

RESEARCH AT UNESCO-IHE

INSTITUTE FOR WATER EDUCATION



UNESCO-IHE
Institute for Water Education

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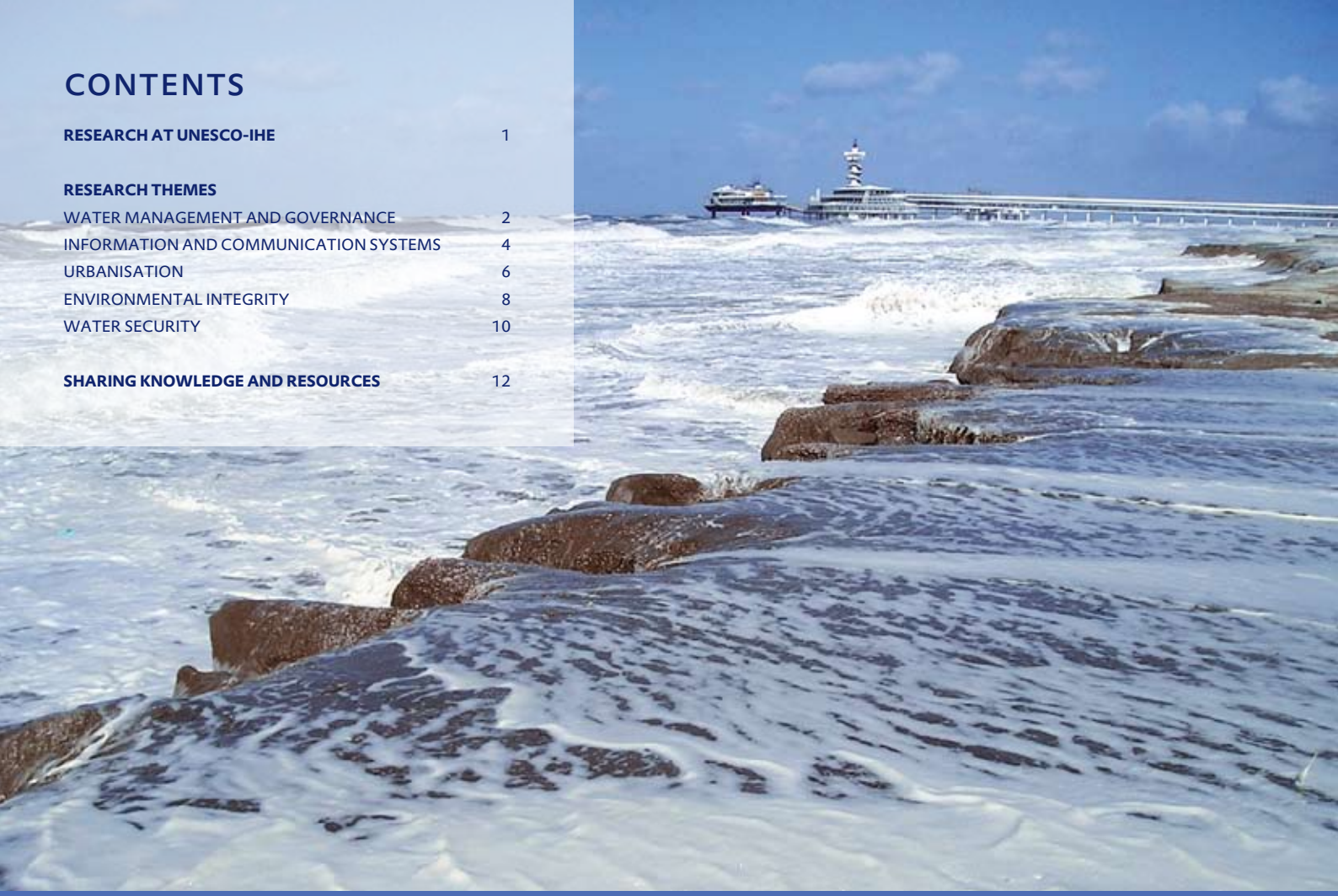

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CHALLENGES

Water is the key resource for social and economic development of populations. Only increased capacity to manage the limited available fresh water resources will allow local communities to cope with the growing demand for water for food production and other socio-economic requirements. Large numbers of people lack access to adequate drinking water and sanitation services. At the same time people are increasingly at risk from the extremes of floods and droughts. Additionally, there is growing concern that global climate change will bring massive changes to the living conditions of many, especially the poor, and must be dealt with as a matter of urgency. The urgency also shows from forecasts: Water use will increase by 20% between the years 2000 and 2020, and by 2025, 58% of the population is expected to live in countries of low to catastrophic water availability.

RESEARCH AT UNESCO-IHE

THEMES

UNESCO-IHE develops its research around five thematic themes: Water Security, Environmental Integrity, Urbanisation, Water Management and Governance, and Information and Communication Systems.

Through its research, the Institute aims to:

- **Develop innovation and promote the uptake of technologies and policies that address the issues of the global water agenda.**
- **Seek, evaluate and facilitate responses for the sustainable management of water and the environment, to meet the needs of all sectors of society, particularly the poor.**
- **Develop and promote principles of good governance to drive institutional and management change.**

UNESCO-IHE's research is solution oriented, with a focus on development. It contributes to the overall knowledge base concerning water and environment, and fuels the education and capacity building programmes the Institute undertakes with its worldwide network of partners. In Delft, the Netherlands, the UNESCO-IHE research community consists of 90 academic staff members, 70 PhD fellows and about 350 MSc students. The Institute's staff produces over 200 publications per year. They cover all relevant disciplines in the fields of natural science, engineering and technology, socio-economics, law, and institutional development.

In many regions, the steadily increasing pressure on natural resources has led to a precarious balance between the needs of different water users. It has been widely acknowledged that catchment areas should be managed as systems, if potential conflicts between competing uses are to be avoided. A consensus is emerging about the need for good governance in water resources management, as it is realised that water crises are often crises of governance.

This research area focuses on the institutional dimensions of water management, and studies the manner in which decision processes are taking shape in water institutions. Laws, policies and organisations, and to some extent economics are objects of study, as well as the sociological study of claim–made by interest groups and negotiation practices not formally recognised but historically linked to water management. Within this research area, institutions with different spatial spans are studied, from local water point committees, through watershed committees, urban water utilities, river boards and catchment councils to transboundary river basin commissions.

This research area also aims to identify adequate and innovative institutional forms that enhance accountability and public participation, from the local scale and the watershed, with its multistakeholder platforms, to the basin scale, and beyond. It wishes to contribute to effective and legitimate decision-making processes.

RESEARCH THEME

WATER MANAGEMENT AND GOVERNANCE

RESEARCH LINES

Watershed, catchment and basin organisations: negotiating access – The emphasis in contemporary water, land and development policy domains on entitlement and rights (water rights, land titles, rights based approaches) demands close examination of allocation principles and procedures. The water sector amplifies the complexities of legal pluralism alongside informal claims to natural resources. At the watershed scale we study appropriate technologies that lead to an increased degree of stakeholder participation. At the catchment level we study the involvement of agencies, councils and the private sector in water resources planning, as well as the tradeoffs that may exist between competing uses. At the basin scale, specific attention is given to international river basin commissions and to the manner in which equitable and reasonable sharing agreements are negotiated.

Managing the urban water cycle – With increasing global pressures, coupled with existing conventional water management practices, cities of the future will experience difficulties in efficiently managing scarcer and less reliable water resources. In order to meet these challenges, there is a shift to a more integrated approach to urban water management. Currently the Institute undertakes research that analyses the institutional, economic and financial aspects of the entire water cycle in urban centres. The institutional set-up of the water management organisations in small and medium-sized municipalities is investigated, as well as the institutional changes required for a sustainable future.

Organisational change in the water sector – River basin organisation and water utilities in developing countries have been subject to continuous reform over the past decades. Understanding these reform efforts by analysing the nature of the reforms, its drivers and its intended and unintended impacts, underlies a deeper understanding of development patterns in the water sector. What reforms are being conducted in river basins and water utilities and what are the impacts on the management of the water resource? How do decision-making processes unfold in river basin organizations and water utilities? Does private sector participation result in increased efficiencies? How do these institutional reforms translate into political processes and governance issues?

From Potential Conflict to Cooperation Potential in the Incomati River Basin

SAMPLE PROJECT

The Incomati river basin is shared between South Africa, Swaziland and Mozambique, and discharges into the Maputo Bay in the Indian Ocean. Water use is intense, with 50% of the water generated in the basin being withdrawn; and the basin is situated in a part of Africa that has experienced a dynamic, sometimes turbulent and volatile, political history over the last 40 years.

Both ingredients might have been sufficient for the emergence of confrontations between the three riparian countries, but tension never escalated. Instead, tensions translated into agreements.

Why didn't open conflict emerge between the riparian countries over the water resources of the Incomati? Why did cooperation prevail?

In order to answer these questions, researchers explored the natural characteristics of the basin, its political history, the relations among the clans in the region, the institutionalisation of water developments, and the negotiations' evolution during several decades. The methodology was based on archive research and interviews with stakeholders. A quantitative water resources model was developed through several MSc research projects.

The research concluded that people in these countries share a common space and a common history and thus, a common future. There is therefore an inherent pressure to behave as good neighbours, even when political ideologies diverge. Furthermore, there are outside pressures on nation-states to act responsibly and to honour existing regional and international conventions. The strong historical ties between the peoples of Southern Africa are an important and positive element.

Particular political developments in both Mozambique and South Africa have also contributed to avoid escalating conflict. When the need for an agreement was highest, the cold relations started to melt, strengthening economic ties and further cementing their political relations. In addition, Swaziland plays a role as broker because of its particular political and hydrological position, vis-à-vis the other two countries, balancing the equation. Finally, conflicts were avoided through enlarging the pie by allowing more water to be abstracted.

Over time, water sharing will increasingly be a delicate balancing act between cooperation and competition. Water can drive people and countries towards cooperation, as developments in the Incomati basin case show. This research provides an example for other riparian countries to turn potential conflict into increasing cooperation by managing the socio-political, economic and institutional elements in a way that serves all the parties' interests.

More information:
www.unesco.org/water/wwap/pccp/about.shtml

Information and communication systems address the absolute need for effective use of information and communication technologies in monitoring and acquiring data, computer-based modelling, and decision support and knowledge-based systems. At UNESCO-IHE, the field concerns the development and appropriate use of these systems as a facilitating discipline to enable the integration of disciplines such as hydraulic engineering, hydrology and environmental sciences with disciplines such as human sciences as sociology, economics and politics.

This area of research aims to provide the necessary tools that give a better understanding and management of water and environment. The applications of these tools are crucial for the effective and sustainable utilisation of resources to meet the challenges of the global water agenda. The effectiveness and efficiency of the research are evaluated through application to specific areas including: urban flood management, flood forecasting, coastal morphology, ocean surge forecasting, integrated urban water systems modelling and management, eco-hydraulics and environmental modelling, catchment modelling (water quantity and quality) dam break and embankment failure modelling and anticipatory water management

RESEARCH THEME

INFORMATION AND COMMUNICATION SYSTEMS

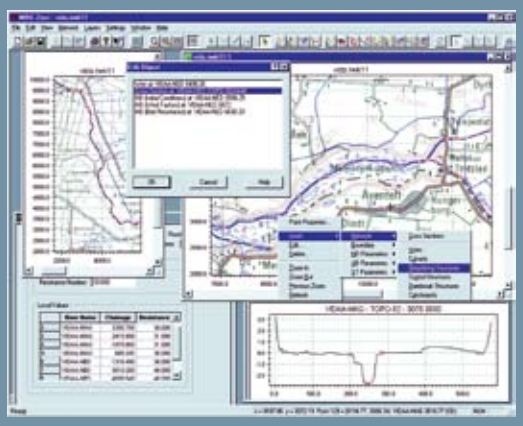
RESEARCH LINES

Exploring major modelling paradigms – The Institute is currently exploring three major modelling paradigms: physically based modelling, data driven modelling and agent based modelling. The objectives are to develop new algorithms and to refine existing algorithms for each paradigm. New techniques are being developed to integrate different paradigms in what is termed hybrid modelling. Special attention is given to the procedural application of the different modelling paradigms to produce safe and reliable instantiated models. This involves the analysis and the treatment of uncertainty in modelling, including the development of new methods and risk assessment through modelling of the consequences of natural hazards.

Development of systems engineering and optimisation frameworks – Systems engineering is the most general framework for building water-related systems. Optimisation is a major element in a systems approach to water resources and water systems management, and to decision making in general. The Institute is developing and testing new methods of optimisation, in particular perfecting a new method based on an evolutionary approach with non-standard recombination mechanisms. In addition, the development of systems engineering frameworks based on a multi-criteria robust approach for the optimisation of water systems is a major activity. Research is also being undertaken in the area of real time control and anticipatory water management.

Collaborative decision making & internet-based computing and learning – This research line explores the extension of existing hydroinformatics tools and systems, predominantly used by water professionals and engineers, into tools and systems that can be used by a broad range of stakeholders. Platforms for the development of these new kinds of systems are electronic networks such as the internet and the extensive mobile telephone networks. Various technologies enabling Internet-based and server-based computing for the purpose of hydroinformatics (modelling, collaborative working and learning) are being tested. The objectives include ensuring appropriate integration of different kinds of models that will provide relevant information. Feasibility, reliability and efficiency of such kind of systems are also topics of research.

Integrated flood risk management in Europe



SAMPLE PROJECT

The Floodsite project develops technologies and strategies for sustainable flood mitigation and defense in Europe. It addresses the interaction between bio-physical and socio-economic systems and deals with the hazard of coastal extremes, coastal morphodynamics and flash flood forecasting, as well as social vulnerability and flood impacts.
The FLOODsite consortium includes 37 of Europe's leading institutes and universities from 13 European countries. Pilot studies are carried-out at the Elbe and Thames rivers, the Scheldt Estuaries and in the Ebro coastal delta.
FLOODsite elaborates an integrated European methodology for flood risk analysis and management by studying the causes of flooding rivers and estuaries and rising sea-level. Researchers develop sustainable "pre-flood" measures such as an early warning system and evacuation and emergency response plans to mitigate the negative impacts of floods.
UNESCO-IHE is involved in the research in coastal floods related to failure of defense mechanisms and develops methods for the uncertainty analysis of models. The Institute is also responsible for knowledge management and develops the web-based platform for knowledge transfer between the partners in the project. An innovative element is the wide use of computational intelligence methods to build models of uncertainty. Such models use fuzzy clustering and ensembles of local error models, as well as neural network-based emulators of Monte Carlo samplers and efficient sampling methods based on adaptive cluster covering. Prototype software will be developed and will be made available for widespread use. The FLOODsite project has a broad demonstration and dissemination component to enhance forecasting/prevention scenarios and prompt political decision-making to deal with increasing uncertainty of natural hazard events.

More information: www.floodsite.net, d.solomatine@unesco-ihe.org

With increasing global pressures such as urbanisation or climate change, coupled with existing un-sustainability factors and risks inherent to conventional urban water management, cities of the future will experience difficulties in efficiently managing scarcer and less reliable water resources and reducing urban flood risk.

In order to meet these challenges, UNESCO-IHE is developing solutions based on several key concepts of urban water management including resilience of urban water systems to global change pressures, interventions over the entire urban water cycle, reconsideration of the way water is used (and reused), greater application of natural systems for water and wastewater treatment and governance and financial management structures covering the entire urban water cycle.

Our research aims to provide solutions for sustainable urban water management by considering the urban water cycle in an integrated manner.

RESEARCH THEME

URBANISATION

RESEARCH LINES

Delivering a blueprint for integrated urban water management – An integrated urban water management approach involves managing freshwater, wastewater, and storm water as links within the resource management structure, using an urban area as the unit of management. Currently the Institute is developing an integrated modelling approach that will enable a full understanding of the implications of these concepts across the entire urban water cycle, while allowing optimal designs to be generated. These integrated urban water models will be driven by sustainability indicators, and will recognise inherent uncertainties.

Recognising risks and uncertainty in urban water management – The result of global change could pose increased threats to cities, including water supply shortages, increased risk of flooding, pollution by combined sewer sewers and contamination by treated or untreated wastewater. Good decisions and research must address uncertainty and variability associated with global changes. Developing frameworks for establishing risk indicators is another activity. These indicators can be used for an integrated assessment of the risks associated with urban water systems. The indicators will be used in a quantitative way (using physical models and fact generators) and a qualitative way (using management models and decision support systems and judgment generators).

Developing treatment processes based on natural systems – Natural treatment systems, for drinking water production and wastewater disposal/reuse, are attractive because of their low cost, sustainability, and relevance to developing countries. The Institute investigates the potential of river or lake bank filtration (BF) systems for drinking water treatment process. BF is a multi-objective treatment process, providing removal of turbidity, organic micropollutants, microorganisms and nitrogen. Research activities include investigating the potential of soil aquifer treatment (SAT) as a natural and sustainable wastewater treatment process. SAT is a multi-objective treatment process, providing removal of solids, effluent organic matter, organic micropollutants, microorganisms and nitrogen.

Developing low-cost decentralised water supply and sanitation – In response to the situation regarding poor groundwater quality in several developing countries, UNESCO-IHE developed the 'family filter' for treatment of arsenic and iron containing groundwater. The Institute will further develop this technology and test it more extensively around the world. Ecological sanitation is another emerging area, where focus is placed on urine-diversion dehydrating toilets with downstream processing and reuse, and options to improve faecal sludge management in order to enable safe reuse and energy recovery via decentralised biogas plants.

Developing technologies for advanced treatment – Both conventional drinking water and wastewater treatment have difficulties in meeting the increasing and more stringent water quality objectives. Hence the Institute currently focus on four areas to tackle this problem: membranes (membrane filtration for drinking water production, membrane desalination, membrane bioreactors in sewage and industrial effluent treatment, and wastewater reclamation and/or reuse); adsorbents (targeting inorganic micropollutants such as arsenic and chromium); characterisation and removal of natural organic matter, and advanced nutrient removal from wastewater including aspects of biological process fundamentals and activated sludge population dynamics.

SAMPLE PROJECT

Arsenic-free drinking water

After several years of intensive laboratory and field research, a UNESCO-IHE team brought forward the 'family filter', an effective and affordable technology for arsenic removal from drinking water. The filter uses iron-coated sand to absorb arsenic. It produces approximately 100 litres of arsenic-free water per day, sufficient for drinking and cooking purposes of more than 20 people. There is also a larger-scale technology suitable for small towns. The technology won the Holland Innovation Award in 2004 and has been requested by several countries.

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SWITCH, shaping the city of the Future

SAMPLE PROJECT

SWITCH, a concerted effort of the European Commission and 32 partners from 15 countries, will help cities to adapt to the impact of climate change and increased population migration to the cities. The project proposes a shift in how cities manage their water resources by addressing all elements of the urban water cycle.

SWITCH, a five-year project launched in 2006, looks into scientific, technological and socio-economic alternatives contributing to set up effective urban water management schemes. The research activities –carried out by more than 150 researchers– focus on developing indicators for sustainability and risk assessment, modelling of urban water systems, technological options for storm water control and reuse, demand management for optimization of services, eco-sanitation and decentralised waste water management and management of industrial emissions, among others topics. The project also aims at changing attitudes and habits, which will shape the City of the Future by 2050.

In order to bring the research advancements into practice, the project involves 10 demonstration cities. The results of the research will be included in the city water plans.

For example, Birmingham focuses its research on a type of extensive green roofs called brown roofs. The research studies the factors influencing the ecological and hydrological functions of these roofs. A brown roof laboratory has been set up to study the conditions of the soil and vegetation, the water quality and water retention, the flood reduction, the pressure on drainage infrastructure, as well as the potential to re-direct the storm water for non-potable uses within houses with green roofs. The project is designed to provide a habitat for black redstarts and other species and to test other potential benefits such as reuse of waste materials, energy consumption, biodiversity enhancement and storm water mitigation.

For the demonstration, the City Council will build green roofs in 7 representative buildings of the city centre. Assuming optimal performance, the cooling demand in these buildings during the summer can be reduced by 10%, while water flows from the roofs will save 30% of drinking water. Overall, if 20% of the buildings in a city centre (say 60000m2) are converted to extensive green roofs, the savings financially would be on the order of £300.000/annum. Other research demonstration cities include improved water distribution and sanitation in Accra, integrated urban water management in the context of increasing population in Alexandria and eco-sanitation and descentralised wastewater management in Chongqing. The project also experiments with Learning Alliances, bringing together researchers and local stakeholders to ensure coordination of decisions and optima adoption of feasible solutions. The dissemination goals of the project will bring the successful innovations into an increasing number of cities around the world.

More information: www.switchurbanwater.eu, switch@unesco-ihe.org

Urban flood risk – Due to the high density of population and infrastructure in urban areas, the risk of damage from flooding is high. Research at UNESCO-IHE is developing models of how we can predict flood risk in urban areas for both planning and real-time emergency management. These models require innovative approaches to address the differing length scales and must harness the latest developments in remote sensing.

There is realisation throughout the world that we need to conserve essential life-support ecosystems for our well-being and survival and to maintain an adequate resource base for coming generations. At the same time there is a realisation that ecosystems are used for human activities. Therefore, they should be used wisely.

The maintenance of environmental integrity for sustainable development requires both technical knowledge, such as ecotechnology, ecology, sanitation, environmentally friendly design; and institutional knowledge, like legal and policy frameworks, regulatory capacity, implementation mechanisms.

The Institute's research operates within the overall framework of Integrated Water Resources Management (IWRM). It tests theories, analyses data and contributes to strategies and policies aimed at sustainable management and the wise use of water and environmental resources. It covers the linkages between the biophysical dimensions of water resources and the social-institutional dimensions.

RESEARCH THEME

ENVIRONMENTAL INTEGRITY

RESEARCH LINES

Exploring the impacts of global change on water – The Institute is currently studying the specific interactions between climate change and water both in terms of biophysical processes, as well as in terms of social patterns and coping mechanisms. An important research question is how the vulnerability of water systems can be reduced and resilience enhanced in order to minimise the negative impacts of these interactions. Moreover, the institutional and knowledge requirements to deal with the resulting uncertainties and shocks are being studied.

Delivering a blueprint for integrated water systems management – This area studies the interconnectedness of water systems and users, and aims to develop methods and multi-criteria analysis models for participatory integrated assessment. Research questions that are being addressed include how the techniques of modelling water allocation can be improved, and how multi-criteria analysis can be used to reconcile different and non-commensurable objectives and criteria. A new area of inquiry attempts to analyse physical and social processes within one common framework.

Development of guidelines for the design and management of wetlands – Wetland management aims at the sustainable utilisation of wetland resources for the benefit of humankind while ensuring their environmental integrity. The performance of constructed and natural wetlands for water and wastewater treatment, by modelling the biofilm activity is addressed. In addition, the Institute is studying the structure and processes of the natural wetland and river basin systems (soil and water quality, nutrient flows, productivity, biodiversity) and wetland ecotones as nutrient buffers in the upstream-downstream continuum. Wetland farming systems and their relation to productivity, ecosystem functioning and livelihoods is also tackled.

Development of environmental water allocation models – The aim is to test methods of assessing environmental flows in rivers, lakes and wetlands in a range of climatic and socio-economic contexts. Challenges include predicting how much water needs to be retained in rivers to achieve different levels of protection, persuading users to limit their demands and implementing the required flows. The research compares the suitability of different economically efficient methods in differing climatic and socio-economic conditions, and provides the tools to achieve environmental flows that allow a balance between resource use and resource protection for the long-term.

Studying the role of water for food and poverty alleviation – This research line addresses the important role that water plays in the livelihoods of small-scale farming households in the semi-arid savannah areas of the world. A key research question is how rainfed agriculture can be improved by rainwater harvesting techniques, supplementary irrigation and better nutrient management. Can the resilience of rainfed agriculture against climate shocks be increased and can the vulnerability of smallholder farmers that are dependent on these systems be reduced? To what extent does the rainfed smallholder farming sector hold the key to solving the looming food crisis?

Fingerponds: food safety in African wetlands

SAMPLE PROJECT

Inland freshwater resources are extremely important for food security and livelihoods of people in the Lake Victoria basin, as they provide drinking and irrigation water, and fish, an essential source of protein in this area. Nevertheless, over-fishing and wetland degradation have led to a decline of subsistence fisheries yields in Lake Victoria, and subsequently a protein deficit for local communities. UNESCO-IHE investigated the potential of seasonal wetland fishponds, with the objective to enhance fish production from wetlands.

This research was initiated in 2001 with partners in Kenya, Uganda, Tanzania, UK and the Czech Republic. Four research sites were identified in the Lake Victoria basin and two sites in the lower Rufiji floodplain. At each site, four fingerponds were dug from the landward edge of the wetland (from a bird-eye's view, the ponds appear like fingers in the landscape, hence the name "Fingerponds"). Soil from the ponds formed raised beds for cultivation of seasonal crops. Seasonal floods brought water and fish, and as the waters receded, trapped fish were farmed in the ponds. The fish population consisted mainly of tilapias with some catfish, lungfish and other species, enough to stock the ponds fully. The productivity of the ponds was stimulated with natural organic fertilizers such as kitchen waste and manure, and the pond sediments were periodically used to fertilize the vegetable beds.

In subsequent years, UNESCO-IHE and its partners investigated the biotechnical aspects, such as pond hydrology and functional period, fish stocks and pond productivity. The socio-economic impact was also investigated – how do ponds fit into the farming system, how do they contribute to the livelihood of the households, what is the impact of the ponds on household economics? A hydrological model was developed to predict the water levels and functional period of the ponds based on pond depth and climate factors. An ecological model quantified the nutrient flows in the wetland ecosystem and assessed the role of fingerponds in enhancing the efficiency of nutrient cycling.

Results from the project showed that the principle of fingerponds works: one 200 m2 fingerpond produced about 20 kg of fish per year on average. Therefore, one family of 7 people owning one fingerpond can produce about 3 kg of fish per person per year. This is quite a significant addition to the current average consumption of about 5 kg per person per year. The protein supply from fingerponds was higher than most of the other farming system enterprises. With improved management and effective harvesting, it is expected that higher fish production can be achieved in the future.

For more information, see www.unesco-ihe.org/fingerponds or contact a.vandam@unesco-ihe.org.

Water security involves protection of vulnerable water systems, protection against water related hazards such as floods and droughts, sustainable development of water resources and safeguarding access to water functions and services. It is primarily concerned with human interventions in water systems. These are aimed at the enhancement of the beneficial and sustainable use of water for various purposes such as water supply, irrigation, drainage, navigation, hydropower, environmental purposes and the protection against water related risks.

Interventions in water systems are necessary to meet the needs of society in the widest sense and in order to be able to face the challenges of all kinds of global changes, such as climate change and changing land use. Research at UNESCO-IHE deals with surface and groundwater systems, river basins, coastal and estuarine water systems and ports and waterways and includes the following main aspects:

- Analysis, understanding and modelling of hydrological, hydraulic, geo-technical and morphological processes and phenomena;
- Planning and design of engineering interventions at regional/trans-boundary and local scales;
- Management, operation and maintenance of water related infrastructure;
- Environmental assessment and mitigation of impacts due to water use and interventions in water systems.

RESEARCH THEME

WATER SECURITY

RESEARCH LINES

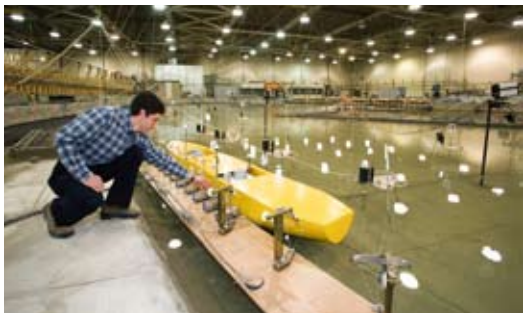
Integrated Coastal Zone Management and coastal zone – This research area seeks to learn and understand the needs and methods for an integrated approach to planning and design of infrastructure in the coastal zone and estuaries. This requires the development of integrated coastal and marine area management plans, port development and management, maritime transport and inland navigation and integrated modelling for environmental impact assessment, planning and analysis.

Flood Risk Management & vulnerability indices – Flooding is inevitable as people seek the benefits of living near water, but it is possible to mitigate the adverse effects. Projects in this area seek to enhance our ability to forecast floods, real-time flood prediction, risk and uncertainty techniques and the modelling of urban floods. In this context, flood vulnerability indices can be used on a large scale and in areas where flood modelling is not possible. The indices are calculated from data on land use, hydrological conditions, socio-economic indicators etc. They can be used by decision-makers to identify areas where further development may be ill-advised.

Flood-resilient buildings – A key non-structural measure for reducing flood risk is to design buildings to withstand floods. With increasing climate variability this will be a key part of flood risk management. Research seeks to improve the available technology and to develop and test new methods.

Hydrological Processes and Modelling – Understanding hydrological processes and developing suitable models is crucial for water resources management and to able to predict future impacts initiated through global changes. Research is undertaken at different scales, for example rainfall-runoff generation, water-soil-plant-atmosphere interactions, water dating and surface water-groundwater interactions. Therefore, the Institute further develops different experimental and modelling techniques using tracers, geophysics and remote sensing data.

Bio-geomorphology – It is now widely accepted that the constraints placed on rivers through excessive engineering in the past are not appropriate if we are to satisfy the many demands on rivers in a sustainable manner. This has resulted in policies in several countries to move flood defences back from rivers and to allow more vegetation in the floodplains. This requires an understanding of how vegetation affects both the flow of water in rivers and the erosion and deposition of sediment.



Water monitoring and flow forecasting in the Yellow River

SAMPLE PROJECT

The Yellow River is the second largest river in China. It is 5,500 km long and has a total drainage area of 720,000 km2. Its recurrent floods affect millions of people living along its basin.
UNESCO-IHE and its partners work to improve the flow monitoring and flood forecasting in large parts of the Yellow River. They are implementing a hydrological modelling system for the prediction of river flows using a large scale modeling concept. The system is based on real time information over precipitation and evaporation provided by meteorological satellites, in combination with ground station observations.
The satellite provides daily spatially-distributed images of precipitation, evaporation, and snowmelt quantities for the Yellow River basin, which are being used by the large scale hydrological modelling system developed by UNESCO-IHE. Parameters used by the hydrological model relate to spatial information on soil type, vegetation and land use and to some field data.
Validation results show that the system performs well. This suggests that for large-scale hydrological models, satellite-derived precipitation data can provide a suitable alternative to ground-based data, in particular when ground observations are minimal. As such, there is potential of using satellite based rainfall and evaporation estimates for improved flood prediction, particularly in large and poorly gauged catchments.

For more information, contact r.venneker@unesco-ihe.org.

WORKING IN PARTNERSHIP

The applied, strategic and fundamental research of UNESCO-IHE is carried out in collaboration with a network of partner institutions in Europe, Africa, Asia, the Americas and the Middle East.

The Institute is constantly strengthening its networks through the UNESCO-IHE Global Partnership for Water Education and Research initiative. Networks and partnerships are of vital importance in terms of access and sharing information. In this context, UNESCO-IHE acts as a member of and an interface between knowledge centres, sector organisations and professionals. It tries to catalyse synergies among activities to maximise their contribution to the development of the water sector. Activities include cooperation in education and training, joint research and development, staff exchange, information sharing, knowledge management and joint capacity building.

At present, UNESCO-IHE cooperates with about 50 institutional partners worldwide, including universities and research centres, public, private and civil society institutions and organisations, NGOs, intergovernmental agencies and development banks.

UNESCO-IHE works in close cooperation with UNESCO programmes and institutes, as well as with UNITED NATION agencies and programmes. The strongest ties are with the International Hydrological Programme of UNESCO, and the World Water Assessment Programme.

SENSE MEMBERSHIP

UNESCO-IHE is a member of the Research School for Socio-Economic and Natural Sciences of the Environment (SENSE). This Dutch research school focuses on both the natural sciences and socio-economic fields of environmental research. SENSE is accredited by the Royal Netherlands Academy of Sciences (KNAW), and brings together excellent academic research groups from nine universities and research centres.

SHARING KNOWLEDGE AND RESOURCES

KNOWLEDGE TRANSFER

To fully exploit the benefits of research, the Institute has developed a communication and knowledge transfer plan, designed to ensure that UNESCO-IHE reaches and informes key target audiences and that dissemination is firmly embedded into research processes. Hence, knowledge transfer is a strategic activity of all UNESCO-IHE research staff.

The knowledge transfer and communication plan includes presenting research outputs at international conferences and publishing in high quality international journals. In addition, policy briefings, manuals and international guidelines are published aimed at the practitioner and other interested parties. These are disseminated through open workshops and seminars held at various locations and online.

UNESCO-IHE is committed to engage with a wide range of new and established users and audiences from the policy, business, NGO's and research communities. The Institute is keen to use its research findings in ways that ensure public engagement in global water issues.

SPONSORS

A significant part of the research is done by postgraduate degree participants who need funding for their studies. A sizeable proportion of the participants in the MSc (90%) and PhD (90%) programmes receive this funding from public and private sources.

The Institute operates an independently administered Fellowship Trust Fund that receives donations from sponsors. UNESCO-IHE participants depend on the generosity of donors to finance the Fellowship Trust Fund. Contributions directly help to finance the expertise needed to meet the vitally important UN Millennium Development Goals and to improve water services and infrastructure in the poorest countries.

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FACILITIES AND RESOURCES

UNESCO-IHE's premises are located in the centre of Delft, covering an area of 14,000 square metres. Facilities include multifunctional lecture theatres, a fully equipped auditorium, staff rooms and study rooms for MSc and PhD participants, four modern teaching and research laboratories (including state of the art instrumentation), extensive computing facilities, and a library equipped with on-line connections to national and international resource centres. The Institute also enjoys extensive and highly specialised lab facilities at its partner institutions around the world.

Through an innovative learning system using two-way videoconferencing, internet and other state-of the-art technology, the Institute's Distance Learning Centre (DLC) facilitates access to a wide range of communication and learning opportunities. The DLC forms part of the World Bank's Global Development Learning Network.

As a result of its entrepreneurial efforts, 65% of the UNESCO-IHE budget is generated from contracted activities, while 35% is a core subsidy from the Dutch government.

THE INSTITUTE

UNESCO-IHE is the largest postgraduate water education facility in the world and the only institution in the UN system authorised to confer accredited MSc degrees and promote PhDs. In 2003 UNESCO and the Government of the Netherlands transitioned IHE Delft into the UNESCO-IHE Institute for Water Education.

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. The mission of UNESCOIHE 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.

Since 1957 the Institute has provided postgraduate education to more than 13,400 water professionals from 162 (developing) countries. More than 50 PhD candidates have been promoted from the Institute, and numerous research and capacity building projects have been carried out throughout the world. Alumni reach senior positions in their home countries and become nationally and internationally recognised experts in their fields of speciality. Many have made significant contributions to the development of the water and environmental sectors. UNESCO-IHE alumni have access to and remain part of a global network, consisting of alumni, guest lecturers, experts and renowned centres of knowledge, together providing a vast source of expertise to draw upon.

UNESCO-IHE centres its education, research and capacity building programmes around five themes: Water Security, Environmental Integrity, Urbanisation, Water Management and Governance, and Information and Communication Systems. Through each of these themes, the Institute focuses its contributions on resolving the major issues and challenges faced by many developing countries, as stated in the Millennium Development Goals and as identified by – among others – the UN Millennium Summit, the World Water Forums, the World Summit on Sustainable Development, and the Commission on Sustainable Development.

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