# HIGHLIGHTS

UNESCO-IHE
Institute for Water Education

# Message from the Rectorate

Dear readers,

2015 was a rich year for the science and water community and therefore for the Institute. We celebrated 70 years of UNESCO and 50 years of the UNESCO Hydrological Programme. We congratulated 137 Delft based and 76 non-Delft based students who graduated, the latter from our joint degree and double degree programmes. In October we welcomed more than 234 new students from 67 different countries, an important springboard for better water management when they return home.

The diversity of our students and staff and our work throughout the world is unique. In December we were therefore pleased to sign DUPC2, the new programmatic cooperation between the Institute and the Directorate-General for International Cooperation (DGIS) of the Dutch Ministry of Foreign Affairs (following on from DUPC1). A key principle of DUPC is 'working in partnership', which enables us to have impact on the ground through a large number of diverse projects and, at the same time, strengthen the capacities of our partners. DUPC programme activities relate to education and training, research and innovation, knowledge sharing and networking and will help us respond to global challenges, including the refugee crisis.

This ties into another large initiative completed in 2015 – the updating of the UNESCO-IHE Strategy (2015-2020). The approval of the Governing Board demonstrates its commitment to our role in 'equipping people and organizations to solve water and development challenges worldwide'. This is the main objective of the Institute and we achieve this through our three strategic drives: Education, Research and Innovation, and Capacity Development. We continue our successful work and furthermore have a number of new initiatives, including expanding our e-learning offerings and introducing new MSc programmes.

The adoption of the 2030 Agenda for Sustainable Development was important for UNESCO-IHE, as most of the 17 Sustainable Development Goals (SDGs) apply to our activities and Goal no. 6 is focused on access to clean water and sanitation.

2015 was a year of strengthening our ties: with the Ministry of Education, the Ministry of Infrastructure and Environment and the Ministry of Foreign Affairs, with which we launched the project 'Strengthening Small Island Developing States' capacity in the water sector to cope with the effects of climate change". We also continued our close relations with the Dutch Water sector and our partners around the globe.

The work of the Institute recognises the importance of water for human rights and dignity, for sustainable development, for lasting peace.

With best regards,

The Rectorate

Dr. Fritz Holzwarth
Dr. Johan A. van Dijk

# In a Nutshell


UNESCO-IHE is based in Delft, the Netherlands and carries out educational, research and capacity development activities in the broad fields of water engineering, water management, environment, sanitation and governance.

UNESCO–IHE is the largest international graduate education institute in the field of water. The Institute offers 4 MSc programmes, various short and online courses and a PhD programme in collaboration with partner universities. Since 1957, the Institute has provided graduate education to more than 15,000 practicing water professionals, as well as thousands of short course participants from 162 countries.

The Institute is an essential part of the UNESCO Water Family as a major pillar providing education and research. The United Nations has given the Institute the mandate to play a global role in educating and training a new generation of water professionals, facilitating the development of capable organizations, providing an enabling environment for well-informed decision-making and improving integrated water management practices.

The Institute's ties to the Dutch water sector are equally important, as they provide access to specific knowledge and add to the Institute's relevance in the Dutch socio-economic context.

## Vision

UNESCO-IHE envisions a world in which people manage their water and environmental resources in a sustainable manner, and in which all sectors of society, particularly the poor, can enjoy the benefits of basic services.

## Mission

We contribute to the education and training of professionals, expand the knowledge base through research and build the capacity of sector organizations, knowledge centers and other institutions active in the fields of water, the environment and infrastructure in developing countries and countries in transition.


## Core activities

### Education & Training

UNESCO-IHE offers both degree programmes (MSc and PhD levels) and non-degree programmes (short courses, online courses and tailor-made training) for engineers, scientists and professionals from various disciplines working in the water, environment and infrastructure sectors. UNESCO-IHE is increasingly implementing its educational activities with partner institutes worldwide, making water education more accessible and affordable for an increasing number of students.

### Research & Innovation

The Institute's research activities concentrate on six main research themes and contribute to the knowledge base concerning the water environment, and complement its education and capacity development activities. Significant parts of the research programme are done via PhD research (the programme is implemented in cooperation with partner universities in the Netherlands), MSc thesis research and post-doctoral research programmes.

### Capacity Development

UNESCO–IHE engages in institutional strengthening projects and provides advisory and consultancy services to knowledge institutes, water sector organizations, knowledge networks and UNESCO member states. Through these operations, the Institute increases its global impact and helps to build sustainable organizations that are equipped to properly manage water resources and deliver water services sustainably. The Institute also has a policy forum function and acts as an intermediary between science and policy making.

# UNESCO-IHE Highlights 2015

**The overview below presents highlights, events and activities in which the Institute was engaged.**

### 3 February
The World Resources Institute (WRI) and UNESCO-IHE signed a Memorandum of Understanding on Water Resources Management.

### 9 February
Innovations for Water and Development booklet is published.

### 12 February
MEDRC and UNESCO-IHE signed Memorandum of Understanding on water research capacity in Palestina.

### 15 February
Book launch: Applications of Activated Sludge Models.

### 12 March
International Women's Day conference: 'Women and Water Make Sustainable Food Security Happen'.

### 22 March
World Water Day: Water & Sustainable Development.

### 12-17 April
7th World Water Forum Republic of Korea.

### 14 Apr
MSc programme on Water Cooperation and Peace launched at World Water Forum.

### 16 April
Water Sector Market: 120 MSc students from African, Asian and Latin-American countries interact with the Dutch public and private water sector.

### 20 April
Memorandum of Understanding (MoU) signed: next step in cooperation between UNESCO-IHE and Dutch Ministry of Infrastructure and Environment.

### 20-21 April
Stakeholder event with strategic partners and stakeholders developing future strategies.

### 24 April
Closing Ceremony academic period 2013-2015. 149 water professionals received their MSc diploma.

### 24 April
Honorary fellowship awarded to Professor George Ekama from South Africa on his work in the field of wastewater treatment.

### 19 May
The Asian Development Bank provided an extra 2.5 million dollars until 2018 for the execution of projects and events related to e.g. water accounting, crop water productivity and urban flood management.

### 12 June
Institutional Audit by NVAO successfully completed.

### 22 June
Memorandum of Understanding on water law signed between WaterLex and UNESCO-IHE.

**26 June**
The IADC's 5-day Seminar on Dredging and Reclamation celebrates its 50th edition at UNESCO-IHE.

**31 July**
Science Magazine published an essay by Joyeeta Gupta, Professor of Law and Policy in Water Resources and Environment at UNESCO-IHE on the scale of water governance.

**3 August**
The 193 Member States of the United Nations reached consensus on new Sustainable Development Agenda.

**13 August**
eSOS smart toilet nominated for the World Design Impact Prize.

**23-28 August**
UNESCO-IHE attends World Water Week in Stockholm as part of the UNESCO water family.

**28 August**
UNESCO-IHE Alumna Hope Mwanake delivers vision speech at World Water Week.

**5 September**
Dutch Ministry of Foreign Affairs and UNESCO-IHE jointly launched the project 'Strengthening Small Island Developing States' capacity in the water sector to cope with the effects of climate change'.

**10 September**
Ms. Iris Frida Josch from Argentina wins the UNESCO-IHE Alumni Award 2015.

**28 September**
UNESCO-IHE staff and students celebrated the adoption of water-related Sustainable Development Goals by the United Nations in September by wearing blue.

**15 October**
Eldon Raj receives Young Scientist Award for his research work on 'Optimization of continuously operated biofilter performance for volatile pollutants present in air'.

**1 November**
Launch of UNESCO-IHE's restyled and completely online magazine UPDATE.

**3 November**
4th Asia-Netherlands Water Learning Week with participants from 8 Asian countries discussing water-related disasters and climate change.

**16 November**
Global e-learning alliance launched on Faecal Sludge Management by 6 educational institutions.

**20 November**
Prof. Iwona Wagner elected as new Chair of UNESCO-IHE Governing Board.

**20 November**
UNESCO-IHE/IHE Foundation Delft signed up to Talent to the Top Charter, aiming a continuous smooth flow of women in particular into top positions.

**27 November**
Retirement of Arthur Mynett, Professor of Hydraulic Engineering and former Head of the Department of Water Science Engineering.

**2 December**
DUPC2 officially signed. DUPC is the programmatic cooperation with the Directorate General for International Cooperation (DGIS) of the Dutch Ministry of Foreign Affairs.

**3 December**
UNESCO-IHE convened a panel at COP21 entitled: 'Capacity Development in Water and Climate'.

**7 December**
Meet the Dutch hospitality agreement signed.

**18 December**
Staff wait on students at Christmas party.

# Non-degree Programmes' Overview

**UNESCO-IHE offers both degree programmes (MSc and PhD levels) and non-degree programmes (short courses, online courses and tailor-made training). In addition, we organized 6 refresher courses for alumni and 8 summer courses to bring together students and professionals with a different academic or professional background.**

## 75 Short Courses

**305 participants**

A short course on Groundwater Data Collection and Interpretation for Caribbean Countries was successfully run in Baseterre, St. Kitts and Nevis on 5-9 October, 2015. The course was jointly organized by the International Hydrological Programme for Latin America and the Caribbean (IHP- LAC), the Saint Kitts and Nevis Water Department Services, in collaboration with UNESCO-IHE. The course, originally designed by UNESCO-IHE, has been adapted to the Caribbean context with the aim of enhancing capacities of Caribbean professionals in hydrogeology and water resources management on data collection and monitoring tasks. The short course will also be available in 2016.

## 24 Tailor-made Training Courses

**414 participants**

The first tailor-made training in Albania was led together by TU Delft and the National Territorial Planning Agency, funded by NUFFIC. The training focused on Integrating Water and Climate Sensitive Planning in Albania. Over the course of two weeks, participants were introduced to theoretical concepts such as integrated water resource management and adaptive planning.

## 21 Online Courses

**150**
**participants**

This year we had 21 online courses. 150 participants followed an online course.The online courses are intended for professionals working in public and private institutions, NGOs, and academic institutions, and are ideal for those who want to upgrade their skills from the comfort of their own home or office.


## 6 Alumni Refresher Courses

**146**
**participants**

UNESCO-IHE organised six courses in 2015 that were held in Colombia, Indonesia, South Africa, Uganda, Kenya and Sudan during the second part of the year, addressing topics relevant for the regions. 484 alumni applied to participate and 20 scholarships per course were granted, half of these for female alumni. The courses are evaluated by alumni as a very important experience that increases their knowledge, as well as reinforcing their professional network. During the courses, participants attended classes, went on a field trip, and had time to share their professional experiences. A special session on 'Women in Engineering' was held in all courses, as a way to address gender issues. During some courses, an alumni gathering was held to give the opportunity to other alumni living in the host country to meet and greet the course participants and UNESCO-IHE staff members.

## 8 Summer Courses

**181**
**participants**

The five-day summer courses included a variety of cross-cutting topics. Eight summer courses were successfully organised. Their purpose was to bring together students and professionals with a different academic or professional background. Topics included WASH in emergencies, leadership, entrepreneurship, serious gaming and green cities.Various partners co-convened the courses, for example UNHCR, UNICEF in the WASH in Emergencies course and Tygron in the course on serious gaming.

GET TO KNOW OUR STUDENTS

# Why I chose to come to Delft

**Crystal Conway**
Guyana

*"For a water professional from a developing country like me, in search of a world class education and the subsequent opportunities, studying at an Institute like this seemed almost impossible, due to lack of funding. UNESCO-IHE creates possibilities and I would like to encourage more people to look into these: if you have the will, ways tend to appear."*

MSc programme in Water Science and Engineering | Hydraulic Engineering

**Vittorio Nespeca**
Italy

*"I chose UNESCO-IHE as I think it is the best in the world and it is fun because there are people from everywhere. It's not just about benefits for your country, but about worldwide benefits related to water."*

MSc programme in Water Science and Engineering | Hydraulic Engineering

**Justin Adonadaga**
Ghana

*"I want to use the knowledge and skills I am learning at UNESCO-IHE to address the water challenges in Ghana."*

MSc programme in Water Management | Water Management

**Amit Singh**
Fiji

*"Due to environmental changes and the subsequent sea level rise, it's time that we try to manage what we have. I would like to encourage fellow Pacific Islanders to apply for the Strengthening Small Island Developing States Fellowships (SIDS)."*

MSc programme in Water Management | Water Resources Management

**Sospeter Wekesa**
Kenya

*"I decided to study in the field of water, because water is core to everything in life, it is essential. A benefit of studying here, is that this is the largest postgraduate water institute in the world. Furthermore, I get to interact with people from all over the world."*

MSc programme in Water Science and Engineering | Hydrology and Water Resources

**Chidiebere Nnebuo**
Nigeria

*"The Netherlands is known for its innovations in water technology, therefore I think it is the right place for me to gain the experience and knowledge needed to solve water problems back home in Nigeria."*

MSc programme in Water Supply Engineering | Urban Water and Sanitation

**Indah Salvia Amin**
Indonesia

*"I decided to study in the field of water, because water is vital. Water is a resource that you cannot replace, it is unique. I aim to make a contribution to my country by managing water in a better way. The Netherlands is the best place to study water resource engineering."*

MSc programme in Water Management | Water Resources Management

**Santhosh Garakahalli Siddaiah**
India

*"After three years of experience I understand the importance of providing solutions to sanitation related issues, particularly in India. The laboratory work is interesting, it is well equipped and that environment inspires me. After I finish my studies, I would like to support my team back in India and implement my knowledge."*

MSc programme in Urban Water and Sanitation | Sanitary Engineering

**Cecilia Emanueli Gandara**
Uruguay

*"In Uruguay we have problems with drought, floods and the water quality. I believe that by gaining knowledge in this field I will be able to contribute. In a country with limited economic resources, the solution to these problems has to be cost-effective and the use of hydroinformatic tools is necessary. Studying at UNESCO-IHE: It's a great opportunity and enriches your life. We are all different, but share the same goals and interests."*

MSc programme in Water Science Engineering | Hydroinformatics - Modelling and Information Systems for Water Management

**Uma Sigdel**
Nepal

*"More than 60% of my work back home is fieldwork and I like that. After my studies I would like to go back to work in Nepal to contribute to society using the skills I have gained at UNESCO-IHE."*

MSc programme in Environmental Science | Environmental Planning and Management

92%

of the students felt that the 12-month taught MSc programme prepared them well for the research phase. Nobody felt not at all prepared.

# Positive outcome of Institutional Audit on education

**NVAO endorsed the positive outcome of the Institutional Audit in April 2015 (in Dutch Instellingstoets Kwaliteitszorg). The decision was based on the positive assessment report by the audit committee that visited UNESCO-IHE in January 2015. The validity of this Institutional Audit is until 7 April 2020. Having successfully passed the audit, UNESCO-IHE now requests a three-year extension of the NVAO accreditation of its MSc programmes, until 31 December 2019. Jan-Herman Koster, senior advisor educational development and international cooperation at UNESCO-IHE reflects on the process.**

**The Institutional Audit was successful, so why is this important for UNESCO-IHE's day-to-day business?**
"The Audit was conducted because the Institute chose to have its education quality assurance system evaluated externally. This is part of the accreditation framework in the Netherlands where an organization can choose to have a general audit of the quality of its education, rather than education quality being assessed as part of the (re)accreditation of each individual MSc programme.

It is important to UNESCO-IHE that the audit was successful because it is a recognition that we have our house in order and maintain the quality of our education."

**What kind of criteria are evaluated?**
"The audit consists of 5 elements within the organization:
1. Does the organization have a vision on education quality?
2. Are there policies in place to implement that vision?
3. Does it monitor to what extent the policies are implemented?
4. Are mechanisms in place to remedy situations that are not in accordance with the vision on education?
5. Is it clear who or which body within the organization is responsible for what?"

**Do you foresee any challenges ahead?**
"We were visited twice by the panel. After the first visit, the panel indicated the improvements they expected to take place before the next visit. It was clear that a lot of things were in place, but often implicitly, as can be expected in a relatively small institute, rather than formalised and explicit. For example our education policies were not written down, and therefore not easily accessible for staff. We also found that our monitoring cycle could be improved. This now includes, for example, an annual reporting and feedback cycle, to the Rectorate, on the individual MSc programmes. So we now have an improved education quality assurance framework, and the challenge is to have the discipline to continue to work according to this new quality framework and not let things slip. It is not enough to take action only when the next audit comes along."

**What are you currently working on?**
"One result of the audit is that we decided, as part of the quality system, to have each of our programmes externally peer reviewed once every six years, in addition to the official accreditation assessments by NVAO. We are currently preparing for that external review cycle.

The other thing we are working on is an improvement of our student evaluation system, both at the module level and at the programme level."

**Jan Herman Koster**
Senior Advisor Educational Development and International Cooperation

**QUALITY ASSURANCE SYSTEM OUTLINE**

| Vision on the Quality of Education | Education Concept | Policies | Quality Assessment Framework | QA Calendar |
|---|---|---|---|---|
| | • Relevance<br>• Integrating Knowledge & Skills<br>• Staff<br>• T-Shape<br>• Didactics | • Education<br>  • Curriculum<br>  • Final qualifications<br>  • Admission<br>  • Didactics<br>  • Assessment<br>  • Evaluation<br>  • Etc.<br>• HR | • Norms<br>• Documents<br>• QA instruments<br>• Periodicity<br>• Responsibility | PDCA:<br>• Yearly<br>• 6-yearly |

# MSc NEWS



## New MSc Programme Groundwater & Global Change

UNESCO-IHE launched a new MSc programme in 2015 on groundwater and global change in collaboration with partner universities in Lisbon and Dresden. The Erasmus Mundus Programme offers a curriculum built on the cornerstones of hydrology, hydrogeology, climatology, impacts and adaptation. It aims to address the current gaps in higher education with regard to the understanding of the interactions between groundwater, surface water, climate and global change, and how we need to consider and can benefit from these interactions when dealing with adaptation. Fifteen students started the MSc programme in September in Lisbon and came to Delft in February 2016.

**www.groundwatermaster.eu**

## Tailor-made Study Profiles in Water Management Programme

The Water Management MSc programme offers students the opportunity to choose their own study programme based on their professional and educational interests. This personalized study trajectory was introduced in 2014 and continued in 2015 with nine students enrolling in the programme.

In this set-up, students enrol in the multi-disciplinary foundation phase of the WM programme and during this generic phase they will develop a personal portfolio in consultation with an assigned staff member as coach and possibly their (future) employer.

The portfolio includes a reflection on their educational and professional background, a career plan and a tailored study profile. The study profile covers the modules they will follow to complete the taught part of the programme as well as the initial focus for the MSc thesis research. The study profile can include modules offered in other UNESCO-IHE MSc programmes or at partner universities. By offering tailor-made tracks and career-oriented advice, the WM programme aims to improve the learning experience of students.

**www.unesco-ihe.org/water-management**

## New MSc Programme on Water Cooperation and Peace

**On 14 April, 2015 UNESCO-IHE, the University for Peace (UPEACE) and Oregon State University (OSU), jointly launched a new MSc programme on Water Cooperation and Peace at the 7th World Water Forum in the Republic of Korea.**

The goal of this new initiative is to broaden the approach to conflict and peace, provide a more theoretical dimension to conflict as opposed to practicing skills and engage with the different scales at which conflict occurs.

The programme will provide tools and training in an international setting, with a unique opportunity to undertake coursework and hands-on experience in Costa Rica, The Netherlands and the United States. Participants will be exposed to case studies involving diverse challenges and contexts at different scales.

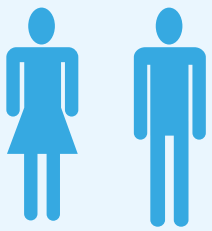
Students will be able to choose between a project and thesis option, with further opportunities to specialize based on skills and future career goals. Students will be awarded an MA and an MSc in Water Cooperation and Peace, or have the option to continue on at the University of Oregon for a Juris Doctor or Master of Law.

The taught part of the course will begin at UPEACE in Costa Rica, continue at UNESCO-IHE in The Netherlands, where also part of the course will be taught at the Clingendael Institute for International Relations, and end at OSU in the USA. The research element can be carried out at any of the three institutions.

**www.unesco-ihe.org/wcp**

# Facts & Figures 2015

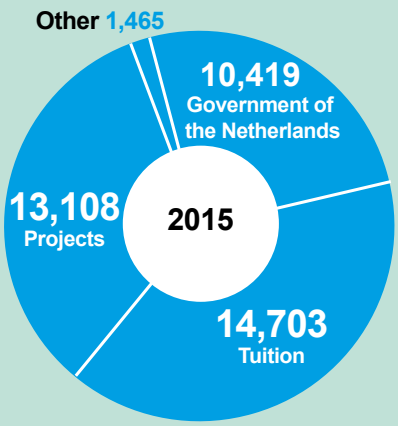
## 189 UNESCO-IHE staff



85 104

31 nationalities

## Income in Euro

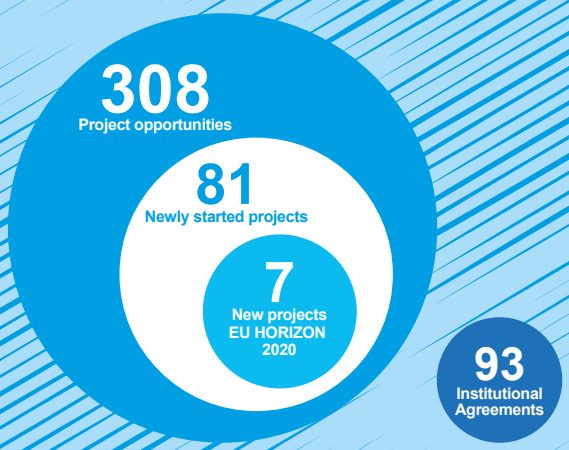



39,695
Total turnover

1,213
Overall result

x 1,000

## Projects




## Students enrolled per MSc programme

56
Environmental Science

38
Urban Water and Sanitation

33
Water Management

107
Water Science and Engineering

## Facebook likes

| 1-1-2015 | 31-12-2015 |
|---|---|
| 10,850 | 12,691 |

## Twitter followers

| 1-1-2015 | 31-12-2015 |
|---|---|
| >5,000 | 6,200 |

## MSc Students

**2,263** MSc applications

**186** MSc graduates

**10.3** percent enrolled (234)

90 144

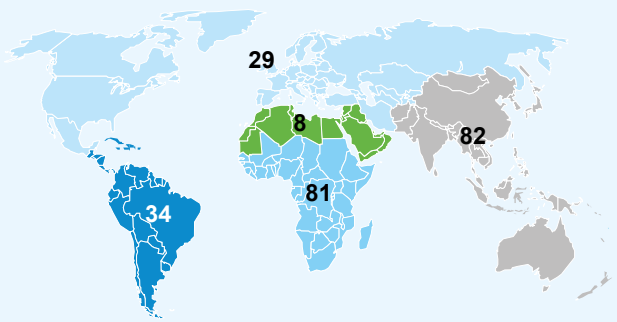
## PhD Fellows

**164** PhD fellows

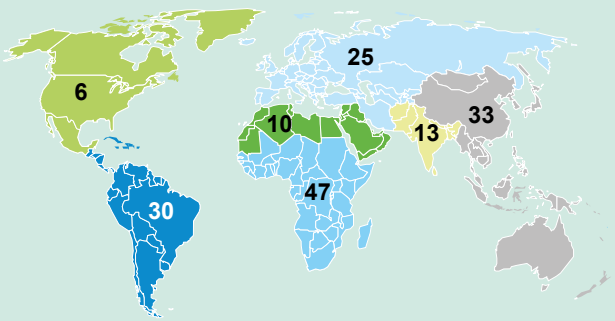
**26** PhD theses produced

59 105

### Number of MSc students per region of origin




### Number of PhD fellows per region of origin




### E-newsletter subscribers

1-1-2015 **3,094**

31-12-2015 **4,373**

### Website

**Unique visitors** 390,900

**Pageviews** 1,913,611

RESEARCH THEME

# Climate Change & Natural Hazards

**Water-related hazards such as floods, droughts and pollution are increasing in their frequency and intensity around the globe, due to the effects of climate change and the surge in population growth. These hazards can lead to even more challenging issues, which are posing a severe threat to human health and existence, such as severe food shortage, mass migration and wars. UNESCO-IHE contributes to solving problems related to climate change, by facilitating projects, doing research, offering education programmes and by participating in international events.**

## Projects

The **Climate Change Adaptation Research Grants Program** has developed a modelling approach to quantitatively assess economic risks due to climate change. These are able to determine more precisely optimal coastal setback lines.

Climate change-driven variations in hydrodynamic forcing conditions, such as wave climate, storm characteristics and streamflow, will result in more frequent and longer closures of inlets. This may lead to significantly limited ocean access, water quality degradation, and flooding of low-lying land and infrastructure. The aim of the project **Climate Change Impacts on Seasonally and Intermittently Open Tidal Inlets Study** is to develop effective process-based and probabilistic modelling methods and tools to assess the physical impacts of climate change on Seasonally or Intermittently Open Tidal Inlets (SIOTI). It will also develop a benchmark approach for determining effective adaptation strategies for SIOTI environments.

The project **Preparing for Extreme and Rare Events in Coastal Regions** aims to design and develop adaptive risk management approaches that minimise social and economic losses and environmental impacts and increase resilience to such events.

The objective of the project **Socio-Technical Flood Resilience** is to improve adaptation-related decision-making to focus expenditure for greatest return on investment and simultaneously deliver robust infrastructure and communities resilient to flooding. The project will also further develop and tailor existing Dutch and European approaches for resilient adaptation within an Australian and Vietnamese context.

**MARE Asia** supports medium and small-sized Asian cities in becoming greener and more climate-proof within the scope of CDTA Green Cities of the Asian Development Bank, by enabling learning from each other's experience at different scales - between cities and stakeholders.

The **NUFFIC NICHE project** in Vietnam aims to strengthen the capacity of Hanoi University of Natural Resources (HUNRE) and the Water Resources University (WRU), at institutional and management level, to implement education, research and training and to improve the capacity of their staff in developing and transferring knowledge. In addition to this, NICHE hopes to meet the needs of the sector in Vietnam by strengthening and further developing high-quality education offered in water management, regarding climate change at HUNRE and WRU.

## Education

The education and training programmes at UNESCO-IHE address the many challenges of adapting to climate change from different perspectives. In 2015, two specific highlights included the new Erasmus Mundus Joint Master Programme on Groundwater and Global Change and the start of the Fellowships programme 'Strengthening Small Island Developing States' capacity in the water sector to cope with the effects of climate change'.

More information on climate change related education can be found on:

**www.unesco-ihe.org/education**

*"Since 2007 more than half of the world's population lives in cities. Cities are the defining factor in our susceptibility to both manmade and natural hazards, as well as their mitigation."*

**William Veerbeek**
Cities expert at UNESCO-IHE

*"The infrastructure of cities in developing countries is inadequate. If disaster strikes a city, because of increased density, the number of people affected will be higher."*

**Mohan Radhakrishnan**
PhD fellow

# News & Events

UNESCO-IHE convened the panel **Capacity Development in Water and Climate**, at the COP21 during Water and Climate Day. The panel, moderated by Professor Michael McClain and including panellists Gaetano Casale, William Veerbeek and former Officer-in-Charge Professor Stefan Uhlenbrook, shared examples of capacity development activities at UNESCO-IHE.

Teams of Indonesian UNESCO-IHE students presented their ideas for Water Smart Cities in Indonesia at the **Water Smart Cities seminar**.

The **4th Asia-Netherlands Water Learning Week** was organized by UNESCO-IHE and the Asian Development Bank on water-related disasters and climate change. Presentations were held on the water challenges participants face in their country and how the growing role of social media is changing perspectives on water-related hazards, with new ways of collecting, analysing and disseminating information to citizens and policy-makers. At the end of the week, participants presented key lessons they had learned, an action plan and follow-up activities upon their return home.

The training course, **Application of water resources models for climate change impact studies in the Mekong Basin**, was organized by UNESCO-IHE in cooperation with Khon Kaen University (Thailand) and the Water Resources University Hanoi (Vietnam), under the framework of the PRoACC2 project.

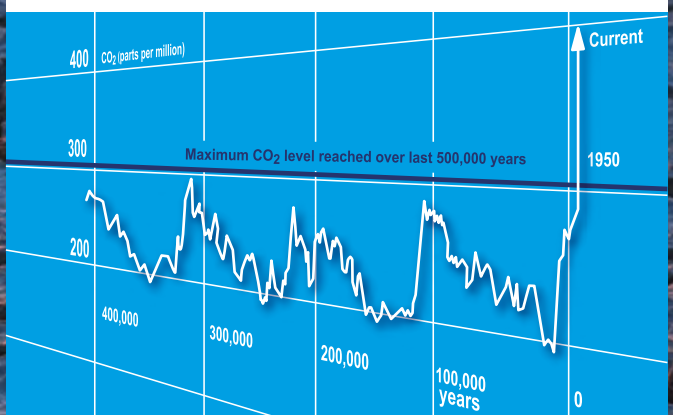
The European Union-funded project **MAS AGUA PARA TODOS: Adapting to climate change and mitigating water scarcity by innovative urban water management in Cuba**, launched new demonstration wastewater treatment plants, which are contributing to reducing water scarcity whilst preserving the environment.

# Research

The thesis entitled **Climate change impacts on the stability of small tidal inlets**, written by UNESCO-IHE PhD fellow Ms. Trang Minh Duong, was published as a part of the project Climate Change Impacts on Seasonally and Intermittently Open Tidal Inlets. Her thesis is the first of its kind, providing insight into how climate change-driven variations in natural forcing conditions, such as waves, riverflow and sea level, may affect the stability of small tidal inlets. The research resulted in a reduced complexity model, providing projections of inlet stability over the next 100 years in under 3 seconds.

UNESCO-IHE Senior Lecturer in Hydrogeology and Groundwater Resources Tibor Stigter published a research paper entitled **Combined Assessment of Climate Change and Socio-Economic Development as Drivers of Freshwater Availability in the South of Portugal**. The paper assesses potential impacts from climate change (CC) and socio-economic development (SED) on water resources for the most important aquifer in the south of Portugal, to understand how CC and SED affect water-consuming and contaminating activities.

UNESCO-IHE Associate Professor of Integrated Urban Water Cycle Management, Assela Pathirana, published a research paper entitled **Managing Urban Water Systems With Significant Adaptation Benefits - Unified Framework For Secondary Cities: Part I - Conceptual Framework**. His paper presents a framework for adaptation of urban development in secondary cities in the global south which attempts to unify adaptation to address both drivers for adaptation, namely adaptation deficits and adaptation gaps.



RESEARCH

# Examples of Innovative Research

**We interpret innovation as the translation of research outputs into products, services, processes and new activities that are introduced to the real world. The innovations of the Institute are and will continue to be often of a technological nature, but their adoption also has social, economic, environmental, governance, institutional and political impact. A few examples of these kinds of innovations are briefly presented here.**

## The Shit Killer® reduces the volume of faecal sludge

The Shit Killer® was developed by UNESCO-IHE under the pro-poor sanitation project funded by the Bill and Melinda Gates Foundation. It is designed to sanitize fresh human excreta as well as to reduce the volume of faecal sludge.
The device is based on the novel application of microwave-based technology that can deactivate the pathogenic microorganisms by generating heat inside the reactor, and by further thermal action, can reduce the volume of treated sludge.

The Shit Killer® is currently being tested in Slovenia and the first results are promising. It will be soon further optimized and tested on the treatment of fresh excreta (urine and faeces) from mobile toilets, septic tank sludge, fresh waste sludge and dewatered sludge from local municipal wastewater treatment plants.

The Shit Killer® is manufactured by Fricke und Mallah Microwave Technology GmbH, Germany, and optimized by Tehnobiro d.o.o., Slovenia. The field testing is being carried out by UNESCO-IHE.
After Slovenia and possibly the Netherlands, the Shit Killer® will be further tested on fresh faeces from the slums of Nairobi in Kenya or Durban in South Africa. After these pilot investigations, the experience gained will be used to build a full-scale prototype of larger capacity, subject to availability of funding. The envisaged applications of the Shit Killer® range from sanitation provision to refugee camps and urban slums to sludge treatment at municipal wastewater treatment plans.

Pro-poor emergency sanitation

## Nature-based flood defences

The Flood Resilience Chair Group (FRG) is developing a pilot in Kendari, Sulawesi, on the concept of 'Nature Based Solutions' (NBS). This entails the installation of NBS sedimentation traps along the Wanggu river, in conjunction with river widening (Room for the River). The objectives are multiple but the most important ones are to reduce the occurrence of floods in the city of Kendari and sedimentation of Kendari Bay. This pilot is one of the very first to examine and test this NBS innovation.

Another innovation which has a broader scope than NBS is the new Urbanizing Delta's of the World project in Bangladesh, where we will establish a 'testbed' or field laboratory to test and show innovative Delta Technology (e.g. floating gardens to clean water, temporary flood barriers, floating homes ) in Bangladesh. The concept of testbeds is emerging as a new way of knowledge transfer, as it has the potential to integrate research, capacity development and education. The FRG already has experience with this innovation, as we have supported the establishment of a predecessor of such a testbed in Dordrecht.

## Improved forecasting techniques

Timely forecasting of water resources availability and extreme events, such as floods and droughts, has become an essential tool for mitigating hydro-climatic hazards, and for planning short and medium term adaptation measures. UNESCO-IHE has been active in supporting various river basin authorities with innovative hydrological forecasting tools and techniques. We have also developed research that can help prioritise flood warnings to communities that are most at risk.

Recently UNESCO-IHE has been working with the Niger Basin Authority in Niamey, as well as with the National Hydro-Meteorological Agency of Colombia in Bogotá, to develop and enhance their flood forecasting systems. Previously UNESCO-IHE worked with large river basins for flood forecasting, such as the Yellow River in China and Limpopo in Africa, and has carried out flood forecasting research on various river basins, such as the Narayani and Bagmati rivers in Nepal, the Hanjiang river in China and the Sisaony river in Madagascar.

## Coastal warning systems & risk assessment

UNESCO-IHE has developed a new modelling approach to assess quantatively the economic risk due to climate-change-driven coastal erosion. This approach enables us to take a leap forward where the determination of optimal coastal setback lines is concerned (i.e. the line along the coast, seaward of which developments are restricted or prohibited due to safety reasons). Historically adopted methods are very ad-hoc and result in either unsafe coastal development or over-safe developments (thereby foregoing lucrative land use opportunities in the coastal zone).

In 2015, following a request by the Sri Lanka Coast conservation department, the Asian Development Bank funded a project to apply this approach for on-the-ground decision making along the east coast of Sri Lanka.

# Low-cost water and wastewater treatment systems

## Improving the operation of reverse osmosis desalination plants

The increase in world population, in municipal and industrial water demand, and drought, are driving forces for finding alternative water sources. Around 97% of the earth's water is saline. In addition many mega-cities are located on the coast or within 50 km of the coastline.

Desalination with reverse osmosis (RO) has significantly reduced the cost of producing drinking water from seawater to around 0.6$/m$^3$. In the last 25 years, UNESCO-IHE's Water Supply Engineering Chair Group has studied the operation of RO plants including: pre-treatment technologies, fouling of the RO membranes, and post-treatment including the related environmental impact.

Depending on the water quality of the source, pre-treatment is needed to guarantee the lifetime of the RO membranes. The design of pre-treatment and its assessment, are performed by measuring the particulate fouling potential of the water with help of fouling indices such as the silt density index (SDI) or modified fouling index (MFI). UNESCO-IHE - initially in collaboration with the Watercycle Research Institute KWR - has developed the modified fouling index of 0.45 over a period of twenty years.

The MFI index has been extensively tested and is currently applied in the Netherlands and in many countries of the world (France, Israel, Spain, Chile, Oman, and South Korea). At the end of 2015, the MFI-0.45 was approved by the American Society for Testing and Materials (ASTM) as the standard method to be applied for measuring the water quality before RO systems.

## Photo-activated sludge: developing a new method for energy-friendly wastewater treatment

Wastewater treatment can be carried out by a whole range of different technologies. Some of these technologies require quite a lot of energy to purify the water, while others need large surface areas. In photo-activated sludge, we are trying to develop a technology that uses algae photosynthesis for oxygen generation, instead of energy-consuming aerators. Simultaneously, by smartly using different groups of algae and bacteria and by creating the right conditions for each of them, we are working towards reducing the required reactor volume and surface area. Moreover, by reusing the effluent for irrigation, we are using solar light to disinfect the water naturally. The ambition is to develop a medium-tech technology that is suitable for tropical developing countries.

MSc students Happiness Izunobi and Brigitte Mukarunyana are treating wastewater in the UNESCO-IHE lab by removing nitrogen using algae and bacteria.

Brigitte: "This treatment is ideal to apply in developing countries, as they often have a lot of sunlight but not much money. This treatment uses algae and a type of bacteria called Anammox, which can already be found naturally in developing countries, making it cheaper than conventional treatments."

Happiness and Brigitte recommend further studies to make the process more efficient, because the combination of algae and Anammox in the same reactor is still very new.

RESEARCH TOPIC

# Resource Recovery from Waste

**Several activities took place at UNESCO-IHE in 2015 with regard to resource recovery from waste, ranging from PhD research outputs to collaborative projects with partner institutes and events such as an international conference the Institute hosted on chalcogen science and technology.**

## PhD research topics

The PhD work of **Suthee Janyasuthiwong** (Thailand) focused on the use of sulfate-reducing bacteria (SRB) in an inverse fluidized bed (IFB) bioreactor, for the treatment of metal-contaminated wastewater. The SRB reduce sulfate to sulfide which further reacts with the metals present in acid mine drainage, to form metal sulfide precipitates. Using this SRB technology, copper, nickel and zinc were successfully recovered from the drainage.

PhD fellow **Arda Işıldar** (Turkey) developed an effective strategy for the biological recovery of copper and gold from discarded printed circuit boards (PCB) in a two-step bioleaching process. Using this bioprocess, copper and gold were removed from PCB with an efficiency of 98.4% and 44.0%, respectively.

Constructed wetlands (CWs) are among the few natural treatment systems that can guarantee an efficient wastewater treatment and an appealing green space at the same time. However, they require large areas for their construction that in many cases are not available. PhD fellow **Maribel Zapater** (Peru) designed and studied two domestic wastewater treatment options with the purpose of having a low space requirement: the Duplex-CW and the constructed wet roof (CWR).

Lack of clean water is one of the most important public health challenges in less developed communities. Due to insufficient financial and technical resources in the places in need, the development of low-cost water treatment technologies can play a key role in sustainable water provision. In this context, PhD fellow **Wook Chung** (South Korea) investigated the removal of pathogenic microorganisms in simple sand filtration set-ups, supplemented with low-cost adsorbents (hydrochar) produced via hydrothermal carbonization of biowastes.

## G16 conference on chalcogen science and technology

The 4th International Conference on Research Frontiers in Chalcogen Cycle Science and Technology (G16) took place at UNESCO-IHE, Delft, The Netherlands, on May 28-29, 2015. Organizers (Prof. Piet Lens and Dr. Eldon Raj) said the event proved a major success, enjoyed by students, researchers and scientists from Asia, Europe, the Middle East and North America. The two-day event was organized in four sessions, covering thematic research areas such as bioreactor systems for water and wastewater treatment.

### Special issue in the Journal of Hazardous Materials

The G16 conference organizers are finalizing the selected articles for publication as a special issue in the Journal of Hazardous Materials (Elsevier). The following topics are being covered in this special issue: (bio)chemistry of G16 elements, production/synthesis, properties and speciation of chalcogen compounds and their derivatives, sulfate removal from wastewater and hydrogen sulfide removal from air emissions using two-stage (bio)reactor configurations and other emerging applications of chalcogens.

As a consequence of technology advancement and increase in population, the industrial sector requires large amounts of raw material (metals) in response to increasing market demand. According to recent statistics, it has been predicted that in the year 2050, the global metal demand will increase by approximately 5 times compared to the current prevailing situation. UNESCO-IHE's Pollution Prevention & Resource Recovery Chair Group recently started doing innovative research on metal recovery from waste, such as acid mine drainage (AMD) and electronic waste.

*"My short journey at UNESCO-IHE was valuable and life changing for me. This is an environment that supports dreamers. Exchanging experiences with students from all over the world provided me with a framework to develop my full potential."*

**Wala' Alshiekh Abdallah**
Research assistant in the PADUCO project (Palestinian Dutch Academic Cooperation Program on Water)

# Marie Curie joint doctorate programme

The Marie Skłodowska-Curie European Joint Doctorate (EJD) in Advanced Biological Waste-to-Energy Technologies (ABWET) was initiated in 2015 by a consortium of four partner institutes from the EU: the University of Cassino and Southern Lazio (Italy), UNESCO-IHE (Netherlands), University Paris-Est (France) and Tampere University of Technology (Finland). This EJD provides education and advanced research at PhD level on various environmental technologies that aspires to convert waste materials into bioenergy.

# International recognition

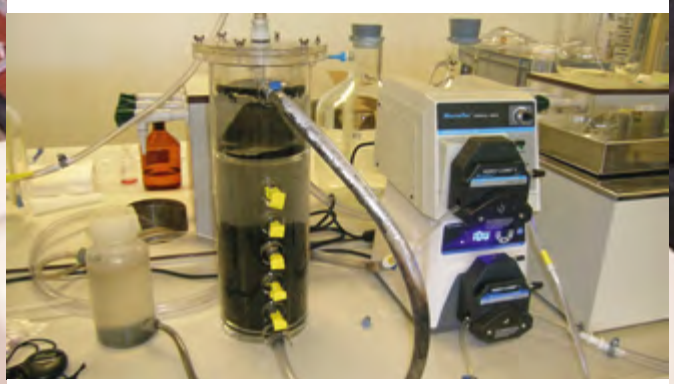
UNESCO-IHE's work on resource recovery from waste and biotechniques for odour treatment was recognised by awarding **Dr. Eldon Raj** the Young Investigator Award at the Challenges in Environmental Science and Engineering CESE2015 Conference in Sydney (Australia).

**Prof. Piet Lens** was appointed as Distinguished Fellow of the International Water Association (IWA). Distinguished Fellows are a limited number of outstanding water professionals, recognized for their uniquely significant long-term contributions to advancing water science and management.

# Research project on olive mill wastewater treatment

Olive oil industries have gained fundamental economic importance in Palestine. However, due to negligence and uncontrolled disposal practices of wastewater, new cases of significant health and environmental impacts have started to emerge. For economic and eco-friendly reasons, bioremediation-based techniques may be both cost-competitive and highly efficient in handling olive mill wastewater (OMWW), yielding stable end-products. From a recovery viewpoint, bioremediation techniqueswill produce valuable products, such as fertilizers, and can act as a potential source of natural dyes for textile dyeing.

**Ms. Wala' Abdallah** from Birzeit University was invited to UNESCO-IHE in 2015 for three months, to investigate the performance of using a lab-scale upflow anaerobic sludge blanket (UASB) reactor to treat olive mill wastewater. Her research investigated identifying the optimum operating conditions of the UASB during the start-up period and under steady-state conditions.



Lab-scale UASB reactor to treat olive mill wastewater.

RESEARCH

# UNESCO-IHE PhD Research 2015

**A large part of the research agenda at UNESCO-IHE is implemented through our PhD fellows from all over the world. Twenty six PhD fellows defended their thesis last year. Their research topics are very varied, ranging from the more technical/natural sciences to the social sciences. Below you can see a presentation of all the thesis topics.**

16 January

**Surface and Subsurface Runoff Generation Processes in a Poorly Gauged Tropical Coastal Catchment.** A study from Nicaragua.

Ms. Heyddy Calderon
Nicaragua

22 January

**Hydraulic and Operational Performance of Irrigation Schemes in View of Water Saving and Sustainability**

Mr. Zeleke Agide Dejen
Ethiopia

26 March

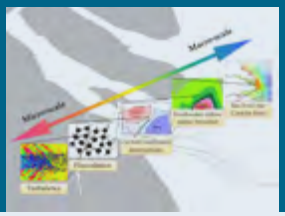
**Subsurface Drainage of Valley Bottom Irrigated Rice Schemes in Tropical Savannah.** Case Studies of Tiefora and Moussodougou in Burkina Faso

Mr. Amadou Keïta
Mali

8 June

**Multiscale Physical Processes of Fine Sediment in an Estuary**

Mr. WAN Yuanyan
China



21 January

**Micro and Small Enterprises, Water and Developing Countries A challenge for sustainability in Colombia**

Ms. Mónica Sanz Galindo

3 February

**Understanding catchment processes and hydrological modelling in the Abay/Upper Blue Nile basin, Ethiopia**

Mr. Sirak Tekleab Gebrekristos
Ethiopia

22 April

**Prestressed Concrete-Lined Pressure Tunnels. Towards Improved Safety and Economical Design**

Mr. Yos Simanjuntak
Indonesia

9 June

**Natural Headland Sand Bypassing. Towards identifying and modelling the mechanisms and processes**

Mr. Mohd Shahrizal bin Ab Razak
Malaysia

22 January

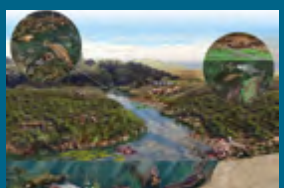
**Agricultural Water Productivity Optimization for Irrigated Teff (*Eragrostic Tef*) in a Water Scarce Semi-arid Region of Ethiopia**

Ms. Yenesew Mengiste Yihun
Ethiopia

11 March

**Dynamics in Organic Matter Processing, Ecosystem Metabolism and Tropic Sources for Consumers in the Mara River, Kenya**

Mr. Frank Onderi Masese
Kenya



28 May

**Sustainable Use of Land and Water under Rainfed and Deficit Irrigation Conditions in Ogun-Osun River Basin, Nigeria**

Mr. Omotayo Babawande Adeboye
Nigeria

10 June

**Capacity Development for Learning and Knowledge Permeation. The Case of Water Utilities in Sub-Saharan Africa**

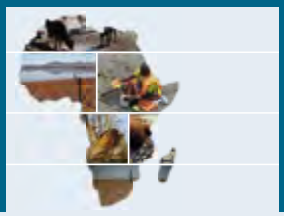
Mr. Silas Mvulirwenande
Rwanda

**To ensure quality control, the UNESCO-IHE PhD Graduate School for Water and Development was launched in 2015, operating as a one-entry PhD training and research point in water and development, with multiple degree providers from international top-level universities.**

30 October
**Design and Development of two Novel Constructed Wetlands: The Duplex-constructed Wetland and the Constructed Wetroof**
Ms. Maribel Zapater Pereyra
Peru

10 December
**Policies lost in translation? Unravelling water reform processes in African waterscapes**
Ms. Jeltsje S. Kemerink-Seyoum
The Netherlands

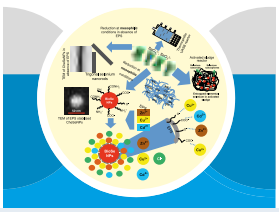
23 June
**Hydrological Drought Forecasting in Africa at Different Spatial and Temporal Scales**
Ms. Patricia Trambauer
Uruguay



9 July
**Low-cost Space-borne Data for Inundation Modelling: Topography, Flood Extent and Water Level**
Mr. Kun Yan
China

30 October
**Pathogen Removal using Saturated Sand Columns Supplemented with Hydrochar**
Mr. Jae Wook Chung
Republic of Korea

10 December
**Bioreduction of selenite and tellurite by Phanerochaete chrysosporium**
Ms. Espinosa Ortiz
Mexico



3 July
**Metal Removal and Recovery from Mining Wastewater and E-Waste Leachate**
Mr. Suthee Janyasuthiwong
Thailand


3 September
**Impact of Improved Operation and Maintenance on Cohesive Sediment Transport in Gezira Scheme, Sudan**
Ms. Ishraga Sir Elkhatim Osman
Sudan

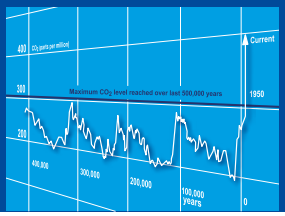
30 October
**Rip Current Prediction System for Swimmer Safety-** Towards Operational Forecasting Using a Process Based Model and Nearshore Bathymetry from Video
Mr. Leo Eliasta Sembiring
Indonesia

14 December
**Performative Nature. Urban Landscape Infrastructure Design in Water Sensitive Cities**
Ms. Kuzniecow Bacchin
Italy

7 July
**Soil hydrological impacts and climatic controls of land use and land cover changes in the Upper Blue Nile (Abay) basin**
Mr. Ermias Teferi Demessie
Ethiopia

8 October
**Water Productivity of Sunflower under Different Irrigation Regimes at Gezira Clay Soil, Sudan**
Ms. Eman R.A. Elsheikh
Sudan

1 December
**Climate Change Impacts on the Stability of Small Tidal Inlets**
Ms. Trang Minh Duong
Vietnam




22 December
**Enhanced Biological Phosphorus Removal-** Metabolic Insights and Salinity Effects
Mr. Laurens Welles
The Netherlands

# Strengthening water governance in the Global South

Water lies at the heart of human development but the global challenges for meeting demands, coupled with increasing urbanisation, land degradation and human population growth, make the challenges of water use in the developing world particularly acute.

**Capacity development at UNESCO-IHE**
Capacity development (CD) is crucial for creating and strengthening the knowledge base to address water-related development challenges via sound water governance. UNESCO-IHE has a strong mandate and track record in capacity development within the water sector.

It is imperative to strengthen the capacity of water sector organisations and not just the individuals inside them, and to pay attention to the needs for the development of complementary skills across the various sectors that play a key role in scales of water management from local to transboundary.

**Some history**
During the 1990s of the last century, concepts related to 'capacity' (capacity building, capacity development) became part of a separate discussion and introspection in the water sector. Based on reflections upon the many failures of infrastructure development projects that, over time, did not result in the expected impacts (owing to planning mistakes, operational shortcomings, deterioration and lack of maintenance), it became increasingly clear that development interventions need to better accommodate existing social systems (people, organisations, institutional settings, culture, power relations, values, politics) that are at a particular level of development because of their historical context.

The scientific debate on 'capacity development' that developed over the past decade has questioned the 'return on investment in CD' owing to growing pressures on developmental aid funds, while reflecting on and contributing to a more scientifically-underpinned knowledge base of principles, approaches, methodologies and good practices. The conviction that 'training' is the solution for (water sector) development has been replaced by a much broader conceptualisation of capacity development, in which training and educating professionals is only one of many possible modalities and only a very specific means of support.

**Activities**
The activities that UNESCO-IHE focuses on (usually in the form of a project) differ from infrastructure development projects, partly because the requests differ: from "we need our staff to be trained in waste water treatment", to "our university would like to develop a Water MSc programme or a water related module" and "help us to adapt to and mitigate climate change effects on water scarcity in Cuba", etc.

Excerpt from research paper: Wehn et al. (2015) Strengthening Water Governance in the Global South: Role and International Experiences of UNESCO-IHE in Capacity Development, Water Governance, 5, 26-34.

**EXAMPLES OF CAPACITY DEVELOPMENT MODALITIES AT UNESCO-IHE**

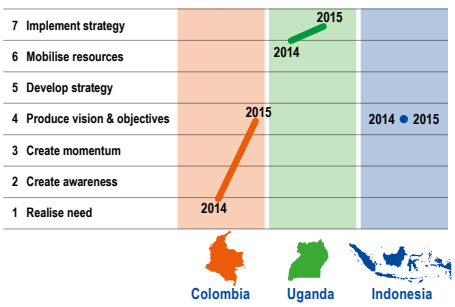
| Education and training | Joint research | Advisory services – support/guidance for: | Knowledge Networking & Partnerships |
|---|---|---|---|
| • standard course material<br>• tailored course material<br>• workshops<br>• classroom teaching<br>• awareness-raising campaign<br>• apprenticeships/on-the-job training<br>• train-the-trainers<br>• study tours /visiting organisations<br>• action learning | • research partnering / co-authoring with local experts / researchers<br>• MSc, PhD, postdoc | • compilation of strategy / policy / research agenda<br>• curriculum development<br>• needs assessment / requirements analysis<br>• change management, knowledge management, policy development and implementation<br>• e-learning & distance learning<br>• online courses<br>• online resources (e.g. films, video-clips, such as TEDtalks)<br>• online platform (e.g. Moodle) | • formal networking of academia & policy makers<br>• water education networks<br>• Communities of Practice<br>• conferences<br>• alumni networking<br>• informal networks |

# National strategies for water sector capacity development

## in Indonesia, Colombia and Uganda

Over the last two years, UNESCO-IHE has supported the process of developing and implementing strategies targeted at national water sector capacity development in three countries in Asia, Africa and Latin America: Indonesia, Uganda and Colombia respectively. Each country is facing different challenges to enhance capacity development (CD) in the water sector and is operating at different stages of devising their capacity development strategy. Colombia finds itself in the phase of assessing their CD needs and creating awareness for a national strategy, whereas Uganda is already implementing its strategy.

**NATIONAL STRATEGY FOR WATER SECTOR CAPACITY DEVELOPMENT**




UNESCO-IHE has coordinated workshops and training sessions in the three countries, working together with stakeholders from Ministries of Water (and Environment), NGOs and universities, by providing them with concrete tools and guidelines for: the operationalisation of the strategy (Uganda), facilitating communication between actors and setting commitments for the continuity of strategy development (Colombia); working on more structured and better coordinated capacity development efforts in order to deal with the future challenges (Indonesia). This had immediate impact in Indonesia, as all the participants of the workshop in December 2015 signed the '**Bogor declaration**': this states that Indonesia's water crisis should be addressed by a National Knowledge and Capacity Development Strategy for Water Resources Security. It urged the government to be more responsive, by preparing the necessary documents and having the will to implement the strategy. The declaration was drafted, read out, signed and handed over to the daily secretary of the National Water Council, Mr. Untung on 2 December 2015, who supported the suggestions made.

# Building Capacity for long term Delta Management in Bangladesh

The fate of Bangladesh is closely tied to how the country manages its water. Located in the most densely populated and largest river delta of the world, the country is facing tremendous challenges in almost every water-related domain. This creates a focus on fixing today's problems but hampers the development of a clear strategic agenda for the mid and long term. Yet Bangladesh is rapidly developing, so many decisions made today might have lasting impact on the future.

To connect current measures with long-term challenges and agendas, the Bangladesh Delta Plan 2100 (BDP2100) is being developed, in a joint cooperation between the Government of Bangladesh and The Netherlands. By tailoring the Dutch Adaptive Delta Management approach to Bangladeshi conditions, an adaptive planning framework is being implemented, that can cope with a volatile and uncertain socioeconomic and climate related future.

Coping with multiple futures
Within the BDP2100, UNESCO-IHE is leading the capacity development programme targeted at both the central government institutions in Bangladesh, as well as different research institutions and water authorities. Adaptive planning skills, components like scenarios, alternative strategies, adaptation tipping points and pathways are being co-developed to create a flexible water policy that can cope with multiple futures, instead of being dependent on particular future conditions. The programme consists of stakeholder workshops with often 150 participants or more, tailor-made courses hosted at UNESCO-IHE; refresher courses as well as support for the so-called delta-ateliers, in which issues and proposals are discussed with regional and local stakeholders.

In November 2015, UNESCO-IHE organized a 10-day tailor-made course on Adaptive Delta Management, for medium and higher management of the Bangladeshi government. The week was filled with dialogue on Dutch-Bangladeshi policy and practice, as well as crash courses in state-of-the-art water-related topics. A follow-up course took place in Bangladesh to put adaptive planning and delta management into practice.

Although the BDP2100 is reaching the end of its formulation phase, the capacity development programme will continue. Current ambitions are to develop a knowledge hub and/or joint programme focusing on Adaptive Delta Management.

# Modelling stakeholder decision making with serious gaming

The Magdalena river basin in Colombia is seen as the social, environmental and economic heart of the country. Home to 80% of the nation's 48 million inhabitants, the river basin produces 86% of the nation's GDP and generates 75% of the country's agricultural production. The basin accounts for 70% of the country's hydroelectric energy and 90% of its thermoelectric power. It also provides drinking water for 38 million people.

UNESCO-IHE's MSc student Joanne Craven developed a serious game 'SimBasin' for Magdalena river decision makers to simulate real day-to-day decisions. Sixty high-level decision makers involved in sustainably managing water and other natural resources in the basin came together in October 2015 to develop a future plan for the next 30 years. With the game, they could respond to realistic decisions presented to them, such as whether to declare protected areas, expand agricultural areas or change farming methods, or build a new hydroelectric scheme. Many of the participants demonstrated interest in the game and the underlying decision support system, currently developed by The Nature Conservancy (TNC), either as users or collaborators. They were convinced of the benefits it can bring to all sectors to foresee the social and environmental impacts of their actions. They also believed the SimBasin game to have a high potential for capacity building and familiarizing other actors with the concept of decision support systems; so much so, in fact, that some public institutions want to use the game in national decision-making processes.

**Download the game online via http://simbasin.hilab.nl**

*"It is great to see how games can make science more accessible to policy-makers and get everyone around the same table."*

**Joanne Craven**
Visiting Researcher

UNESCO-IHE
Institute for Water Education

**UNESCO-IHE Institute for Water Education is the largest international graduate water education facility in the world and it is based in Delft, the Netherlands. The Institute confers fully accredited MSc degrees, and PhD degrees in collaboration with partners. Over 15,000 water professionals from more than 160 mainly developing countries and countries in transition have been educated at the Institute.**

**The mission of UNESCO-IHE is to contribute to the education and training of professionals, to expand the knowledge base through research and to build the capacity of sector organizations, knowledge centres and other institutions active in the fields of water, the environment and infrastructure in developing countries and countries in transition.**

**www.unesco-ihe.org**