysis.
5. Services marketing and customer protection issues.
6. Economic and financial modelling techniques.
7. Financial operations management, group exercise.

### Lecturing Material

- Lecture notes, Powerpoint presentations.
- Related scientific articles.
- Reference books.

### Assessment

- 60%: Written Exam (open book)
- 10%: Assignment
- 20%: Assignment
- 10%: Assignment

**2012/2014-WSM07: Financial management in the water sector**

Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM:		Lecturer(s)
								contact hours	study/load hours	
1	Introduction to Financial Management	2						2	6	Mugisha
2	Finance and accounts management	10		4				14	34	LibaudiÅre
3	Demand assessment, water pricing and cost recovery	10		4				14	34	van Dijk
4	Cost-Benefit Analysis	4		4				8	16	Mugisha/LibaudiÅre
5	Sevices marketing and customer protection issues	4						4	12	Mugisha
6	Economic and financial modelling techniques	4						4	12	Mugisha
7	Financial operations management, group exercise	2	6					2	12	Mugisha/LibaudiÅre
	Individual assignmentÅ		14						14	
	Exam		3						3	
	<b>Total</b>	<b>36</b>	<b>23</b>	<b>12</b>				<b>48</b>	<b>143</b>	

**MSc module - UNESCO-IHE**

# ENVIRONMENTAL SCIENCE

## MASTERS PROGRAMME

Academic Year: 2012-2014  
Specialization: Core Programme  
Module Coordinator: H. Clouting, PhD

### Module Sheet

Module Name		Module Code	Credits
Environmental planning and implementation		ES07MW	5
<b>Target Group</b> Young and mid-career professionals (scientists, decision-makers) with a background in environmental management, water management and / or watershed management.	<b>Prerequisites</b> Affinity with environment policy and enforcement, development economics, and preferably experience in water management arena. Good command of English.		

### Learning Objectives

*Upon completion of the module participants will be able to..*

- Explain the concept and importance of sustainable development into environmental planning and management
- Apply and discuss economic valuation methods and policy instruments for environmental policy
- Explain principles, processes and methods of environmental assessment (EIA-SEA) and be able to apply them in water related plans, programmes and projects
- Apply basic theories behind policy enforcement, monitoring and evaluation to master effective environmental policies
- Use environmental information systems to support planning and management

### Topics and Learning Activities

**Sustainable Development**

**Environmental Planning Process**

**Environmental Assessments (EIA/SEA)**

**Environmental Economics**

**Environmental Policy Enforcement**

### Lecturing Material

- Lecture Notes
- Additional Reading Materials
- Lecture powerpoint slides

### Assessment

- **70%: Written Exam (closed book)**
- **30%: Assignment**

**2012/2014-ES07MW: Environmental planning and implementation**

Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: study/load hours	Lecturer(s)
1	Sustainable Development	6	8					6	26	Hoekstra
2	Environmental Planning	2						2	6	Hamdard
3	Environmental Economics	14						14	42	Bijlsma
4	Environmental Assessment (EIA/SEA)	10	8					10	38	Vis, Clouting, Hamdard
5	Environmental Policy Enforcement	5	6					5	21	Douven, Guest lecture
6	Fieldtrip					8		8	8	Hamdard
7	Exam		3						3	
<b>Total</b>		<b>37</b>	<b>25</b>			<b>8</b>		<b>45</b>	<b>144</b>	

**MSc module - UNESCO-IHE**

# WATER MANAGEMENT

## MASTERS PROGRAMME

Academic Year: 2012-2014  
Specialization: Core Programme  
Module Coordinator: Jaspers

### Module Sheet

Module Name Water and environmental law		Module Code WM08	Credits 5
<b>Target Group</b> Students of the Masters of Science Programmes of Water Management and Environmental Science and Technology Practitioners with a relevant Bachelor's degree in a water related discipline	<b>Prerequisites</b> Preferably a relevant water science and engineering related bachelor's degree or equivalent; affinity with water management; good command of English.		

### Learning Objectives

*Upon completion of the module participants will be able to..*

- demonstrate and apply knowledge in the fields of national and international water and environmental law and to perceive and discuss the main concepts, theories, discourses
- apply, compose and recreate legal instruments to operationalize integrated water resources management (water quantity and water quality)
- demonstrate and apply knowledge in the field of contract management for use in water projects.
- analyze and prepare a contract for a specific situation
- describe and apply concepts of water allocation, water rights and international benefit sharing
- discuss and explain complexity of decision making for water allocation in national and international rivers.

### Topics and Learning Activities

#### Introduction to national and international water law and institutions

Comparative environmental law and water law principles. Innovative legal and policy instruments; changing patterns of global governance. Introduction to the UN system. Introduction to the Law of Treaties. Key international environmental and water treaties. Principles of dispute resolution.

#### Processes of water policy development

Water sector reform, functional decentralization and development and benchmarking of river basin organizations.

#### Systems of (transboundary) water allocation and (customary) water rights

Shared vision and strategy development, water and benefit sharing from international rivers.

#### Regulations for international and trans-boundary water quality management

EU Framework Directive, Dutch water policy and organizations, application of environmental standards and others.

### Lecturing Material

- F.G.W. Jaspers - Chapters in Water and Environmental Resources Law, UNESCO-IHE Lecture Notes.
- F.G.W. Jaspers - Role Play International Rivers, UNESCO-IHE Lecture Note.
- F.G.W. Jaspers - Introduction in Contract Management, UNESCO-IHE Lecture Note.
- J. Gupta - International Water Law and Institutions, UNESCO-IHE Lecture Note.
- P. van der Zaag e.a - Legislation of International Waters, UNESCO-IHE Lecture Note.
- Various inputs from guest lecturers.

### Assessment

- **60%: Written Exam (closed book)**
- **40%: Assignment**

**2012/2014-WM08: Water and environmental law**

Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: study/load hours	Lecturer(s)
<b>1</b>	<b>Water Law</b>									
1.1	Introduction Water Law	2						2	6	Jaspers
1.2	International Water Law	4		2				6	14	Gupta
1.3	Legal Instruments Environmental Law	4						4	12	Jaspers
1.4	Contract Management	4						4	12	Jaspers
1.5	International Environmental Law	4		2				6	14	Gupta
1.6	Case studies Environment / Forestry			4				4	4	Gupta
<b>2</b>	<b>Legal Arrangements</b>									
2.1	Contract Management Case Study / Workshop			4				4	4	Jaspers
2.2	Trans-boundary Water Allocation	4						4	12	Van der Zaag/Shubber
2.3	Beneift Sharing	4						4	12	Van der Zaag/Shubber
2.4	WQM Regulation	4		2				6	14	Hendry
2.5	EUWFD	4		2				6	14	Hendry
<b>3</b>	<b>Organisations</b>									
3.1	À Contract Management			4				4	4	Jaspers
3.2	River Basin Organization (Intro)	4		2				6	14	Jaspers
2.2	Visit International Court of Justice					8		8	8	Shubber
2.4	Case: Customary Water Rights			6				6	6	van der Zaag/Wessels
	<b>Assignment</b>		<b>12</b>						<b>12</b>	
	<b>Exam</b>		<b>3</b>						<b>3</b>	
	<b>Total</b>	<b>38</b>	<b>15</b>	<b>28</b>		<b>8</b>		<b>74</b>	<b>165</b>	
<b>MSc module - UNESCO-IHE</b>										

# WATER MANAGEMENT

## MASTERS PROGRAMME

Academic Year: 2012-2014  
 Specialization: Core Programme  
 Module Coordinator: S. Graas and N. Van Cauwenbergh

### Module Sheet

Module Name International fieldwork	Module Code WM09	Credits 5
<b>Target Group</b> This module is required for all participants in the Water Management programme. Participants of the WQM specialisation may choose to participate in the fieldtrip of the Environmental Science. In this case, they will also follow the Environmental Science Groupwork.	<b>Prerequisites</b> Bachelor's degree. Basic computer skills (MS-Windows, Office) Good English command. Basic knowledge of IWRM and EU FWD.	

### Learning Objectives

*Upon completion of the module participants will be able to..*

- Compare the different water management perspectives and uses in practice in Spain and Portugal. Issues that will be elaborated upon during the fieldwork include Multiple uses for and multiple sources of water; Up and downstream water issues; Institutional framework and implementation of the EU WFD; Public and private water supply; Conventional and alternative waste water treatment and reuse; Large Dams and transboundary river basin issues; Ancient vs modern irrigation and water supply systems; Non conventional water resources: desalination and wastewater reuse; Formal and informal decision making processes.
- Formulate a problem statement
- Collect and analyse data from field measurements and interviews
- Develop a problem analysis

### Topics and Learning Activities

#### General info

During two weeks, students will visit institutions and stakeholder groups in the Andarax and Guadiana basins in Spain and Portugal. The purpose of these visits is to familiarize students with technical (physical, chemical, biological and engineering) and non-technical (legal, social, economic, cultural, financial, institutional and managerial) aspects of water management and the interactions between them.

#### Problem analysis of Andarax basin

The fieldwork in the Andarax basin is linked with the Water Management groupwork in August. As such, the fieldwork fulfills a double role. Students are asked to develop a clear problem analysis for a given water management theme in the Andarax basin. This problem analysis feeds into the groupwork where an integrated management plan for the Andarax basin will be developed.

Prior to going to the Andarax basin, participants will prepare for the fieldwork through literature review, lectures and discussion. On the basis of these activities, the group will formulate research questions and methodology to accomplish a thorough problem analysis. During the fieldwork in the Andarax basin, data will be collected during the visits to various institutions and stakeholder groups. This means that participants have to ask questions, ask for data, collect information, etc., that will be used for the problem analysis.

#### Fieldwork

Good water management is founded on reliable data. The person making measurements has the responsibility of ensuring that raw data of an acceptable quality is collected. During this fieldwork a number of discharge measurements and physicochemical water quality parameters will be determined at selected points by direct measurements. The data collected will be analysed to gain insight into the topography (land use, geology, users, etc.), hydrology and water quality of the catchment, and identifying some of the mechanisms that determine this water quantity and quality.

#### Guadiana - Large infrastructure and transboundary issues

The visits in the Guadiana basin focus on the issues related to transboundary water management and the design, implementation and governance of large dams. Both Spanish and Portuguese water managers will comment on the established (or absence of) collaboration on management of quantity and quality of water flowing across the Spanish/Portuguese border. Negotiation and conflict resolution in place will be discussed with experts. Authorities and stakeholders will comment on technical, socio-economic and governance issues of the dam and its relation to upstream and downstream development.

### Lecturing Material



- Please visit <http://www.altaguax.org/> for relevant literature

### Assessment

- 30%: Presentation
- 40%: Presentation
- 30%: Assignment

2012/2014-WM09: International fieldwork										
Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: studyload hours	Lecturer(s)
	International fieldwork		60			80		80	140	Various
		Total	60			80		80	140	
MSc module - UNESCO-IHE										

# WATER MANAGEMENT

## MASTERS PROGRAMME

Academic Year: 2012-2014  
 Specialization: Elective  
 Module Coordinator: Jeltsje Kemerink and Klaas Schwartz

### Module Sheet

Module Name Institutional analysis	Module Code WRM10	Credits 5
<b>Target Group</b> Young and Mid-career professionals who are 1) working at middle and upper management level in an organization in the water sector, 2) employed in policy making institutions in the water sector or 3) working for organizations engaged in management of water resources and water services.	<b>Prerequisites</b> This module involves considerable critical reading (approximately 15) of peer-reviewed articles from various social science disciplines. Experience and motivation to undertake this reading is essential for successful completion of this module.	

### Learning Objectives

*Upon completion of the module participants will be able to..*

- Analyze the role of institutions in water management.
- Summarize different approaches to institutional analysis linked to different schools of thought.
- Apply these approaches for analyzing cases of water management.

### Topics and Learning Activities

#### Approaches to Institutional Analysis

In discussing approaches to institutional analysis, different conceptual approaches will be discussed. These approaches include the Institutional Analysis and Development Framework, Institutional Bricolage, Institutional Isomorphism and Legal Pluralism. In discussing these approaches we will highlight different streams in thinking about institutions and how these institutions develop.

#### **Learning Activities:**

*Each approach will be elaborated upon through a presentation/lecture. One session will be organized to specifically contrast different analytical approaches and to discuss these approaches using a documentary as an example.*

#### Case studies highlighting different approaches to institutional analysis

In a case study different institutional approaches are visible. In the second week of the module, these different institutional approaches will be illustrated by a number of case studies. Case studies include the Tennessee Valley Authority, the water user association model, and a case of soil erosion in Ethiopia. Discussing different institutional approaches through case studies is aimed at highlighting the usefulness of engaging with a particular case using different conceptual approaches.

#### **Learning Activities:**

*Each case study will be developed through a lecture/presentation.*

#### Institutions and socio-ecological change

In this block, we aim to place institutions within a broader socio-ecological context. "Nature and ecological conditions and processes do not operate separately from social processes, and [...] actually existing social conditions are always the result of intricate transformations of pre-existing configurations that are themselves inherently natural and social" (Swyngedouw 1999:445). Institutions are interdependent on and interact with social, ecological and technological processes. Understanding institutions thus requires these institutions to be analyzed within a broader social, technological and ecological framework. In this third block the relationship between institutions and socio-ecological change is investigated.

#### **Learning Activities:**

*This topic will be developed through a series of lectures.*

### Lecturing Material

- Students will be provided a list of articles that are required reading. It should be noted that students are expected to read and understand a considerable number of articles (approximately 15).

## Assessment

- 50%: ..
- 15%: Assignment
- 15%: Assignment
- 20%: Assignment

2012/2014-WRM10: Institutional analysis														
Nr	Course/Topic	Lecture	Assignment	Workshop	Case study	Role play	Exercise	Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: studyload hours	Lecturer(s)
1	Introduction to the Module	1										1	3	Kemerink and Schwartz
2	Institutional Analysis	2										2	6	Ahlers
3	Institutional Analysis and Development Framework: Ostrom	2										2	6	Castro
4	Institutional Bricolage	2										2	6	Cleaver
5	Institutional Isomorphism	2										2	6	Schwartz
6	Legal Pluralism	2										2	6	Kemerink
7	Case Water User Association	2										2	6	Kemerink and Rusca
8	Tennessee Valley Authority	2										2	6	Bolding
9	Gender and Institutions	2										2	6	Zwarteveen
10	Formality and Informality	2										2	6	Schwartz
11	Institutions and Socio-Ecological Change	6										6	18	Ahlers
12	Case Erosian in Ethopia	2										2	6	Smit
13	Introduction to Assignment	1										1	3	Kemerink and Schwartz
14	Assignment		60										60	
	<b>Total</b>	<b>28</b>	<b>60</b>									<b>28</b>	<b>144</b>	

MSc module - UNESCO-IHE

# WATER MANAGEMENT

## MASTERS PROGRAMME

Academic Year: 2012-2014  
Specialization: Core Programme  
Module Coordinator: P.J.M. Libaudière, MSc

### Module Sheet

Module Name		Module Code	Credits
Public-private partnerships in the water sector		WSM10	5
<b>Target Group</b> Professional staff active in water related institutions, such as governmental bodies, NGOs, consultancy firms, research institutions and water utilities. Future professionals, such as promising bachelor students.	<b>Prerequisites</b> Preferably a water science, economics or management related bachelor degree; Experience in the water sector; Good command of the English language.		

### Learning Objectives

*Upon completion of the module participants will be able to..*

- Recognize different PPP options and principles governing PPPs.
- Estimate the suitability of PPP options, based on lessons learned from past PPP contracts.
- Determine whether the prerequisite enabling environment of a chosen PPP option is present.
- Evaluate the pitfalls in a PPP implementation process, including the procurement cycle.

### Topics and Learning Activities

**Introduction.**

**Principles of PPP.**

**PPP in practice.**

**Issues regarding PPPs.**

**Fieldtrip: Harnasch polder; Delfluent Services.**

**Mini Symposium.**

### Lecturing Material

- Lecture notes by prof. M. P. van Dijk.
- Scientific articles.
- Powerpoint presentations.
- Marin, P. (2009). Public-Private Partnerships: A review of experiences in developing countries. PPIAF & The World Bank.

### Assessment

- **70%: Written Exam (closed book)**
- **30%: Assignment**

**2012/2014-WSM10: Public-private partnerships in the water sector**

Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: study/load hours	Lecturer(s)
<b>1</b>	<b>Introduction</b>									
1.1	Introduction to the course	1						1	3	van Dijk
1.2	Introduction to PPPs	3						3	9	van Dijk
1.3	Case study presentations			2				2	2	van Dijk
<b>2</b>	<b>Principles of PPPs</b>									
2.1	PPP options	2						2	6	van Dijk
2.2	PPP environment	2						2	6	van Dijk
2.3	PPP economics	2						2	6	van Dijk
2.4	Tutorials	4	4					4	16	van Dijk
<b>3</b>	<b>PPP in practice</b>									
3.1	Current situation and actors	2						2	6	Guest lecturer
3.2	Contracts	4						4	12	Guest lecturer
3.3	Risks and limitations	2						2	6	Guest lecturer
3.4	Success factors of PPPs	1						1	3	Guest lecturer
3.5	Case study exercises			4				4	4	Guest lecturer
3.6	Real life examples	1		2				3	5	Guest lecturer
<b>4</b>	<b>Issues regarding PPPs</b>									Å
4.1	Best practices			2				2	2	Guest lecturer
4.2	Controversies in the water sector	2		2				4	8	van Dijk
4.3	Pro-poor approaches	4						4	12	van Dijk
4.4	Trends in the water sector	2						2	6	van Dijk
<b>5</b>	<b>Fieldtrip: Harnasch polder / Delfluent services</b>					4		4	4	Libaudi-Åtre
<b>6</b>	<b>Mini Symposium</b>	4						4	12	van Dijk & Gourdin
	<b>Individual assignment</b>		12						12	
	<b>Exam</b>		3						3	
	<b>Total</b>	<b>36</b>	<b>19</b>	<b>12</b>		<b>4</b>		<b>52</b>	<b>143</b>	
<b>MSc module - UNESCO-IHE</b>										

# ENVIRONMENTAL SCIENCE

## MASTERS PROGRAMME

Academic Year: 2012-2014  
Specialization: Core Programme  
Module Coordinator: G.M. Gettel, PhD, MSc

### Module Sheet

Module Name		Module Code	Credits
Aquatic ecosystems: processes and applications		ES10TWL	5
<b>Target Group</b> Programme target group (Participants in the programmes at IHE) and qualified short course participants	<b>Prerequisites</b> Programme prerequisites (BSc in a topic appropriate to UNESCO-IHE programme) and basic knowledge of aquatic ecology.		

### Learning Objectives

*Upon completion of the module participants will be able to..*

- Conduct laboratory techniques used for basic limnological studies. Specifically, you will be able to measure physical-chemical properties, chlorophyll a concentration in seston and periphyton; measure and calculate primary production and community respiration, measure nutrient concentration and turbidity, calculate and measure ash free dry mass, and perform zooplankton counts.
- Develop a research question based on the experimental design.
- Analyze data using either statistical or modeling techniques to answer your research question.
- Produce a report in the format of a scientific article that presents your research question, the data supporting it, and a discussion of your results, including a review of relevant literature.
- Critically analyze your colleagues' work in the form of a professional peer review.

### Topics and Learning Activities

#### Eutrophication in shallow-lake ecosystems

A mesocosm experiment will be used to analyse the effects of eutrophication in shallow lakes and to familiarise participants with techniques that are common in ecological research. Ample attention will be paid to the development of a critical scientific approach, including study design, statistical analysis and data presentation. Lectures on ecological processes and human impacts on aquatic ecosystems will provide the necessary theoretical background.

#### **Learning Activities:**

*Students will conduct laboratory experiments to generate a data set, which they will analyze using appropriate tools. Students will then write a scientific report and perform a peer review.*

### Lecturing Material

#### Assessment

- 80%: Assignment
- 10%: Assignment
- 10%: Presentation

**2012/2014-ES10TWL: Aquatic ecosystems: processes and applications**

Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: study/load hours	Lecturer(s)
	<b>Lecture</b>	14						14	42	Gettel, Irvine
	<b>Laboratory Work</b>				16			16	32	Gettel, Irvine
	<b>In-class activity (data analysis, group work)</b>			44				44	44	Gettel, Irvine
	<b>Paper Writing and Review</b>		20						20	Gettel, Irvine
	<b>Total</b>	14	20	44	16			74	138	
<b>MSc module - UNESCO-IHE</b>										

# WATER MANAGEMENT

## MASTERS PROGRAMME

Academic Year: 2012-2014  
 Specialization: Core Programme  
 Module Coordinator: Kooy / Rusca

### Module Sheet

Module Name Urban water governance (under revision)		Module Code WSM11	Credits 5
<b>Target Group</b> Young mid-career professionals who are 1) working at middle and upper level in an organization in the water sector, 2) employed in policy making institutions in the water sector, 3) working for organizations engaged in management of water resources and water services.	<b>Prerequisites</b> High level of ability to read and discuss academic articles and book chapters in English; willingness to engage in social science theory and new conceptual frameworks; willingness to engage in cross-disciplinary discussions and applications.		

### Learning Objectives

*Upon completion of the module participants will be able to..*

- Identify and analyse the relationships between urban governance structures and processes, and urban water governance;
- Identify the relationships between the urban hydrological cycle, and socio-political processes (the hydro-social cycle).
- Distinguish and explain the emergence of discourses and theoretical frameworks applied to urban water governance (hydro-social cycle, adaptive governance; multi-level governance), and their understand of equity and environmental sustainability.
- Define the urban water system and analyse climate change resilience for the urban water system.
- Analyse the inter-relationships between social issues (governance, politics, identity) and technical issues (infrastructure and urbanisation) and identify relevance for urban water(s).
- Identify and analyze the relationships between urban water(s) services (formal/informal) and (peri-urban/rural) resource bases

### Topics and Learning Activities

#### Urban governance & governance of urban waters

##### **Learning Activities:**

*lecture, exercise*

#### Hydro-social cycle - socio-political theories and urban waters

##### **Learning Activities:**

*lecture, exercise, groupwork*

#### Urban water system

##### **Learning Activities:**

*lecture, exercise*

#### Urban resilience: climate change and governance of urban waters

##### **Learning Activities:**

*lecture, exercise*

#### Rural/urban interface - water resources and urban water services

##### **Learning Activities:**

*lecture, exercise, groupwork*

#### Urban water(s): connecting the social and technical

##### **Learning Activities:**

*lecture, exercise, groupwork*

### Course description

The aim of this module is to provide participants with a general introduction to the issues of urban water governance from a critical social science perspective. The module will introduce and apply critical analysis to decision making for urban water flows: who decides - how - and why - where water goes, what kind of water, in what amount, at what (financial, economic, social) cost, and according to what management criteria? The module is taught based on the principle that there is no blueprint for 'good governance', but discussions on how best to make environmentally sustainable and equitable decisions will identify principles guiding management criteria. The module will highlight the inter-related ecological and socio-political dimensions of urban water governance, and will use case studies to illustrate the implications of various governance models.



The module will go beyond the governance of urban (waste)water services, to include the complete urban water system: wastewaters, surface/ground, and storm waters and therefore will touch on issues related to governance of sanitation/wastewater, disaster risk reduction/climate change adaptation, and the intersection of different scales of water governance (community, municipal, watershed, national etc).

By the end of the module students will be able to analyze the implications of different governance models on environmental sustainability, and socio-economic and inter-generational equity.

The module is elective, and therefore open to all students within the WM stream, but it will build on key concepts introduced in the Water Governance core module and the Institutional Analysis module. Students who have not taken these previous models will be provided with a review/tutorial of the relevant content.

#### Lecturing Material

- Students will be provided a list of articles that are required reading.

#### Assessment

- 20%: Assignment
- 30%: Assignment
- 50%: Assignment

2012/2014-WSM11: Urban water governance (under revision)										
Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: studyload hours	Lecturer(s)
	Urban governance & governance of urban waters	4	3		4			8	23	Kooy, guest lecturer
	Hydro-social cycles	4			6			10	24	Kooy
	Connecting the social & technical	4	3		4			8	23	Kooy, Schwartz, guest lecturer
	Urban water system	4		6				10	18	guest lecturer
	Urban water resilience	6	3					6	21	Kooy, Geronius, guest lecturer
	Rural/urban interface: connecting water resources and urban water(s) services	6		4	4			14	30	Rusca, guest lecturer
	Exam		3						3	
	<b>Total</b>	<b>28</b>	<b>12</b>	<b>10</b>	<b>18</b>			<b>56</b>	<b>142</b>	
<b>MSc module - UNESCO-IHE</b>										

# WATER MANAGEMENT

## MASTERS PROGRAMME

Academic Year: 2012-2014

Specialization: Water Resources Management & Water Quality Management

Module Coordinator: Y. Jiang

### Module Sheet

Module Name Watershed and river basin management		Module Code ES11MW	Credits 5
<b>Target Group</b> Young and mid-career professionals (scientists, decision-makers) with a background in water management, environmental management, and / or watershed management.	<b>Prerequisites</b> Affinity with hydrology, development economics, agronomy or geography (preferably a relevant water science or engineering related bachelor's degree or equivalent) and preferably experience in watershed and / or river basin management. Good command of English.		

### Learning Objectives

Upon completion of the module participants will be able to..

- describe the main natural and anthropogenic interactions at a watershed scale; and how they can be aggregated to river basin scale
- describe the role of water in sustaining different land uses, including ecosystems
- understand the watershed planning and management approaches, specifically in terms of soil and water management
- explain temporal and spatial scales issues in hydrology
- characterize the fundamental economic issues in watersheds and river basins and the role of economic valuation of aquatic ecosystem services in watershed and river basin management

### Topics and Learning Activities

#### Introduction

This section introduces watershed and river basin management

#### **Learning Activities:**

Lecture, group exercise/workshop

#### Biophysical processes and anthropogenic interactions

This section overviews biophysical processes and interactions with human activities in watersheds and river basins, covering soil & water management, watershed hydrology and human interventions, environmental flow, and groundwater management

#### **Learning Activities:**

Lecture, group exercise/workshop

#### Watershed and river basin planning

This section describes the planning process of watershed and river basin management, including technical and participatory tools to support planning processes

#### **Learning Activities:**

Lecture, group exercise/workshop

#### Watershed economics

This section introduces and characterises the fundamental economic issues in watersheds and river basins, explain the relevance and role of economics and economic valuation in watershed and river basin management

#### **Learning Activities:**

Lecture, group exercise/workshop

#### Watershed and river basin management

This section synthesizes the institutional aspects in watershed and river basin management, explains transboundary interdependencies and cooperation, and presents a case study of watershed and river basin management in the real world

#### **Learning Activities:**

Lecture, group exercise/workshop

#### Role play- ShaRiva

This group exercise uses hydrological simulation as a decision support tool to help understand the interdependency of different stakeholders and the importance of communication and cooperation to effective watershed and river basin management

#### **Learning Activities:**

group exercise

**Field trip**

**Lecturing Material**

- Lecture Notes
- Role play reading materials
- Lecture powerpoint slides
- Additional reading materials

**Assessment**

- **70%: Written Exam (closed book)**
- **30%: Assignment**

2012/2014-ES11MW: Watershed and river basin management										
Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: study/load hours	Lecturer(s)
1	<b>Introduction</b>			2				2	2	Jiang/Hamdard
2	<b>Biophysical processes and anthropogenic interactions</b>									
2.1	Soil & Water Management	6						6	18	Van der Zaag
2.2	Watershed hydrology and human interventions	4						4	12	Mul
2.3	Environmental flow allocation	4						4	12	McClain
2.4	Groundwater Management	4						4	12	Guest Lecturer
3	<b>Watershed and river basin planning</b>									
3.1	Planning processes	2						2	6	Douven
3.2	Technical tools to support planning processes	2						2	6	Mohamed
3.3	Participatory tools to support planning processes	2						2	6	Kemerink
4	<b>Watershed economics</b>									
4.1	Fundamental economic issues in watersheds and river basins	3						3	9	Jiang
4.2	Economic valuation of aquatic ecosystem services	3						3	9	Jiang
5	<b>Watershed and river basin management</b>									
5.1	Institutional aspects in watershed and river basin management	2						2	6	Douven
5.2	Transboundary Interdependencies and cooperation	2						2	6	Douven
5.3	Case Study	2						2	6	Guest Lecturer
6	<b>Role-Play SHA-RIVA</b>		20						20	Mul/Jiang/Hamdard
7	<b>Field trip</b>					4		4	4	Jiang
	<b>Exam</b>		3						3	
	<b>Total</b>	<b>36</b>	<b>23</b>	<b>2</b>		<b>4</b>		<b>42</b>	<b>137</b>	

MSc module - UNESCO-IHE

# ENVIRONMENTAL SCIENCE

## MASTERS PROGRAMME

Academic Year: 2012-2014  
 Specialization: Core Programme  
 Module Coordinator: Dr E. de Ruyter van Steveninck

### Module Sheet

Module Name		Module Code	Credits
IWRM as a tool for adaptation to climate change		ES11X	5
<b>Target Group</b> Programme target group (Participants in the programmes at IHE) and qualified short course participants.	<b>Prerequisites</b> Programme prerequisites (BSc in a topic appropriate to UNESCO-IHE programme) and basic knowledge of water management.		

### Learning Objectives

Upon completion of the module participants will be able to..

- describe the expected impacts of climate change on water resources and water use sectors in relation to (other) human activities
- identify the consequences of the predicted impacts of climate change and climate variability for integrated water resources management
- integrate climatic change conditions at different time and spatial scales into (risk) management in the water sector
- justify decisions on adaption to the impacts of climate change under uncertainty

### Topics and Learning Activities

#### Principles of Integrated Water Resources Management

Introduction into the concept of IWRM

##### **Learning Activities:**

*Lecture and discussion*

#### Climate change and impacts

The climate system and the causes of climate change and variability. Impacts of climate change on the hydrological cycle, the environment and on water use sectors

##### **Learning Activities:**

*Lectures and exercises*

#### Vulnerability and adaptation under uncertainty

What determines vulnerability to CC. Adaptation measures and strategies how to adapt under a high level of uncertainty

##### **Learning Activities:**

*Lecture, exercise and fieldtrip*

#### Institutional aspects and stakeholder participation

The importance of involving stakeholders in water management and CC adaptation and strategies on involving stakeholders

##### **Learning Activities:**

*Lecture, exercise and role play*

#### Multi sector/multicriteria decision making

Modelling effects of CC on water resources using Climateland as a case study

##### **Learning Activities:**

*Lecture and computer/modelling exercise*

### Lecturing Material

- Lecture notes, power point presentations, background materials

### Assessment

- 30%: Presentation
- 70%: Written exam (closed book)

**2012/2014-ES11X: IWRM as a tool for adaptation to climate change**

Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM:		Lecturer(s)
								contact hours	study/load hours	
1	IWRM, climate change and the hydrological cycle	8						8	24	de Ruyter, van Dorland, Uhlenbrook
2	Climate change: impacts and adaptation	14		6				20	48	de Ruyter, Pathirana, de Fraiture, Kukuric
3	Vulnerability and adaptation under uncertainty	9		7				16	34	Bresser, vdSluis, vdMeulen/Balica, deRuyter
4	Institutional aspects and stakeholder participation			6				6	6	Kemerink
5	Multi sector/multicriteria decision making			20				20	20	Venneker/Wenninger
6	Oral presentations			2				2	2	
7	Field trip					6		6	6	van der Meulen
8	Examination			3				3	3	
<b>Total</b>		31		44		6		81	143	
<b>MSc module - UNESCO-IHE</b>										

# WATER MANAGEMENT

## MASTERS PROGRAMME

Academic Year: 2012-2014  
Specialization: Core Programme  
Module Coordinator: S. Graas / K.Schwartz

### Module Sheet

Module Name	Module Code	Credits
IWRM Groupwork	WM12	5
<b>Target Group</b> This module is required for all participants in the Water Management programme. Participants of the WQM specialisation may, however, choose to participate in the group work of the Environmental Science.	<b>Prerequisites</b> Bachelor's degree. Basic computer skills (MS-Windows, Office) Good English command. Participation in the WM Fieldwork.	

### Learning Objectives

*Upon completion of the module participants will be able to..*

- Develop a final problem analysis on specific problems of water management in the Andarax Basin.
- Design approaches for mitigating the specific problems in the Andarax Basin.
- Evaluate the different approaches and argue for a preferred approach to mitigate identified problems.
- Integrate different approaches (targeted at different themes/problems) into an integrated water management plan.
- Present and argue for the integrated water management plan.

### Topics and Learning Activities

#### Introduction to the Module

The Groupwork is based on the Andarax basin in southern Spain. As such, the Groupwork is a continuation of the Fieldwork undertaken in June. Information and data collected during the fieldwork forms the basis for the 3-week groupwork. In the introduction session the activities in the module are introduced.

#### Fine-tune Andarax Problem Analysis

Prior to developing an integrated plan, students finalize and present the problem analysis that was started during the international fieldwork in June.

#### Options and Multi-criteria Analysis

Based on the problem analyses, the groups will propose possible approaches/solutions to mitigate the identified problems. In addition, the groups present an approach to analyze the different solutions and identify a preferred solution.

#### Integrated Water Management Report

In this report, an integrated plan will be presented aimed to mitigate the problems identified by the different thematic groups.

#### Lecturing Material

- Please visit <http://www.altaguax.org/> for relevant literature

#### Assessment

- 65%: Assignment
- 35%: Assignment

**2012/2014-WM12: IWRM Groupwork**

Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM:		Lecturer(s)
								contact hours	study/load hours	
1	Introduction Groupwork	1						1	3	Schwartz and Graas
2	Presentations thematic groups			2				2	2	Various
3	Introduction Integrated Groups	1						1	3	Schwartz and Graas
4	Draft Presentations Integrated Groups			2				2	2	Various
5	Groupwork		126						126	
6	Final Presentations Integrated Groups			4				4	4	Various
	<b>Total</b>	<b>2</b>	<b>126</b>	<b>8</b>				<b>10</b>	<b>140</b>	

**MSc module - UNESCO-IHE**

# WATER MANAGEMENT

## MASTERS PROGRAMME

Academic Year: 2012-2014

Specialization: All WM

Module Coordinator: M. Rusca

### Module Sheet

Module Name Research and academic skills development WM		Module Code WM13a	Credits 7
<b>Target Group</b> This module is available to all WM participants. It is also open to participants of the WQM specialisations who started under the Environmental Science programme.	<b>Prerequisites</b> The successful completion of at least 8 of the first 11 modules of the Water Management Programme.		

### Learning Objectives

Upon completion of the module participants will be able to..

- Concisely define the intended research topic, state precise aims and objectives, describe the research methodology, argue expected relevance and justification, and identify boundary conditions and self- or externally imposed limitations
- List available literature and replicate main arguments expounded in the literature on the specified research topic
- Demonstrate analytical problem-analysis skills and the ability to distil the strategic issues to be addressed in the research phase
- Plan, using the project management approach, the research process in weekly time-steps and indicate essential milestones, targets and indicators, required human, financial and other resources, deliverables and perceived threats and constraints at each stage of the research project
- Develop and formulate the research proposal in a clearly written, well argued and convincing report, submitted within a set deadline
- Successfully present and defend individual work, cross-reference it to and critically evaluate it in light of contemporary thinking in a specific field of study

### Topics and Learning Activities

#### Research topic delineation, literature review, Problem analysis, Strategy development

##### - Project plan

The initial research topic of study will be selected in a consultative process with a mentor, the MSc coordinator and a WM professor.

##### **Learning Activities:**

*Reading, discussing*

##### Proposal development and formulation

Research is likely to be based primarily on a review of selected literature, to a limited extent other methods of data gathering and analysis may also be applied (e.g. interviews, laboratory and field work, computer modelling, expert consultations, etc). One hour weekly meetings with the tutor form the main stay of the proposal development process. It is however expected that the MSc candidate will be self-motivated and pro-active, taking all necessary initiatives to reach the set target in a timely fashion.

##### **Learning Activities:**

*Writing of the proposal.*

##### Presentation and defence

The resulting proposal will be presented in written form and orally defended before an audience of critical peers and a panel of staff members.

##### **Learning Activities:**

*Presentation of the proposal.*

### Lecturing Material

- MSc thesis Protocol - WM programme
- How to write an MSc thesis – Wendy Sturrock

### Assessment

- **100%: Presentation**



**2012/2014-WM13a: Research and academic skills development WM**

Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM:		Lecturer(s)
								contact hours	study/load hours	
	<b>Introduction to Research Methodology for the Social Sciences</b>	1						1	3	Schwartz
	<b>Conceptual framework</b>	2						2	6	Rusca
	<b>Introduction to Cluster Meetings</b>			2				2	2	Kemerink
	<b>Interview Techniques and Participant Observation</b>	2						2	6	Kemerink
	<b>Frequently Made Mistakes</b>			3				3	3	Ahlers
	<b>Data Analysis</b>			4				4	4	Schwartz
	<b>Research Exercise</b>		30						30	Ahlers/Schwartz
	<b>Proposal Design</b>	1						1	3	Schwartz
	<b>Case Study Methodology</b>	3						3	9	Schwartz
	<b>Survey Design</b>	4						4	12	Van Dijk
	<b>Survey Analysis</b>	4						4	12	Van Dijk
	<b>Total</b>	17	30	9				26	90	
<b>MSc module - UNESCO-IHE</b>										

# WATER MANAGEMENT

## MASTERS PROGRAMME

Academic Year: 2012-2014  
 Specialization: Core Programme  
 Module Coordinator: ??

### Module Sheet

<b>Module Name</b> Capita selecta (summer courses)		<b>Module Code</b> WM13b	<b>Credits</b> 0
<b>Target Group</b> All participants of the WM programme		<b>Prerequisites</b>	

### Learning Objectives

Upon completion of the module participants will be able to..

- demonstrate a broader scientific view.

### Topics and Learning Activities

#### Capita Selecta

depends of the selection of topics

### Lecturing Material

### Assessment

- 100%: Assignment

2012/2014-WM13b: Capita selecta (summer courses)										
Nr	Course/Topic	Lecture	Assignment	Workshop Case study Role play Exercise Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: studyload hours	Lecturer(s)
1	MSc research proposal drafting									
2	MSC research proposal presentation									Mentor and professor
<b>Total</b>										
<b>MSc module - UNESCO-IHE</b>										

# WATER MANAGEMENT

## MASTERS PROGRAMME

Academic Year: 2012-2014  
 Specialization: Core Programme  
 Module Coordinator: M. Rusca

### Module Sheet

<b>Module Name</b> MSc research		<b>Module Code</b> WM14+15	<b>Credits</b> 36
<b>Target Group</b> This module is available to all WM participants.		<b>Prerequisites</b> The successful completion of at least 8 of the first 11 modules of the Water Management Programme.	

### Learning Objectives

Upon completion of the module participants will be able to..

- Conduct research including the formulation of research questions and hypotheses, the selection and application of adequate research methodologies and techniques and the formulation of well-founded conclusions and recommendations
- Guarantee scientific integrity and independence in content and process, giving due credit to sources and ideas used
- Apply critical and creative thought processes, using standard as well as innovative
- Argue the applicability, relevance and significance of research results to the field of Integrated Water Resources Management
- Clearly and systematically communicate, argue and defend findings in oral and written presentation to a an audience of critical peers

### Topics and Learning Activities

#### MSc Research

MSc research consists of individual work by the candidate, but may be set within the context of a larger research or project activity. Occasionally, the specific MSc research project can be a combined effort of more than one MSc candidate. The project may be carried out at the UNESCO-IHE facilities, third-party facilities or within the home-country context (the so-called Sandwich construction). Weekly coaching is available from the assigned UNESCO-IHE mentor and monthly contact with the supervising professor is encouraged. Responsibility for initiating these contacts lies with the candidate. Additional on-site third-party coaching is recommended when research is carried out at third-party facilities or in a sandwich construction.

### Lecturing Material

#### Assessment

- 100%: Oral Exam

2012/2014-WM14+15: MSc research														
Nr	Course/Topic	Lecture	Assignment	Workshop	Case study	Role play	Exercise	Lab session	Laboratory work	Fieldtrip - Fieldwork	Design exercise	SUM: contact hours	SUM: studyload hours	Lecturer(s)
1	MSc Research		1008									1008		
		Total	1008									1008		
MSc module - UNESCO-IHE														