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IAHR AIRH

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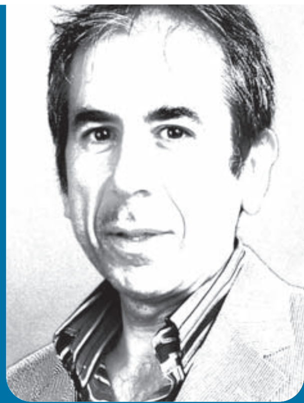
A NEW YEAR, A NEW HYDROLINK

EDITORIAL BY MICHELE MOSSA



Prof. Michele Mossa
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Editor of Hydrolink
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At the IAHR meetings which I have had the opportunity to attend, I have always underlined that the present and future challenges of our association consist in taking into account all the changes in the scientific, engineering and technological communities. In fact we must propose activities in a background that, whether we like it or not, sees us as part of a globalized world. Therefore, in this context, the activities of IAHR require prompt replies to new pressing and fascinating challenges.
Hydrolink is listed in the Web of Science and is the membership magazine of IAHR, with a circulation of about 2500 water scientists and engineers. Starting with Issue 2 in 2010, Hydrolink became a new magazine, a sort of completion of the renewal policy of the entire association, which was also highlighted with its name change.
In order to reach the aforementioned goals, we started with new editorial guides such as 1) the presence of a topical article to which the issue of Hydrolink is mainly devoted, 2) the typical article “10 questions to…” where we ask some famous researchers or engineers to reply to 10 questions regarding his/her research topics, development and results and their possible valuable effects on the industry, economy and society and 3) some stylistic changes in the format of the pages.
However, in my first editorial I pointed to other possible innovations. In fact, from now on Hydrolink will be published quarterly, but the number of pages will be increased. This will enable us to have more time to prepare articles. Furthermore, the reader will receive an issue with a closer examination of the featured topic, with more than one or two articles devoted to the subject.
I am also glad to inform the reader that, thanks to the help of Estibaliz Serrano, in the near future the publication will see further innovations. In particular, Hydrolink will have its own part under the e-library section of the IAHR website, currently under development. It will also be shown on the homepage, with a link to the inside pages. It will be possible to download past issues from our on-line store currently under development, whereas for the more recent ones we will try to give some “tags” so they can be easily found. From this issue onwards the cover and a table of contents will be provided and the issues will be deconstructed in separate PDF files of each article; in this way the reader will be able to search and download separate articles (not the full PDF issue). Furthermore, the full PDFs will be shown on the page so that people will be able to print them.
We are also planning to develop an RSS system (web feed), in order to keep our readers up to date with new articles.
As is well known, RSS is a family of web feed formats used to publish frequently updated works, such as editorials, articles, interviews, audio and video in a standardized format. The system allows the information to be published once and viewed by many different programs. RSS benefits readers who want to subscribe to timely updates from favorite websites or to aggregate feeds from many sites into one place. In particular, the IAHR Hydrolink RSS system will contain news and information useful for the writers and the readers of the magazine.
We are considering to use new techonologies as the QR System. This is a two-dimensional matrix barcode consisting of black modules arranged in a square pattern on a white background. Users with a camera phone equipped with the correct reader application can scan the image of the QR code to display text, contact information, connect to a wireless network, or open a web page in the telephone's browser.
I would like to conclude this editorial by underlining that this issue is mainly devoted to Global Water Security, a subject of growing international concern and which is introduced in Roger Falconer’s article. We examine how water security affects other areas, such as agriculture and food production and industry, and we hear from important organizations with a key interest in the subject, such as the Global Water Partnership and the World Bank. Another aspect to be in consideration is Desalination and Water-Reuse.
This issue also contains several conference reports including the IAHR Kuwait Summit on Advances on Oil Spill Modelling, the first activity of the new IAHR Oil Spill Modelling Working Group of the Kuwait Summit on Advances on Oil Spill Modelling, the first activity of the IAHR Oil Spill Modelling Working Group, which took place in November. Oil spills are a major source of pollution, rendering the water inadequate for consumption and creating difficulties for desalination; spills affect the biota, which in turn can affect vegetation and shoreline stability, thereby affecting sediment erosion.

This shows how IAHR is moving ahead facing the global challenges.

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GLOBAL WATER SECURITY: AN INTRODUCTION AND OPPORTUNITIES FOR IAHR

BY ROGER A. FALCONER, IAHR PRESIDENT

Roger Falconer **is Halcrow Professor of Water Management in the School of Engineering at Cardiff University and President of IAHR. He is currently Chair of the Civil and Construction Engineering Sub-Panel for the 2014 UK Research Excellence Framework Assessment and is a Member of the Institution of Civil Engineers State of the Nation Panel for Water. He is a Fellow of the Royal Academy of Engineering and was a member of the Steering Group for their Report on Global Water Security.**

More information regarding Global Water Issues: https://sites.google.com/site/globalwatersecurity/

Introduction

In recent years there has been considerable growing international concern about the increasing crisis in global water security (see Figure 1), with security here referring to the supply of adequate water of sufficient quality for drinking, food production, ecosystem services etc. As an example of such a concern, in April 2010 the UK Royal Academy of Engineering published a report entitled Global Water Security – An Engineering Perspective [1]. This report was produced by three learned societies, through a Steering Group of 12 specialists working in the field. The Steering Group took evidence (in hearing and written) from a wide range of UK and international experts covering all aspects of water security. The report was commissioned by the Government's Chief Scientific Advisor, with the main drivers being concerns from various sources from within government, the professions and learned societies etc., about the increasing challenges arising relating to global water security and the implications for Britain, both within the UK and internationally. Some of these challenges, threats and opportunities are introduced below. There are approximately 1.2 billion people living on this earth today with no access to safe drinking water and it is estimated that 2 million people die annually of diarrhoea - still one of the biggest causes of infant mortality. I tell my first year students that it is water engineers that hold the key to reducing significantly this sad statistic, rather than the medical profession.

Other statistics reveal that there are 2.4 billion people who do not have basic water sanitation and up to 1 million die annually of hepatitis A. Women in developing countries have to walk typically 6 km daily to carry water for the family; again water engineers can make a huge contribution to the quality of life for these women. Floods often cause significant loss of life and destroy homes, with the August 2010 Pakistan floods leading to 20 million people being left homeless. However, the disease associated with the after effects of such floods can often bring far more loss of life to communities and countries than the floods themselves. It is reported that at any given time, half of the world's hospital beds are occupied by patients

There are approximately 1.2 billion people living on this earth today with no access to safe drinking water

Figure 1. Some recent publications on the topic of Global Water Security

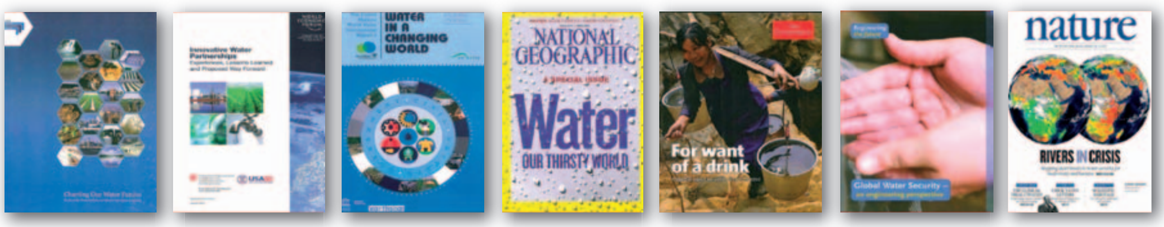
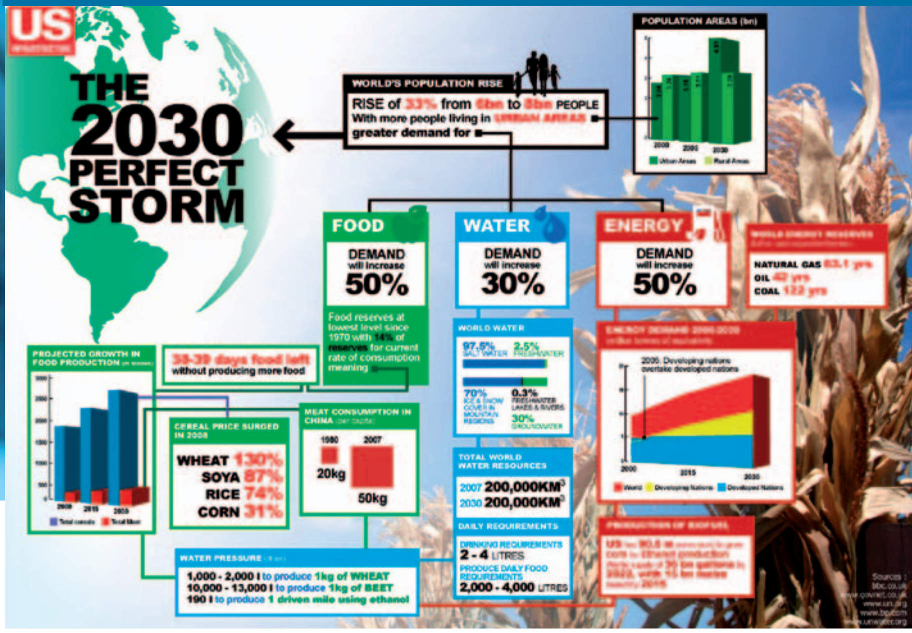


Figure 2: 'Perfect Storm' from a lecture by Professor Sir John Beddington



suffering from diseases associated with lack of access to safe drinking water, inadequate sanitation and poor hygiene. It is also worth noting that 70% of the world's fresh water supply is devoted to agriculture and over 50% of all water projects fail in the first few years after implementation. For further statistics see [2].

The challenges of water security are therefore considerable and are going to affect almost every nation on earth in one form or another – if not already, then certainly in the future.

Along with these challenges there are two further issues that are exacerbating the current threats to global water security. Firstly, there is climate change, where average global temperatures are expected to rise by at least 2˚C by the end of this century. If the temperature increases between 2 and 5˚C there will be major water resources problems globally, as well as significant sea level rise, causing catastrophic coastal flooding in many parts of the world, such as Bangladesh. Secondly, we are encountering 'the Perfect Storm' (as illustrated in Figure 2 from a lecture by Professor Sir John Beddington, UK Government Chief Scientific Advisor), in the form of global population growth by 2030 from currently 6.5 to 8 billion. Associated with this population growth we can expect the demand for food, energy and water to increase by 50%, 50% and 30% respectively. The water ⇨food⇨energy nexus is crucial to our existence, with water being at the heart of everything; it is crucial for our energy supply, food, health, industry, trade etc. If we look at the water stress globally (defined as millions of litres of water available per person per year) from 1960 to 2010, we find that even in the southeast of England water supply is currently particularly stressed. If we predict forward to the end of the century we see that even for a country like the UK, where it is perceived to be always raining, we will be facing water security problems across much of the country by the end of this century.

Problems in water supply will relate not only to the 50% increase in human population over the next 30 years; but urbanisation is occurring over much of the world and is tending to exacerbate this effect. In countries such as China, for example, people are moving into the major cities while in the UK people are moving more and more to the southeast of England; neither of these trends are sustainable in the long term.

Food production is also rising, along with industrial production, and new energy sources will be required to support this industrial production and feed the population growth. As countries become richer they will change their diets, as typified for example by the big increase in changing meat consumption in rapidly developing economies. If we now look at the consequences of changing diets and food consumption etc. in the context of embedded or virtual water, the global implications are considerable.

To produce 1kg of wheat requires 1,300 litres of water, whereas in contrast to produce 1 kg of beef requires typically 15,000 litres of water [3], i.e. over 10 times as much water. Looking at other commodities, it takes 140 litres of embedded water, nearly a bath full (150 litres), to produce one cup of coffee, and that water is used in another country - such as Brazil - when the coffee is drunk in Europe. One pair of cotton jeans requires 73 baths full of embedded water (see Figure 3), which are attributable mainly to the cotton production, and that water is likely to be used in countries such as Egypt, where there are already serious water shortages. The embedded water footprint of the 25 European Union countries bears most heavily on India and Pakistan, which are the primary sources of cotton supply to the EU. The drying up of the Aral Sea is one example which can be partly attributed to cotton production, though this is not the only cause of the drying up of this water body. The point to appreciate, however, is that the demand for embedded water products in one country can have very serious impacts elsewhere in the world, such as Egypt, for example.

Potential Solutions

Desalination is one possible solution in large coastal cities, but this process is still relatively expensive and imposes a large carbon footprint, through large energy demands. Research studies being undertaken within our Hydro-environmental Research Centre at Cardiff University have found that salinity levels along the Arabian coast of the Persian Gulf are increasing slowly, potentially due to the rapid growth in desalination plants and this must have long term impacts for the hydro-ecology of this highly stressed water body. However, Dr Paul Simon, a former member of the US Senate, writes in his book 'Tapped Out' that: "If we spent 5 percent as much each year on desalination research as we spend on weapons research, in a short time we could enrich the lives of all humanity far beyond anything anyone

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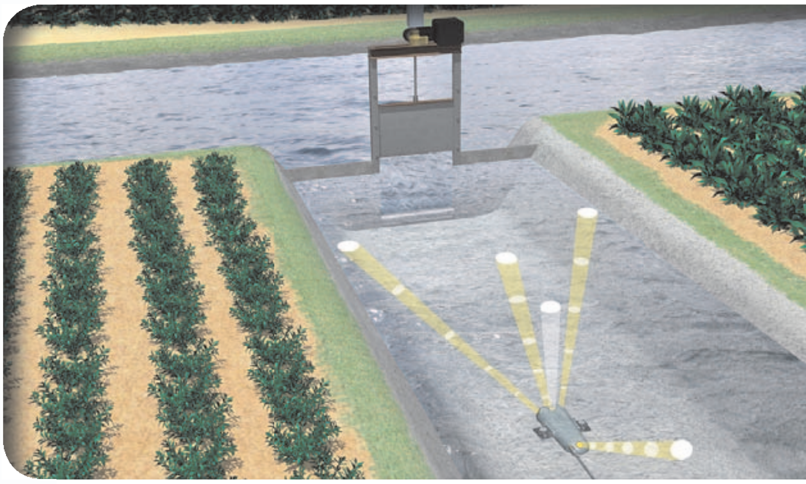
a: term used to express the superior intelligence in an acoustic Doppler measurement device;
b: a score on a standardized intelligence test determined by extraordinary data collection capabilities relative to the average performance of other flow meters.



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has conceived".

Conservation and water re-use is often a short term solution to a longer term problem. Storage involves water transfer and better integrated water management, with a much more holistic approach to river basin management being required than used hitherto. To increase global water security, improved water quality in river basins and coastal waters is required, along with a reduction in global water pollution. Many of our rivers today have very poor water quality

> **To increase global water security, improved water quality in river basins and coastal waters is required, along with a reduction in global water pollution**

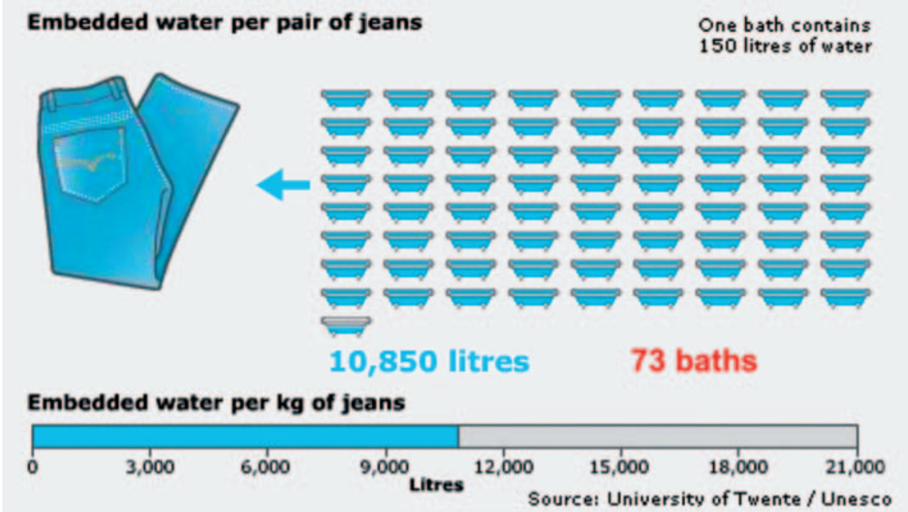
with 'the ancient Romans (having) better water quality than half the people alive now' [2]. It also goes without saying that global population growth needs controlling. Integrated water management requires a Cloud to Coast approach that treats the water cycle as an integrated system, bringing together the professionals who currently specialise in modelling various components of the system, including: hydraulic engineers, hydrologists, biologists etc. and with the distribution from the cloud to the coast, through the catchment, groundwater, sewers, rivers, estuaries, needing to be treated as one.

Actions

In addressing some of these challenges global actions are needed; in particular, we need the water footprint and the concept of embedded or virtual water to be better understood and more widely promoted. Better technologies and further research are needed for more efficient agriculture. New sustainable sources of water are needed from desalination, recycling and water harvesting. Inter-governmental bodies, such as the World Trade Organisation, must elevate issues of water security further up their agenda. The public must become more engaged in the challenges we all face with regard to water security; this is a global problem which affects every nation.

Turning to the value of water, this poses the question: Is water a human right or is it an economic good? Economic theory informs us that it is easier to encourage funding if the true economic value of water is realised. Without it we get a price-cost differential and long-term sustainability becomes unlikely. However, to what extent is water a human right and, if so, whose responsibility is it to deliver it and meet the costs? True water pricing and trading is rare, but Australia and Chile have introduced it in their water scarce regions and they maintain that it has resulted in lower water consumption and significant increases in agricultural productivity. In the UK the average cost of water per cubic metre is £3 (≈$5), paid to the private water companies. This provides the consumer with approximately 1 week of water for drinking, washing, cooking, toilet flushing, car washing and in some places garden watering. This is not expensive in comparison with what else one could buy in the street for $5, including: a sandwich, two litres of bottled water, a Starbucks coffee, a glass of beer, etc. These comparisons place the price of water into context and one must question whether the cost of water is really so expensive that the price could not be raised in countries such as the UK? If we continue to undervalue this precious resource we will not be able to face some of the challenges that our world faces in the future [4].

Figure 3: Concept of embedded or virtual water, where production of a pair of jeans requires 73 baths of water



IAHR Opportunities

In taking up some of the challenges and actions highlighted above, IAHR has already set up a task force to promote Global Water Security and has set up a website as a repository for reports, lecture notes and papers etc. on this topic. Other actions that can be taken by IAHR could include the following:

- Establish links with engineering academies and other learned societies in key countries to collaborate to raise the profile of the water footprint.
- Develop links between the IAHR Divisions and key aspects of Global Water Security where IAHR has strengths, such as: desalination, turbulence, flooding, river hydraulics, groundwater, etc.
- Use Global Water security as a platform to develop closer ties with other kindred international water organisations, such as IAHS, IWRA, EWRI, IWA etc.
- Develop links with NGOs, and offer technical support to such organisations through our Technical Divisions, such as: WWF, FoE, Oxfam, UNICEF, Global Water Partnership.

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10 QUESTIONS TO...

INTERVIEWED BY ESTIBALIZ SERRANO,
IAHR PUBLICATIONS MANAGER

Ania Grobicki, Global Water Partnership Executive Secretary

Dr. Ania Grobicki has spent most of her working life on water-related issues. She has held positions in the private sector as well as with NGOs and the UN.
Dr. Grobicki was a Coordinator for the African National Congress's Science and Technology Group, a Coordinator for the CGIAR's Challenge Program for Water and Food, and Head of Secretariat for a multi-stakeholder forum on strengthening research for health, development and equity.
Dr. Grobicki has a PhD in Biotechnology from Imperial College, London.
She became GWP Executive Secretary in March 2009.

MORE INFORMATION: WWW.GWP.ORG

1. What is the Global Water Partnership?

The Global Water Partnership GWP) is a global action network, with nearly 2,600 Partner organizations world-wide (including IAHR), many of whom are bigger than ourselves! We stress the importance of working in partnership – the "art of partnership" if you like – in order to tackle complex issues and sensitive, often political questions relating to managing water better at all levels. Our vision is for a water secure world. Our mission is to support the sustainable development and management of water resources at all levels.

Having started up in 1996 as a network, GWP is also now established (since 2002) as an intergovernmental organization - a voice speaking for water at the international level, for instance in the climate change negotiations. Worldwide, GWP works with 13 Regional Water Partnerships and 80 Country Water Partnerships which have been formally accredited to use the GWP name. The global Secretariat is based in Stockholm, working closely with the 13 Regional Secretariats.

2. GWP stresses the importance of "Integrated Water Resources Management" – what does this mean for hydro-environment engineering and research?

Integrated approaches to wicked water problems have long been recognized as the best way forward – witness the evolution from hydraulics research and hydrological research to hydro-environmental research and eco-hydrology. I myself travelled a long road from being a chemical engineer working on effluent treatment problems, to understanding the sources and causes of water pollution from an integrated catchment management perspective. At a social level, the issue with water is that the toughest problems can never be solved by water managers alone. Another example – the optimal solution for flooding needs to be found through a variety of stakeholders working together to agree a way forward in a specific situation, as in Bangkok. I would argue that this is what IWRM means for hydro-environment engineers and researchers: being prepared to take social and economic as well as environmental factors on board, when looking to design optimal solutions.

3. What are the challenges for GWP in the future?

The challenges are many. As water has now been listed as one of the top global risks by the Global Risks Report 2012, we are also seeing a step change in the level of activity by many organizations in the key risk areas, from the increasing water scarcity issues, to the extreme water-related climatic events, namely floods and drought. As an organization supporting our Partners to respond effectively to the issues, the big challenges for us are to enable knowledge flow and knowledge exchange as effectively as possible, using cutting-edge networking technologies as well as continuing to link people in a dynamic way. For instance, an essential part of sound policy response by governments is to be firmly science-based and evidence-based. As water moves higher on the political agenda, GWP needs to be able to offer policy options and policy support based upon the best practices, and to contextualise this in a given country through working with top local and national experts.

4. What kinds of initiative does GWP support, and as a "GWP Consulting Partner" how can IAHR members participate?

If your organization joins as a Partner, and you are the main contact person, you can participate in GWP events and be drawn into contributing to the work. There are currently 54 universities and research institutes which are GWP Partners, and we would welcome many more. The GWP ToolBox is an online repository of IWRM tools and policies, and this needs constant updating. Much of GWP´s work is done on a voluntary basis, or Partner organizations contribute the time and effort of their staff to a particular project or event. Partners also raise funds both locally and internationally, working with the GWP name. At the same time, there are also GWP projects and programmes (such as the Water, Climate and Development Programme) where people producing reports and products are contracted to do so. We would welcome IAHR members to get involved

5. The term "Global Water Security" is becoming fashionable – what does it mean to you, and what role can the IAHR engineering community play?

GWP´s vision is for a water secure world – we don´t see this as a fashion, we see it as the basis for human civilization! The various dimensions of water security are important – at the level of the household, for drinking water supply; at the level of community resilience to water-related disasters; or at the level of the city, the river basin, the national economy (ensuring that agriculture, industry, and the energy sector are water secure). Taking water security at each of these levels brings different variables into play.

A great deal more information, data and analysis is required at all of these levels, in many countries. We simply lack important information on global water security. The engineering community has a great role to play in assisting in formulating relevant indicators, and ensuring that the right data and analytical approaches are available.

6. What is the main event related to water that you have been impressed by?

The water-related event that has left the greatest impression on me was the great flood in Bangladesh in 1988. I was working on a project in Dhaka at the time and my departure back to my job in London was delayed by two weeks, as the airport was flooded and no flights were leaving. Our project site on the outskirts of Dhaka, which was on higher ground, filled up with refugees from the flood and there were displaced families camping everywhere. I had to move from the guesthouse where I was staying to one on higher ground. Throughout it all, my Bangladeshi hosts were incredibly gracious, hospitable and helpful, really concerned about my welfare, while their own houses and possessions were being threatened by the flood. I have never forgotten the experience and the memory has kept me focused on people´s water security issues and risks, and floods in particular!

7. What are the responsibilities of the "First World" to Global Water Security?

Get involved! I think our world is now sufficiently globalized and is changing fast enough that we can get away from the artificial barriers set up by the terms "First World" and "Third World". Everyone has a part to play in contributing to global knowledge on water security.

8. How important is technical innovation in delivering Water Security?

Innovation is the key – we need to think our way out of the global water "crisis". It has been shown (by Shiklomanov) that Europe, for instance, has successfully delinked water consumption from economic growth. In other words, the economies continue to grow (intermittently!) while water consumption has actually decreased slightly. Asia is at the point where water consumption is slowing considerably, when compared to economic growth. Technical innovation is what will get us out of the "limits to growth" mindset, to realise that yes, freshwater is a scarce and vulnerable resource, but we can build water security through doing things differently, in particular through intensifying recycling and reuse.

9. Do you think the public (and hence politicians) is sufficiently well aware of the importance of scientific research in solving water problems?

In general I would say the level of awareness is still too low. Stressing the importance of the interface between science and policy-making is vital. Better decisions have to be based upon the best available knowledge. We need good science, we need innovative technical solutions, that will support new approaches to solving the water issues of our time, and reducing the level of risk associated with water insecurity. Whether it is better flood protection or stretching every scarce drop of water to be more productive within agriculture, good science is essential and needs to be promoted. The media have an important role to play here.

10. What are the areas of hydraulic and hydro-environment research which would most benefit water security, and how should communities like IAHR influence investment in this research?

You need the right kinds of institutions to be able to do that, or where these ideal institutions do not exist, you need to start working with partner organizations such as GWP to create the right kind of space, as well as the right kinds of decision support systems, for optimal decision-making. For integrated approaches to work, as in a flood management situation, you need multi-criteria analysis and I believe that a great deal more can be done to support good decision support systems. It´s essential to link in a proper economic analysis, and assess the technical, social and economic benefits of what is now called "natural infrastructure", eg. wetlands and natural geomorphology, alongside technical solutions being proposed. This kind of research would be useful for building water security in many contexts, and as the awareness of water risks rises, there will be certainly more investment in this kind of research. GWP can help to build the linkages and partnerships to make this happen – water security is our common vision.

Article first published in A² (Arup's business magazine). Reprinted with kind permission

BANKING ON WATER

BY JULIA BUCKNALL

World Bank expert Julia Bucknall talks to A² about the organisation's wide ranging investment in water projects.

The vital role that water plays in driving development and growth is reflected in the World Bank's investments. "Simply put, we invest in everything wet," says Julia Bucknall, who manages the bank's central unit for water, known as the Water Anchor. "Our investments cover water resources, irrigation, hydropower, water supply and sanitation."

Written in stone at the World Bank headquarters building are the words 'our dream is a world free of poverty' and investing in water plays an important part in that dream. The bank lends to water projects that otherwise wouldn't get funding. And by investing in these projects, it can tackle wider problems such as health, food security and climate change.

"More children die of diarrhoea than of AIDS, malaria and tuberculosis combined," says Bucknall. "So basic sanitation, combined with hand-washing, is one of the most cost-effective interventions available to improve health. It also has an impact on education, because children with diarrhoea can't attend school."

Bucknall points out that investing in water can tackle one of the biggest constraints to development in poorer countries: power generation. "With an increasing focus on clean energy, hydropower makes wind and solar renewables more attractive because it provides a flexible source of power that can be switched on quickly if the sun goes in or the wind stops blowing."

All this needs a joined-up approach, Bucknall stresses. "Managing water resources ties everything together," she says. "Because if you've allocated more water than you've got available, those investments won't work. If the quality of the water is too poor to use, they won't work. And if you've developed irrigation based on groundwater that's going to run out, they won't work either."

How does the World Bank realise the development benefits to be gained from investing in water? Bucknall points out that although many of the world's problems don't have easy answers, we do know what to do about issues like basic sanitation and water provision – we just need to get on and do it. For this reason, much of the World Bank's efforts focus on moving water issues up the political agenda. Bucknall highlights one example of how the bank approaches this challenge. "A year ago, the donors who finance 80% of aid investment in water and sanitation met with the finance ministers from the 17 countries who are not meeting their Millennium Development goals in these areas. Together, we worked out ways they could accelerate their progress."

8 Millennium Development Goals

Julia Bucknall **is currently the Manager of the Bank's central unit for Water. She has also worked as a Lead Natural Resources Specialist for the World Bank's Middle East and North Africa region. She was the lead author of a flagship publication on water in the region, "Making the Most of Scarcity". Over the past fifteen years, she has worked on water investment projects and analytical work in North Africa, Central Asia, Central Europe, Cambodia and Central America. She has studied at Cambridge University and MIT, where she earned a Master in Environmental Policy and Planning.**

For individual projects, the bank often carries out political economy analysis. "We look at who will benefit and who will lose out," explains Bucknall. "Often issues are polarised and the voice of some minority groups representing legitimate concerns can be lost in the polarisation. We believe that sustainable solutions consider all views and seek to enhance the environment, society and the economy, and where negative issues are an inevitable consequence, mitigate against them."

The water issues the bank tackles differ around the world – and Bucknall points to irrigation as an example. "In Africa, irrigation is often under-exploited and new systems are needed. But in other areas, existing irrigation needs rehabilitation and modernisation. For example, irrigation systems in many former Soviet countries have suffered from years of under-investment."

Ensuring these investments deliver results is no easy task – Bucknall points out that, by definition, the World Bank invests in the things that nobody else wants to invest in. But the organisation is enjoying strong results, with water projects outperforming its other investments.

Building on this theme, Arup was appointed to develop, in conjunction with financial specialists across the globe, a risk assessment framework to support the management of water scarcity related risk associated with the agribusiness and power sectors.

The commission encompassed:

- Sector review of characteristics of water consumption and trends;
- Geographic review of the state of the water environment, and identification of key local water challenges.
- Identification of local current water use profiles in the regions examined.
- Identification of case studies demonstrating best practice in water management.
- Development of a performance framework to assist in understanding water scarcity risk.

Promoting sanitation in rural Benin In Benin, in West Africa, the World Bank invested in an innovative rural sanitation promotion programme championed by the country's Ministry of Health. Launched in 2005, the programme shows people how to:

- **build a sanitary latrine;**
- **transport, store and use improved drinking water safely;**
- **maintain good domestic hygiene; and**
- **wash their hands with soap at key times.**

Within the first one-and-a-half years, the programme has seen sanitation coverage improve by 10 percentage points (from a baseline of 6.2%) across 80,000 monitored households. One in ten households in enrolled communities have built improved latrines. And a further 2 to 3 out of every ten households are either planning improved latrines or in the process of building them.

The reports, referred to as the "Chief Liquidity Series", inform risk analysts, portfolio managers and sustainability experts about financial risks and emerging opportunities associated with water challenges across a range of particularly exposed sectors and hydrologically diverse geographies. Two reports were issued; the first focussed on agribusiness, and the second examined the power generation sector, focussing specifically on thermal and hydropower.

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BUSINESS AND INDUSTRIAL WATER SECURITY

BY ANGELOS N. FINDIKAKIS

Water-related Risks

Water security can be generally defined as the assurance of uninterrupted water supply in sufficient quantity and adequate quality to meet the domestic water needs of a country or a sub-national unit, and support the water-dependant economic activities that are essential for the welfare of its people. For business and the industry water security means the aversion of water related risks that may cause operation disruptions and result in economic losses either due to damages caused by flooding, or due to water shortages. Water shortages are often related to local water scarcity, but they can also result from damage to the water infrastructure by extreme natural events, accidents, or malicious acts such as sabotage or terrorism. The availability of the water supply may also be affected by administrative and regulatory changes concerning water allocation and use. Finally, efforts by a business to secure water rights or the use water management practices that are in conflict with the interests of local communities carry the risk of reputational damage.

Traditionally the risk of flooding of industrial facilities is addressed in their design which aims at ensuring that they are safe during extreme events corresponding to the highest level of acceptable risk. Failure to properly design water supply systems that can continue operating during and after extreme events can have catastrophic consequences, such as the loss of the cooling water supply at the Fukushima nuclear station after the March 11, 2011 earthquake and tsunami.

Many companies assess and report key water use and discharge data in the context of their efforts to adhere to the principles of sustainable development. The Global Reporting Initiative (GRI), a network of business, civil society, academic and other organizations, has developed sustainability reporting guidelines, that include key water parameters such as the total water withdrawal by source, water sources significantly affected by water withdrawal, the percentage and total volume of water recycled and reused, total water discharges by quality and destination, and characterization of water bodies and habitats affected by discharges of water and runoff from the reporting organization. However, this standard reporting does not include the assessment of water-related risks. In 2011 the CDP Water Disclosure project conducted a survey of 316 among the world's 500 largest companies in the FTSE Global Equity Index Series. The survey showed that 59 percent of the 190 companies that responded reported exposure to water-related risks.

A high-level initiative of the global business community was launched by the World Economic Forum (WEF) when in 2008 it declared water as a strategic issue for business. The 2011 meeting of the WEF in Davos focused specifically on water security. The discussions and conclusions of this meeting are summarized in a concise volume, which discusses water security in the context of the water-food-

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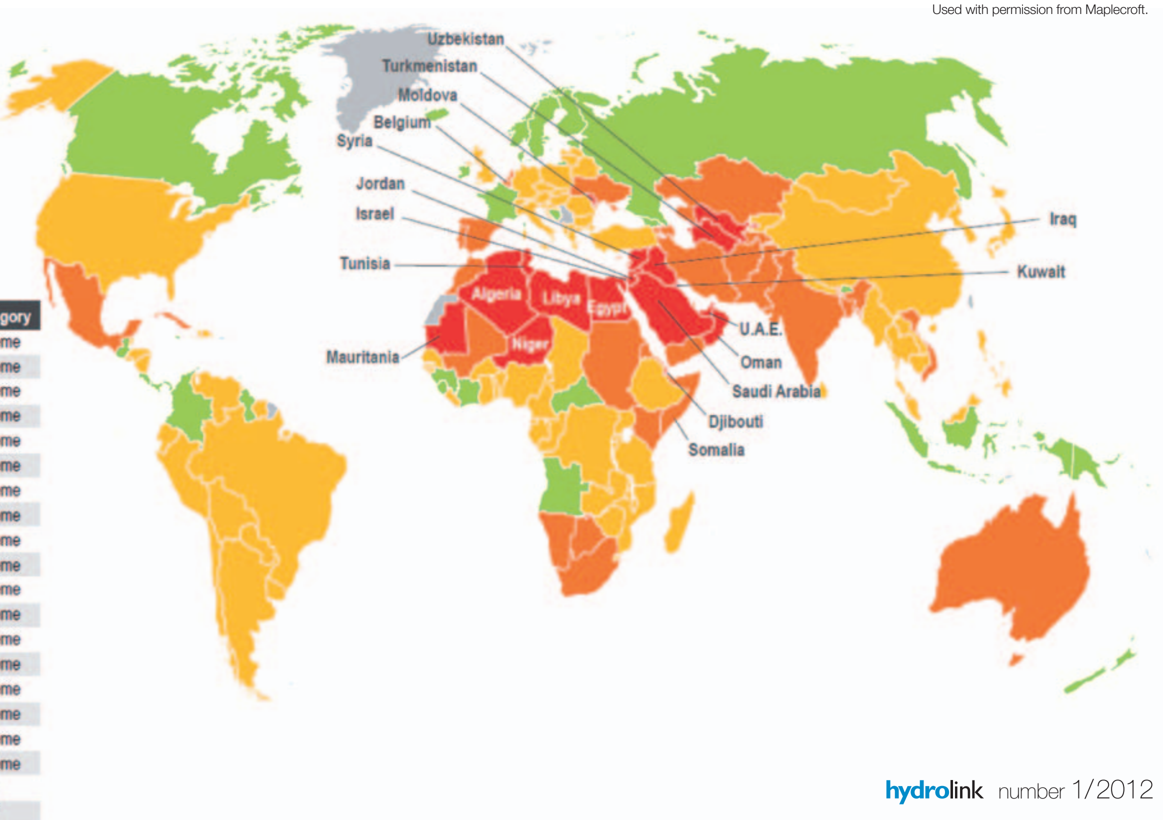
Figure 1. The Maplecroft Water Security Risk index expressing the level of water related risks in different countries around the world [2].

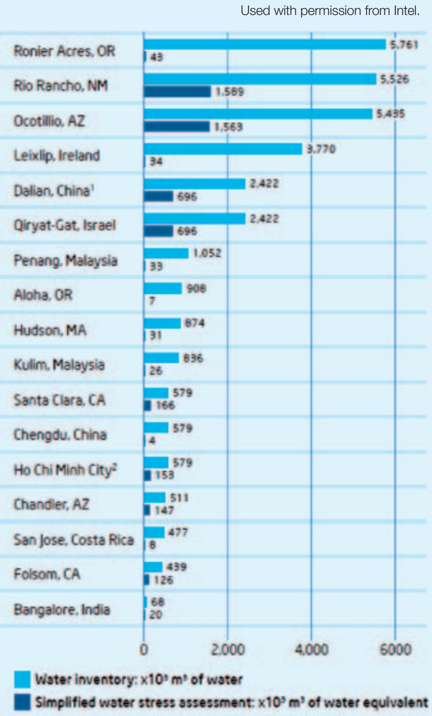
Used with permission from Maplecroft.



Rank	Country	Category
1	Mauritania	extreme
2	Kuwait	extreme
3	Jordan	extreme
4	Egypt	extreme
5	Israel	extreme
6	Niger	extreme
7	Iraq	extreme
8	Oman	extreme
9	U.A.E.	extreme
10	Syria	extreme
11	Saudi Arabia	extreme
12	Uzbekistan	extreme
13	Moldova	extreme
14	Libya	extreme
15	Turkmenistan	extreme
16	Djibouti	extreme
17	Tunisia	extreme
18	Algeria	extreme
19	Belgium	high
20	Somalia	high

Figure 2. Comparison of water inventory and water stress assessment of different facilities of Intel Corporation at various locations [3].

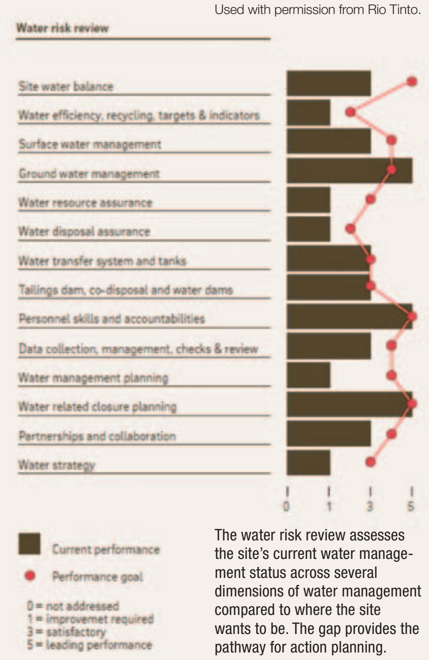
Used with permission from Intel.



The top bar shows total cubic meters of water used at each site in 2010. The bottom bar shows an "equivalent of water" figure adjusted for the water stress of the location using qualitative factors. This analysis confirms that we should prioritize our efforts and investments at our top four arid locations: New Mexico, Arizona, Israel, and China

Figure 3. Illustrative example of Rio Tinto's water risk review along different dimensions of water management [4].

Used with permission from Rio Tinto.



The water risk review assesses the site's current water management status across several dimensions of water management compared to where the site wants to be. The gap provides the pathway for action planning.

energy-climate nexus [1]. Another related high-level initiative is the UN CEO Water Mandate, launched in 2007 and designed to assist companies around the world develop, implement and disclose water sustainability policies and practices. Companies joining this initiative pledge to conduct comprehensive water-use assessments, set water conservation and waste-water treatment targets, seek to invest in and use new technologies to achieve these goals, raise awareness of water sustainability within their corporate culture, and include water sustainability considerations in business decision making.

Indicators, Tools and Methodologies

Well defined quantitative indicators, or metrics, can be used to assess progress towards water security. One of the most widely used such indicators is the water footprint, which, when applied to business, consists of two components, the operational water footprint, the freshwater volume directly used by the business, and the supply chain water footprint, the volume of freshwater used to produce the materials and external services that are inputs to the production process of the business. The Water Footprint Network, established in 2008 to coordinate efforts to further develop and disseminate knowledge on water footprint concepts, methods and tools, has prepared a global water footprint standard. In assessing water-related risks it is important to distinguish between the green, blue and grey components of the operational and supply chain water footprint. The green component of the water footprint refers to the amount of water embedded in products of rainfed agriculture. The blue component measures the use of surface water from rivers, lakes or reservoirs and groundwater. The grey water footprint component is a measure of the water pollution caused in the production process. It is estimated as the volume of water required to dilute the effluents from the production of a product to bring the receiving water body to acceptable water quality standard levels. To improve the water security of a business it is necessary to minimize the blue and grey components of its water footprint

An example of combining different indicators into an overall water security index can be found in the work of the consulting firm Maplecroft that is aimed at helping businesses and investors assess the risk of potential future disruptions to their operations associated with their water supply in different countries. Maplecroft's index is based on the key factors affecting water security including water stress, rate of population growth, dependence on water supplies originated or controlled outside the country, sustainability of water use, intensity of water use in the economy, government effectiveness and virtual water use. Figure 1 shows the result of this assessment highlighting the countries with the highest level of water-related risks. To assess water related risks in large countries with diverse geographic, demographic and water availability conditions, such as for example the United States and China, the water security assessment must be made at a regional or local scale to account for internal differences in the parameters that compose such an index.

The importance of accounting for local conditions is illustrated in an example of water use data reported by the semiconductor manufacturer Intel. Besides direct water use at different facilities, Intel also reported an adjusted equivalent water use, estimated by combining actual use with a regional water stress index at the location of each facility. This equivalent water use is a better indicator that can be used to rank different facilities based on their water security vulnerability. Figure 2, which shows these data, suggests that the ranking of various facilities based on actual and adjusted equivalent water use can be quite different. Facilities with high actual water use in places such as Oregon and Ireland where there is not much water stress, come fairly low in a ranking based on equivalent water use, while, operations in water stressed places like New Mexico, Arizona and Israel rank very high, even if their total actual use is lower.

Several tools and methods for assessing water related risks have been developed in the last few years.

Several tools and methods for assessing water related risks have been developed in the last few years. For example, the Global Environmental Management Initiative, a non-profit organization of several major companies focusing on environmental, health and safety issues, produced the Water Sustainability Tool designed to help individual companies build a business water strategy, and the Water Sustainability Planner designed to help convert corporate sustainability strategy to site or unit strategies for water and understand water use impacts and associated risks. The World Business Council for Sustainable Development developed the Global Water Tool to help companies and organizations map their water use and assess risks relative to their global operations and supply chains. The life cycle assessment methodology, which measures the environmental impacts of individual products from cradle to grave, has also been applied to water use. Goldman Sachs, General Electric and the World Resources Institute are also working to develop a Water Index to measure water-related risks and opportunities for companies and their investors, starting with a pilot project focusing on the thermal power industry in the Yellow River basin in China.

Examples of Industrial Actions to Improve Water security

Many industries are working to improve their water security by analyzing water-related risks and vulnerabilities, redesigning some processes to use water more efficiently, minimizing losses through leaks or evaporation, increasing water reuse and resorting to alternative supply sources.

For example, Rio Tinto, the second largest mining company in the world, has developed a water-risk review methodology that it uses to evaluate its sites across several dimensions of water management and to assess progress towards set goals. Figure 3 shows an illustrative example of Rio Tinto's comparison of actual performance with set goals in their water risk review. In Chile the copper mining industry is working to develop thickening techniques that increase concentrations of solids, therefore lowering water requirements in different steps of ore processing and tailings management. At the same time it is increasing water recycling in its processing operations and exploring the use of sea water for processing where feasible.

The power industry is moving away from once-through, or open-loop, cooling systems that use large volumes of water, and is building most new thermal powerplants with recirculation, or closed-loop, cooling systems that use much less water. Even though the consumptive use of once-through cooling systems is of the order of one percent of the withdrawn water, or less, water availability or environmental constraints on discharge water temperatures may disrupt or limit power generation during periods of drought. In addition the industry is adopting air cooling and wet/dry hybrid cooling systems. These systems are particularly attractive for concentrated solar electricity facilities, which are often located in places with limited water resources. Use of such systems can reduce water use by 80 to 90% at a relatively small penalty of increasing the electricity cost, of the order of 2 to 10% depending on the location of the plant and other factors.

The beverage industry, which is particularly sensitive about its image regarding water use sustainability, has undertaken different campaigns to publicize its progress on this subject. For example, Nestlé publishes a water management report presenting year-to-year data on specific indicators, such as the amount of freshwater used and the amount of waste-water generated per unit of product. PepsiCo recognizing water security as one among the top ten global risks to business has undertaken pilot studies in different watersheds where it has facilities aiming at using the lessons learned from these studies for the development of a strategy around corporate water risk management. Other beverage companies like Coca Cola, Molson Coors and SABMiller are also engaged in similar efforts.

Even industries that do not use much water are working to develop reliable statistics on water use and set targets to reduce it. For example, the Strategic Forum for Construction in the UK has developed an Action Plan to reduce water usage at construction sites and to develop tools and an auditing methodology for the systematic collection of relevant data on water use in construction.

In conclusion, awareness about business water security is on the rise. An increasingly larger number of businesses and industries assess their water-related risks and develop their policies and strategies to improve their water security. In the last few years, several indicators and methodologies have been developed to help businesses assess and improve their water security. As more attention is paid to water-related business risks, it is anticipated that researchers and practitioners will continue improving the tools for systematic quantitative assessments of progress towards minimizing these risks.

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DESALINATION AND WATER-REUSE: DEMAND FOR HYDRO-ENVIRONMENT ENGINEERING AND RESEARCH

BY TOBIAS BLENINGER

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With more than half of the world's population living close to the ocean, and having around 70% of the world's mega cities on their shores, seawater desalination is an attractive option for coastal water supply systems. And the trend is clear for the 21st century: worldwide water consumption is growing, driven by an increasing population combined with increasing industrial and agricultural production.

In arid zones and other water-scarce areas, this consumptive demand must indeed largely be met through desalination plants using a variety of technological processes, e.g. thermal distillation processes, such as multi-stage-flash or multi-effect-distillation plants (MSF, MED, Fig. 1 left), or membrane processes such as reverse osmosis plants (RO, Fig. 1 right). In 2005, the total world installed capacity for seawater desalination was about 27.8 Mill. m^3/d of which about 75% was situated in the Middle East and North Africa (MENA) regions. Some states completely depend on desalinated water, such as Kuwait, others to more than 50% of their domestic use, where other drinking water sources are close to depletion. To avert the real threat to resource sustainability and to satisfy the immediate need to increase the production and supply of potable water, desalination is a key focus for governments across the region, generating massive investment and creating demand for global expertise plus the latest advanced systems and technologies. In the period up to 2015, the countries of the MENA region are expected to spend US$24 billion in desalination costs (www.middleeastelectricity.com). Also

Hadera (Israel), world's largest RO desalination plant (275,000 m³/d, source: IDE Technologies) noteworthy are the increasing plant sizes for these large scale industrial size installations, such as the Al-Jubail (Saudi Arabia) MSF plant with 1.54 Mill. m³/d capacity.

But also outside the MENA region desalination is a growing market (12% yearly growth of installed capacity over the last five years (GWI, 2007)), where new desalination hot-spots in Australia, Southeast-Asia, Spain and California are emerging. Those developments are usually accompanied with water purification technologies, such as water-reuse (see Fig. 2). For example, the Spanish government informed that production has doubled in the last five years and predicts that it will double again in another five years (Technology Review, 2006). The US Bureau of Reclamation (2003) also states: “By 2020, desalination and water purification technologies will contribute significantly to ensuring a safe, sustainable, affordable, and adequate water supply for the United States”.

Desalination and Water Security

Despite great achievements in reducing the overall energy consumption, desalination plants remain an energy-intensive process. Since most of the energy is taken from fossil sources, the CO_2-emission from desalination plants is an important environmental problem. Another major concern is related to coastal water quality problems caused by brine discharges. The brine (or concentrate) is the waste stream produced by desalination plants and is usually discharged into the sea. The brine flow rates are large, generally up to 40 % (RO) and up to 90 % (thermal, including cooling water) of the intake flow rate, thus either almost as large or even considerably larger than the required drinking water flow rate. The brine is characterized by its high concentration of substances taken out of marine waters (i.e. salt). Furthermore, and often more critical, the brine contains additives and corrosion products, requiring post-treatment or outfall systems (www.brinedis.net.ms).

Unfortunately, major desalination and water-reuse projects, as well as other large water projects in coastal regions, such as marine outfall systems and wastewater treatment schemes are experiencing considerable delays in commissioning. For example, objections in Australia and the USA regarding environmental impacts have already become key issues for project permits, often considerably influencing plant commissioning and design (e.g. Huntington Beach, or Carlsbad, www.carlsbad-desal.com), and thus overall project costs.

Henry Salas, formerly of the Pan American Health Organization (PAHO) showed in his keynote at the International Symposium on Outfall Systems (www.outfalls.info.ms) in Mar del Plata, Argentina that many coastal wastewater projects in Latin America did not yet conclude the outfall system. More than 10 large-scale projects (each more than 1 million population served) were mentioned where almost completely raw sewage has been continuously discharged at the shoreline for more than 10 years due to these delays. Such problems of water projects seem to be mainly related to political and administrative problems, but often also to poor understanding of those systems.

There is often a misconception that treatment results in a ‘pure’ and ‘clean’ effluent which can be discharged directly on the beaches. Or back to desalination, that the sun "simply" can evaporate seawater to produce freshwater, and, at the end that one "only" needs to reduce the consumption and individual use of water. On one hand, this can lead to overly expensive wastewater systems, as has been shown in a second keynote given on the same symposium by Burton H. Jones from the University of Southern California, USA, about Huntington Beach. He described intensive field studies, showing that the political decision to upgrade the treatment plant for the existing outfall did not solve the water quality problems because the existing problems are not related to the outfall. Around 1 billion dollars were spent that could have been invested much more productively. On the other hand some of the technical solutions do not reach the consumer. For example, almost identical technologies are used for desalting seawater, and purifying wastewater (water reuse). However, water supply companies have difficulties in selling potable re-

Fig. 1: Left: Thermal distillation plant. Right: 4 membrane pressure vessels of a reverse osmosis plant (Courtesy: Sabine Lattemann)

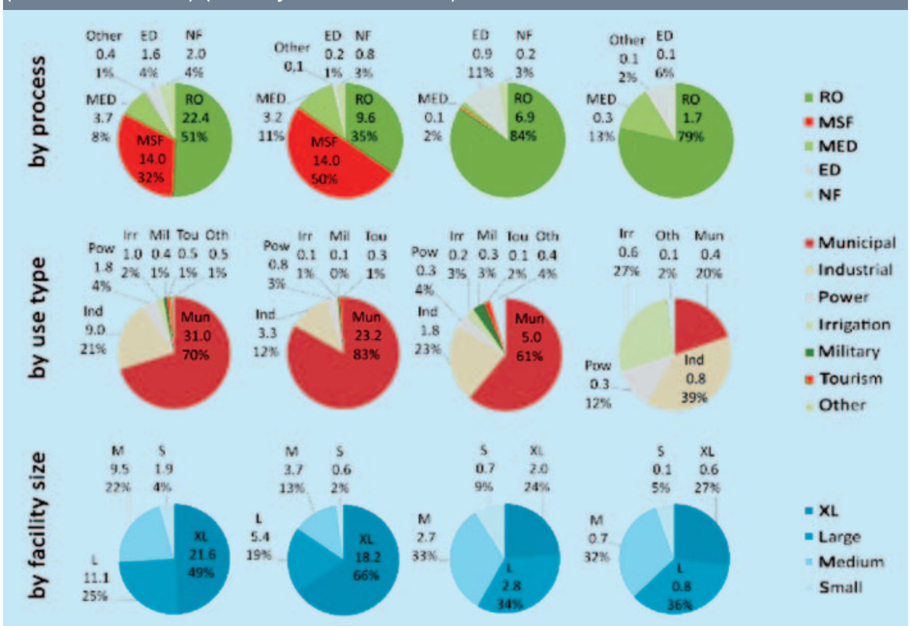

Fig. 2: Global desalination capacity (in Mm³/d and %) by source water type (top row), by process and source water type (2nd row), by use type and source water type (3rd row) and by plant size and source water type (last row). Abbreviations: reverse osmosis (RO), multi-stage flash distillation (MSF), multi-effect distillation (MED), nanofiltration (NF), electrodialysis (ED), XL>50,000m³/d, L>10,000m³/d, M>1,000m³/d (www.brinedis.net.ms). (Courtesy: Sabine Lattemann)

used water compared to selling desalinated water. Thus, technological solutions oversee the potential and necessity for a more holistic approach. The trend is clear again, and should not be about competing systems but blended systems, but to what cost for society and environment, and to what share?

Discussing and solving this controversy is one of the key objectives of Water Security with concepts looking on holistic water and energy budgets and subsequent labeling of products and services using footprint calculations (www.waterfootprint.org). These water budgets describe not only conventional hydrological balances in a watershed, but include the balance (i.e. the transport) of embedded water used to grow food or produce products. For example a kilogram of steak embeds about 15,000 litres, the total amount needed to feed the cow and run all the processes that make the steak. Numerous agricultural production sites however are located in water-scarce regions with strongly growing capacities of desalination and water-reuse, such as Spain and Israel. So besides the hydrological water-cycles, there is a considerable water transport through goods and services, which is usually not a closed cycle, but a one-way transport to often water rich regions.

Changes will require a higher level of information and public participation on the individual level. Water security concepts proposed herefore product labeling systems similar to those on electrical devices (e.g. refrigerators), and the calculation of water footprints, allowing not only to change source demand and characteristics, but also to improve acceptance, and understanding of technologies and practices. However, it is not only about optimizing individual technologies, but on integrated approaches. And it is not about green image campaigns, but on well based facts and technologies, and this might be an opportunity for IAHR. Historically, desalination technologies have mainly been related to mechanical engineering developments, whereas treatment technologies where related to the civil/sanitary engineering domain. Currently they become more interdisciplinary, but often still underutilizing the hydro-environmental components. The growing number of joint committees within IAHR and IWA (IAHR/IWA Joint Committee on Marine Outfall Systems (www.outfalls.net.ms), IAHR/IWA Joint Committee on Urban Drainage (www.jcud.org/), IAHR/IWA/IAHS Committee on Hydroinformatics (http://hydroinformatics-community.org/)) reflects that development, and represents a large part of the applied engineering activities within IAHR.

Fig. 3: Seawater Desalination intake system at Barcelona (Spain). Several horizontal subseabed drills with filtration region shown in light blue provide large flows of high quality seawater due to the pre-filtration within the seabed (Courtesy: Neodren system).

Challenges and Impact mitigation

Recent research projects set the base for such approaches and provided comprehensive background information on energy and discharge characteristics of desalination plants, and other coastal water projects in a larger context (e.g. www.brinedis.net.ms). The energy demand of desalination or water-reuse depends on the chosen process (distillation or membranes), and required pre-treatment, and efficiency of those components. Modern seawater RO plants can achieve specific energy demands of <2.5 kWh/m³ and a total energy demand of <3.5 kWh/m³ at 50% recovery. Distillation plants require approximately 250-330 MJ of thermal energy and 1.5 - 3.5 kWh/m³ of electrical energy, thus in total more energy than RO plants. This explains the increasing capacity of RO plant recently overtaking thermal desalination capacities.

In comparison, Pearce (2009) mentions a total energy consumption of 1.7 kWh/m³ for potable reuse, and 0.8 kWh/m³ for water reuse (irrigation), and 0.5 kWh/m³ for tertiary wastewater treatment plants. Conventional surface water treatment and groundwater pumping account for only 0.3 kWh/m³. However, in locations where the water requires a transport over large distances, seawater desalination might turn out the more energy-efficient option, as in the Perth metropolitan area in Australia. The plant with its capacity of 144,000 m³/d accounts for about 0.7% of the peak electricity demand in the region, and provides 17% of the city's water. A more holistic view shows also that 30% of electrity is consumed by air conditioning in summer (Crisp, 2008) meaning that 3-4h air-conditioning in a private home is equivalent to the production of 1m³ of desalted drinking water, which will last for 3-6 days on average. This calls for water security concepts.

The increasing competitiveness of desalination can be related to considerable improvements in hydraulics, such as energy recovery devices or outfall systems, and membrane optimization, causing desalination water costs to decrease from 1.6 US$/m³ in 1995 down to currently 0.6 US$/m³, thus already on competing levels with traditional water supply options. Membrane plants are operated at very high pressures (around 60 bar), where the product water leaves the process at around 1 bar, whereas the concentrate still is highly pressurized. The energy recovery devices are transferring concentrate pressure directly to the feed stream applying turbochargers, pelton turbines, work exchangers, pressure exchangers, recovering up to 95% of the concentrate energy into the feed stream. Booster pumps compensate for remaining pressure losses. Unfortunately, the optimization of energy recovery is almost at the limit, but further developments are required to reduce for example pressure losses within the membranes. Those are not only associated to specific geometries, but to biofouling and clogging, thus specifically hydro-environmental processes on a microfluidic scale, and unsteady conditions (including almost hourly backwashing procedures). This applies not only for the desalination membranes, but for all pre-treatment membranes, where nowadays ultra and nanofiltration systems are applied to compensate the usually highly varying intake water quality.

> **The increasing competitiveness of desalination can be related to considerable improvements in hydraulics**

Latter leads to a second large research field related to improvements on intake, and related physical pre-treatment systems, such as grids and settling tanks. For open intakes there are major concerns related to fish impingement (species stuck at the intake facility), and entrainment (species taken through the process, where they will not survive), causing strong hydraulic limitations on such structures (requiring intake velocities less than 0.1m/s) resulting in very large intake structures. There is a huge demand on studies related to fish behavior close to such structures, as well as on fish handling system or jelly-fish diversion to avoid clogging. There are also further options available, such as subsurface intakes (Fig. 3) which however strongly depend on soil characteristics.

On the other end of these plans, the discharge side, however, strong turbulent mixing is required to reduce the density differences, and to avoid the establishment of strong and highly concentrated density currents influencing the benthic communities. More field and lab studies are required to study these phenomena, where very thin (less than a meter thick) density currents develop, which are influenced by the coastal bathymetry and roughness, as well as by the coastal currents. This requires new developments for measuring, and monitoring in marine waters, as well as for related modeling issues.

And further advantages can be taken out of traditional hydraulic research by combining existing long lasting hydraulic research activities with the needs in desalination, such as providing the pressure for the membranes through renewable hydraulic energies (wave, tidal, coastal currents), which even might act similar to the previously mentioned energy recovery devices.

Thus, coupling between energy systems, treatment and purification systems, and hydro-enviromental systems will definitely be required for future projects. Existing projects are already affected by that trend. For example the Changi outfall in Singapore was designed for receiving 100% of the wastewater after treatment. Intensive water reclamation for water supply reduced the flow considerably, which changes effluent characteristics and quantity. A similar example is Orange County, California, were worlds largest reclamation plant has been built, now injecting the reclaimed water into the ground (http://articles.latimes.com/2008/jan/02/local/me-reclaim2). This also reduced the flow to the existing outfall, and increased its salinity, thus changing mixing characteristics and hydraulic performance.

Muscat (Oman), Al Ghubrah power generation and seawater desalination plant (biggest in Oman, capacity: 191,000 m³/d, courtesy: HMR Consultants)

Last but not least, there is the challenge to improve public involvement and the interactions between planners, designers, politicians, administrators, and the public. Conventional planning, bidding, and contracting schemes are quite deficient in that regard, and can result in significant (financial) damages to some projects. In addition, water regulations were changing significantly within the last decade (e.g. the European Water Framework Directive). And for desalination and water-reuse several initiatives are running to define new standards (e.g. California, http://www.sccwrp.org/ResearchAreas/contaminants/MeasurementFateAndBioavailability/BrineDischargePanel.aspx, and http://www.waterboards.ca.gov/water_issues/programs/ocean/desalination/ with the participation of IAHR member and committee chair Philip Roberts).

This shows that we "have the skills and technologies to develop effective solutions to many of the problems that surround global water security" (cited from the foreword of Royal Academy of Engineering, UK, 2010), however, "in isolation these technologies and skills are not enough. It is incumbent on engineers to articulate the issues surrounding water security to those outside of their usual sphere. Engineers must engage with policy makers, economists, financiers, farmers, industry and development agencies in order to build the public-political consensus needed to approach the problem of global water security."

IAHR setup a Task Force (https://sites.google.com/site/globalwatersecurity/), to cover that gap in current developments and putting the research into practice. The big growth in desalination and reuse, and the concepts of water security represent a perfect opportunity for hydro-environmental engineering and research and where IAHR has much to offer.

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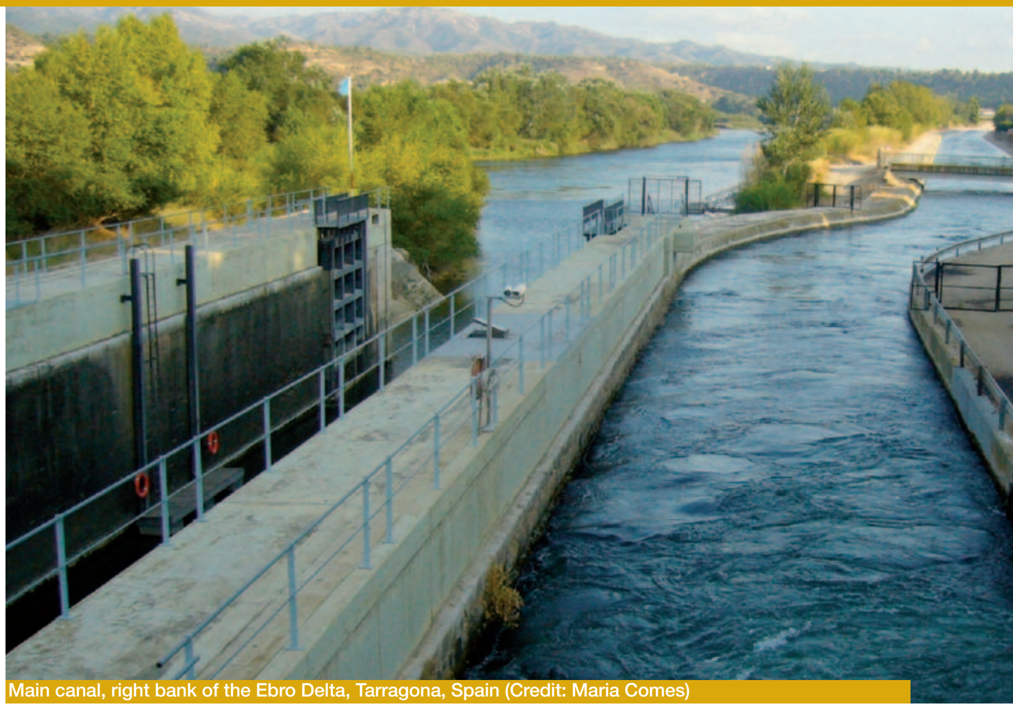
THE ROLE OF **WATER AND IRRIGATIO**

BY JULIÁN MARTÍNEZ BELTRÁN



Main canal, right bank of the Ebro Delta, Tarragona, Spain (Credit: Maria Comes)

Introduction: food security

In 2011, of a global population of approximately 7 billion people, the Food and Agriculture Organization of the United Nations (FAO) estimated that about 1 billion were undernourished. In addition, Trueba and Macmillan (2011) estimated that about 3 billion people suffer malnutrition. Although currently agricultural production is enough to feed the world population, food is partially wasted and not evenly distributed, and hungry people have no economic resources for an easy access to food. Poverty and food price volatility are major limitations to eradicate food insecurity in developing countries.

By 2050, the world population is expected to reach around 9 billion people. Therefore, in addition to the need to feed the people currently hungry, agriculture must produce enough food for the growing population.

FAO has proposed a double via approach to solve the problem of food insecurity: first, to facilitate the access of the poor and hungry people to food, and second, to increase the world agricultural production, especially in developing countries. Appropriate thoughts on the first track have been provided by Trueba and Macmillan in a recent publication (2011), with a first urgent and achievable aim of eradicating hunger by 2025. This article is focused on the second aspect, particularly on the contribution of water supply and irrigated agriculture to food production.

Irrigation and agricultural production

Some figures highlight the role of water and irrigation development on food production: of a total of approximately 1500 million hectares of cultivated lands in the world, about 300 million hectares were under irrigation in 2006; although only 20 percent of the cultivated area is equipped with irrigation systems, it contributes to the 40 percent of global food production.

In Figure 1 a global map with the area under irrigation in percentage of land area, is included (FAO, 2011a). This map shows the unevenly distribution of irrigation in the world: while in Asia irrigation is widely developed, a low percentage of the land area is currently under irrigation in sub-Saharan Africa and Southern America.

Differences in crop productivity between rainfed and irrigated agriculture are due to the water control achieved in irrigated lands in comparison with rainfed lands, where soil moisture availability is often insufficient and uncertain. In addition to the quality of crop varieties and the amount and on time application of agricultural inputs, such as fertilizers, crop yields depend on water availability. The following figures highlight the relationship between water availability and cereal yields: for high yielding varieties and high inputs, cereal yields can reach 7000 kg/ha if about 550 mm (5500 m^3/ha) are available for crop growth; meanwhile, yields of just about 3000 kg/ha can be obtained if only 450 mm are available (Smith et al., 2001 and FAO, 2003).

The greater productivity of irrigated agriculture explains why the global area under irrigation has more than doubled during the past 50 years. Meanwhile, the area of rainfed agriculture has been maintained almost constant, being the net increase of the cultivated area of about 12 percent (FAO, 2011a).

However, some problems associated with irrigated agriculture must be taken into account while considering irrigation benefits. Water consumption is a first concern, as irrigation uses approximately 70 percent of water withdrawals from surface water bodies and groundwater aquifers. However, only part of the water withdrawn is consumed by crops and part runs off to the fluvial system and percolates into aquifers. Nevertheless, at global scale, water productivity and irrigation efficiency are low.

Waterlogging of irrigated lands lacking drainage is a second problem, which in arid and semiarid zones is associated to soil salinity. About 11 percent of the present irrigated lands are affected by salinity due to inefficient irrigation and drainage management (FAO, 2011a). That figure means that around 34 million hectares of lands equipped with irrigation systems do not achieve the potential benefit associated to irrigation.

A third problem is related to the impacts of irrigation return flows on the quality of water bodies associated to irrigation schemes, through disposal of surface water to rivers and lakes and by deep percolation downwards to phreatic aquifers. The quality of the water can be deteriorated by salts and microelements mobilized from the soil, salts leached to control

N DEVELOPMENT IN FOOD SECURITY

soil salinity and excess of fertilizers and pesticides.

Because of the above mentioned problems, the rate of irrigation expansion during the past 20 years has been lower than that corresponding to the 1970s and 1980s.

Prospects for irrigation development

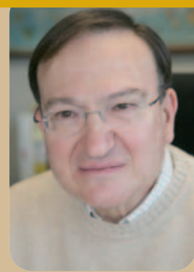
In order to solve the current food security problems, and those derived from the future increase of population, global agricultural production is expected to increase by 43 percent by 2030 and by around 70 percent by 2050 and to double in developing countries (FAO, 2011a). The increase of agricultural production required to satisfy the new food demand will primarily come from irrigated agriculture. This increase can be obtained by increasing the irrigation acreage but essentially by improving crop productivity in current irrigated lands.

Concerning the first option of irrigation expansion, FAO (2011a) considers an increase of approximately 6 percent of the irrigated area by 2050. Most of the new 18 million hectares of irrigated lands will be located in developing countries. There is scope for new irrigation projects in regions where presently irrigation development is limited, as in the case of South America and sub-Saharan Africa.

There is potential for expanding irrigated agriculture in terms of lands presently used in rainfed agriculture that are suitable for irrigated agriculture. However, the major constraint for new irrigation developments is water scarcity both in physical and economic terms.

Figure 2 shows the global distribution of physical water scarcity by major river basin (FAO, 2011a). Physical water scarcity is a common problem in many river basins, especially in arid and semi-arid regions. This problem will probably be aggravated in the future due to the effects of climate change on water resources (FAO, 2011b). While North Africa, the Middle East and Central Asia face increasing water scarcity, in sub-Saharan Africa, water resources are physically available but lack the hydraulic infrastructure required.

FAO (2011a) has estimated the net increase of water withdrawal in around 150 km^3 from



Dr. Julián Martínez Beltrán **is Head of the Sustainable Land and Water Management Unit, Centre for Water Studies of the CEDEX, Ministry of Public Works - Spain. He has more than 40 years of experience in land and water management. Before joining CEDEX in 2009, he worked for thirteen years in the Land and Water Division of FAO. He has given numerous lectures related to Irrigation and Drainage and published some books and articles on the same issue.**

Figure 1. Area equipped for irrigation as a percentage of land area (FAO, 2011a)

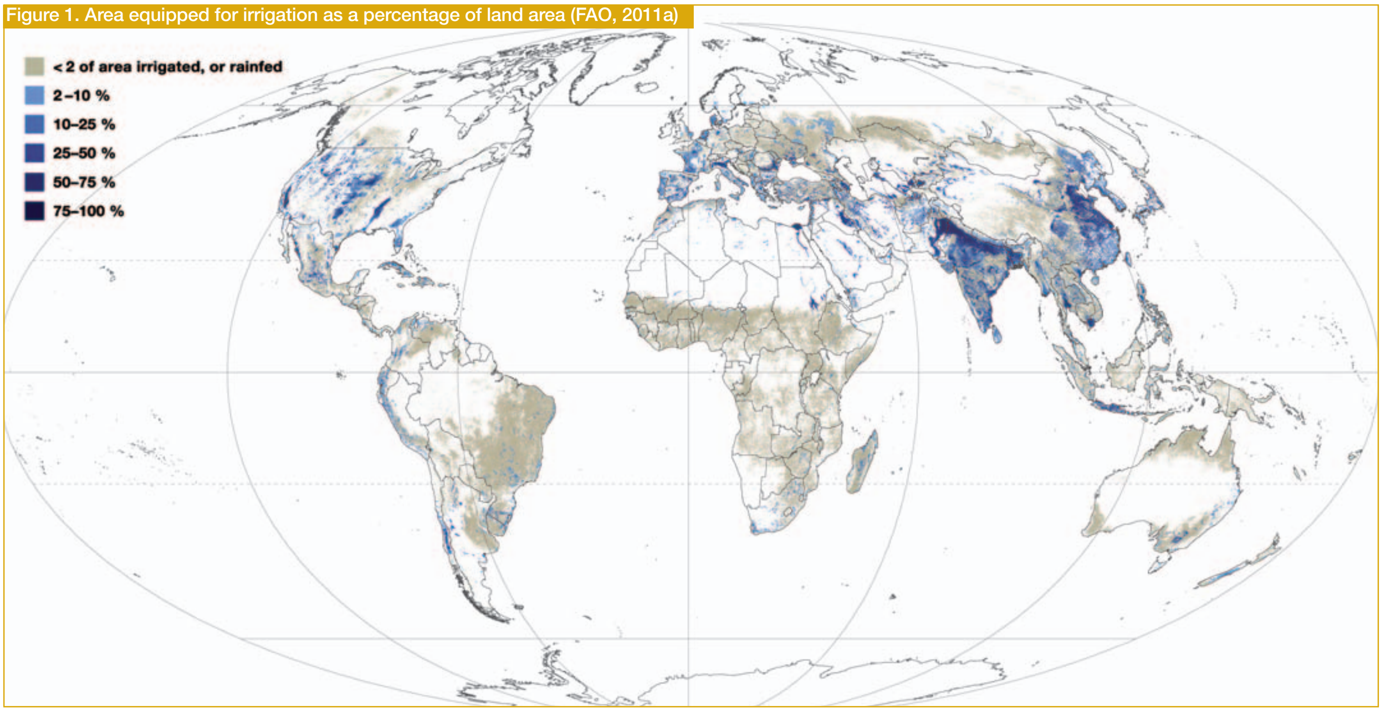
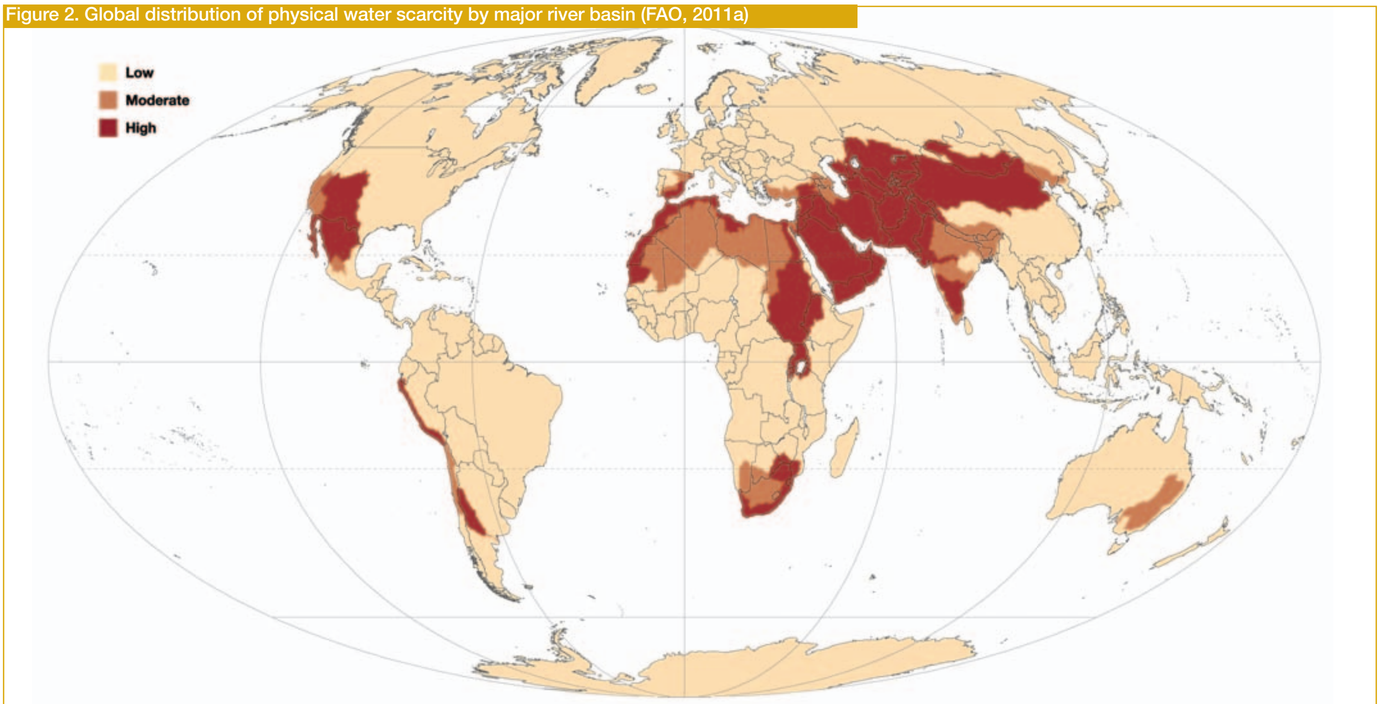


Figure 2. Global distribution of physical water scarcity by major river basin (FAO, 2011a)



now to 2050, being surface water, regulated mainly by small dams, the main source. No new major extractions of groundwater are foreseen, but existing aquifers, which contribute currently to about 40 percent of the water resources used for irrigation, will continue being exploited in a sustainable manner.

Non-conventional water resources, such as drainage water and treated wastewater, are increasingly being used in areas physically affected by water scarcity. However, this use requires a thorough control, due to the salinity risk in the first case and the health risks associated to the second. Nowadays, treated wastewater is a minor source of irrigation water, accounting for about 1 percent of the water used for this purpose, but it is becoming important in peri-urban agriculture. Rainfall harvesting and the use of collected and treated water for irrigation is being also used to improve the diet of peri-urban populations in developing countries. Desalinated water is not yet affordable for irrigation of conventional crops due to the costs. However, if these costs are reduced it could be considered for irrigating cash crops, particularly in coastal areas where brine disposal presents less environmental impacts compared to inland areas.

Additional constraints for irrigation expansion are twofold: the investments needed and the lack of institution and legal development required to strengthening the irrigation sector in some developing countries. Therefore, for low-income countries small scale irrigation jointly with capacity building should be considered as main steps for irrigation development.

Due to the above mentioned constraints, the priority in irrigation development programmes should be the increase of water productivity in areas currently irrigated. Modernization and rehabilitation of irrigation schemes under operation are the essential actions for this purpose.

Modernization involves improvements in the systems for conveyance and distribution of the irrigation water, in order to diminish water losses and improve the flexibility, reliability and delivery of water on time. This can be achieved by lining main canals, constructing structures to control water flow and small side regulation reservoirs in the main canals; in the distribution network, by changing open canals by pipes. Modernization also includes improving the capacity of the farmers to operate and maintain by themselves the renovated hydraulic infrastructure through their water user association.

The increase of water productivity is also based on improving the efficiency of the application of the irrigation water. Therefore, eliminating surface run off and reducing deep percolation is necessary in order to save water and reduce the volume of drainage water to be disposed. Shifting to sprinkler and drip irrigation is a common action to increase the irrigation application efficiency, but there is still scope to improve surface irrigation. Agronomic practices, such as fertilizer management and integrated pest control, are also needed in order to increase crop yields and therefore water productivity.

Rehabilitation of irrigation schemes involves reclamation of salt affected soils and management of drainage water to reduce impacts on the quality of the associated water bodies. Land drainage systems are required to control the excess of water and salts in irrigated lands lacking natural drainage.

Both for irrigation expansion and modernization, institutional strengthening as well as the application of determined policies by governments are key actions to forward irrigation development. Hence, an increase of the agricultural production, in order to ensure food security in developing countries, will be possible. There is also the need of increasing the technical capacity of the poorest farmers as well as obtaining public support to finance the up-scaling of successful irrigation and drainage pilot projects, so far implemented in developing countries.

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Acknowledgements
Acknowledgement is due to the Food and Agriculture Organization of the United Nations (FAO) for granting permission to reproduce the maps included in this article.

"SUSTAINABLE DEVELOPMENT OF WATER REGULATION AND HARMONIOUS EXISTENCE OF HUMAN WITH WATER"

THE 5TH CHINA NATIONAL CONFERENCE ON HYDRAULICS AND HYDROINFORMATICS

TIANJIN, CHINA, OCTOBER 2011

The 5th China National Conference on Hydraulics and Hydroinformatics was held over three days in October 2011 at the Tianjin University, Tianjin, China. The conference is a bi-annual conference held every odd year, jointly-hosted by the IAHR China Chapter together with CHES Hydraulics Committee and CSHE Engineering Hydraulics Committee. The 5th Conference was organized by Tianjin University, attended by 175 participants with 160 papers, coming from university, research and design institutes, water resources administration departments, project management bureaus, as well as instrument manufacturers. The Conference focused on new development and advances of Chinese research work and engineering application in: engineering hydraulics, eco- and environment hydraulics, hydroinformatics and counter-measures to climate changes and hydraulics for new-energy technology development. The Proceedings "Advances in Hydraulics and Hydroinformatics in China 2011" (in Chinese) have been published.

Six key-note lectures were delivered covering hot topics in the recent development in hydraulic and environment research and application, such as green hydropower in China, flood and drought disasters, mountainous river evolution and its eco-rehabilitation, multi-stage energy dissipation and offshore wind power development. Three technical sessions were conducted for discussion on relevant topics, where 90 papers were presented. A special session was conducted, where 16 papers were presented and discussed in English, with the purpose of enhancing young scholars' ability in English communication, aiming at preparing for the 35th IAHR Congress in 2013 in Chengdu. A Managers Forum on new hydraulic instrumentation was also conducted.

Dr. Lianxiang Wang **(on behalf of the IAHR China Chapter)**
China Institute of Water Resources and Hydropower Research
lxwang6358@163.com

Following the tradition of this conference series, the organizers awarded 5 winners of "Best Youth Papers Award" : Liu Huaixiang, Li Zhiwei, Yu Xiao, Liang Shendong and Li Chengyi

IAHR KUWAIT INTERNATIONAL SUMMIT ON ADVANCES IN OIL SPILL MODELING

NOVEMBER 15th TO 16th 2011

The summit brought together some of the most recognized and reputable names within the oil spill modeling community sponsored by the Kuwait Oil Company and the Kuwait Institute of Scientific Research (KISR), with the aim of discussing the state-of-the-art. In addition, their goal was to identify key needs for future research from a multi-disciplinary standpoint to satisfy the requirements of the oil industry when preparing emergency oil spill contingency plans.

Dr. Khaled Al-Banaa
Vice-chair IAHR Working Group on Oil Spill Modeling and Secretary General IAHR-MENA Collaboration Committee. Dr. Al-Banaa has over 10 years of research experience on coastal processes and wave hydrodynamics. He has experience in the development of application in Computational methods.

Dr. Bassam Shuhaibar
Researcher, Hydraulics and Coastal Engineering Group Manpower, KISR. Ph.D. in Environmental Eng., George Washington University, USA. Assistant Research Scientist. Works with GIS-based systems and coastal engineering applications.

The event also served as the initial meeting of the interdisciplinary working group with the clear goal to create a roadmap for the Oil Spill Modeling Working Group.

The invited speakers covered topics ranging from the models currently employed by the industry to the different processes and techniques that are associated with those models. Each talk was followed by a short question-and-answer period that complemented a longer and more comprehensive discussion session that concluded the schedule on either day. The most salient points of those sessions were noted and appear below.

Data Availability/Accessibility/Transparency. The lack of adequate and exhaustive datasets (from both field and laboratory work) was highlighted, coupled with a lack of more quality assured/quality controlled data. There is also a tendency to withhold data for a certain amount of time before release, due to a number of different reasons (e.g. intellectual property rights; ongoing litigation etc.). An analogy was made with the oceanography community of 30 years ago, who used to release data several years after obtaining it versus immediate availability present-day. A consensus was reached that more effort should be expended by interested parties to procure the data they need.

Funding. A constantly recurring criticism of the status quo was how severely lacking funding is in the area of "regular" research vis-à-vis spending during a major accident (e.g. Deepwater Horizon). The question "why are pocketbooks seemingly bottomless only during a crisis?" was repeatedly raised. The case of approaching a government institution such as the National Science Foundation (NSF) in the

LIST OF INVITED SPEAKERS

Prof. Poojitha Yapa, Chair, IAHR Working Group on Oil Spill Modelling, Professor of Civil and Environmental Engineering, Clarkson University, USA
Dr. Bill Lehr, Senior Scientist, Office of Response and Restoration, National Oceanic and Atmospheric Administration (NOAA), USA
Dr. Khaled Al-Banaa, Coastal Management Program, KIRS, Kuwait
Dr. Bruce Hollebone Oil Research Laboratory, Emergencies Science and Technology Section of Environment Canada, Oil
Dr. Mark Reed, Senior Scientist, Norway
Prof. Peter Sheng Department of Civil and Coastal Engineering, University of Florida, USA
Dr. Hiroshi Yamada, Mizuho Information and Research Institute, Inc., Tokyo, Japan
Dr. Erich Gundlach, ETech International, USA
Dr. Augusto Maidana, International Center for Numerical Methods in Engineering (CIMNE), UPC, Spain
Rodrigo Fernades, MARETEC, Lisbon

United States for funding was mentioned, but this carries a caveat of transparent and immediately available data in order to qualify. This then raises the aforementioned issues dealing with data availability, accessibility and transparency. The need to collectively communicate the importance of related research to the relevant funding entities as a group of oil spill modelers was emphasized and a number of tables developed to illustrate and prioritize those research areas (please see attached power point presentation).

Lack of up-to-date literature/research. Most topical references cite works from the 1980's and early 1990's, with the most recent collective bulk of work represented by the 1991 Arabian Gulf oil spill. It was also highlighted that a large portion of related studies focus on major oil spills and not those of a smaller-scale, which can be equally relevant when it comes to research and data collection. The absence of a definitive data catalogue/depository of historic incidents was also raised.

Data interoperability/standardization. Too many disparate dataset formats exist throughout the oil spill modeling community, making their exchange difficult and cumbersome. The standardization of nomenclature, conventions and so on was discussed. It was announced that some efforts are already being made to achieve this in several regions/institutes (e.g. action in process to establish a standard format for oil particles) but it was clear that there was still a lot of work to be done in this vein.

Insufficient communication between oil spill modeling community and industry. The issue of intercommunication between the two aforementioned entities was discussed, with the possibility of including the latter in future meetings/Working Group sessions. It was concluded that this topic would need further investigation before making any kind of decision either way.

For more information on the IAHR Oil Spill Modelling Working Group:
https://sites.google.com/site/oilspillsworking-group/

STATEMENT OF THE 5TH INTERNATIONAL CONFERENCE ON FLOOD MANAGEMENT (ICFM5) "FLOODS: FROM RISK TO OPPORTUNITY" 27-29 SEPTEMBER 2011, TOKYO, JAPAN

On 27-29 September 2011, the 5th International Conference on Flood Management (ICFM5) was held in Tokyo, Japan with more than 450 participants gathered from 41 different nations throughout the world. The participants applaud the local organizers for their great efforts to ensure the success of ICFM5 in the face of the extreme difficulties that Japan experienced as a result of the Great East Japan Earthquake and Tsunami in March of this year.

Following three days of extensive discussions on the important issues that communities, nations and regions face in flood management, the participants of ICFM5 declare the following as their own commitment, and appeal to all of the professionals, managers and decision makers in this important field as well as the public to carry out such statements for life security, social welfare, and enhancement of land and water related environmental management:

1. ACKNOWLEDGE:

- ***Events beyond Expectation.*** The Great East Japan Earthquake and Tsunami of 11 March 2011 revealed that events beyond expectation (Soteigai in Japanese), or beyond the realm of assumptions used in disaster management planning do occur. It is a violation of the law of living with nature to establish limits related to extreme events and, thus, neglect the potential occurrence of events that might exceed those limits.
- ***Increasing Complexity of Socio-Economic Systems.*** It is recognized that the components of socio-economic activities are increasingly dependent upon each other and the impact of local disasters may quickly extend to national, regional and global scales through the market network (e.g., supply chains). There is a critical need to evaluate, comprehend and address the complexity of existing and future socio-economic systems. As societal vulnerability to disasters increases through economic development and globalization, Asia is a "hot spot" of increasing global disaster risk while local disasters have disrupting consequences anywhere in the world.

FROM RISK TO

ISHINOMAKI, JAPAN - September 27, 2011: House on the main road close to the water in Ishonomki. Damage by the 2011-3-11 earthquake/tsunami.

- ***Increasing Floods.*** Floods are the most extensive and frequently occurring disaster in the world, resulting in the largest socio-economic impacts to most nations in comparison to all other natural disasters. Flood frequency and severity continue to rise at many places, along with the accompanying socio-economic impacts. It is further recognized that the flood risk is becoming increasingly important in those urban areas that are experiencing expansion and higher densities of population throughout the world.
- ***Increasing Flood Risk.*** Climate change is a serious factor that acts to increase the flood risk. The intensity and frequency of torrential rains have markedly increased, as evidenced in Taiwan in 2009 and in Japan in 2011. The flood risk is further heightened as a consequence of unprecedented urban growth, human encroachment in disaster prone areas, continued poverty rates, poor governance, environmental degradation, water illiteracy, corruption and other related human practices.

2. DECLARE:

- ***From Risk to Opportunity.*** The scientific knowledge of risk, as a combination of hazard and vulnerability, provides an opportunity to improve societies and their ways of life. This era of increased risk presents new opportunities for societies to shift from high risk, unsustainable cycles to low risk, sustainable cycles. Particularly when the scientific basis of a risk becomes known, it serves as an indispensable occasion to make critical societal adjustments. We now have the opportunity to balance desired life styles with enriched ecological environments. We have a unique opportunity to advance science and make wise use of our scientific knowledge. Reducing the disaster risk reduces damages that might otherwise impede continued economic development and environmental sustainability.
- ***Management of Flood Disasters under High Levels of Uncertainty.*** As a result of increased complexities, shifting populations and climate change the concept of flood management under uncertainty is no longer an abstract concept. The total elimination of the flood risk is impossible and new risk-based tools and techniques are necessary to advance flood management policy, engineering design and operations, along with the disaster management process.
- ***Flood Management as Part of IWRM.*** Flood management is a critical part of Integrated Water Resources Management (IWRM). More efforts to integrate land and water development with basin-level management are necessary, including the involvement of the industrial, agricultural, environmental and administrative sectors. Integrative practices continue to lag in many nations. In this respect, the UNESCO publication on IWRM guidelines (2009) and the Concept Paper on Integrated Flood Management (2009) by the Associated Program on Flood Management are major contributions and their recommendations should be more fully promoted.
- ***Balance of Structural and Non-Structural Infrastructure.*** There is an increased emphasis in modern flood management thinking on non structural methods, such as land use planning, insurance, education, early warning and evacuation protecting high valued and/or important real estate. While these options are all very important, it cannot be understated that in many nations, many people have no choice but to live in flood prone areas where structural measures are critical for their settlement. Especially for high economic activities, such exercises as evacuation, business discontinuity with or without insurance and strong limitation in land use are not compatible. Continued economic development, therefore, requires a rational balance of structural and non-structural infrastructure.
- ***Preparedness beyond Expectation.*** It is now necessary to prepare for potential events that exceed expectations. The theoretical maxim of combined multi-hazard effects must be considered in community, national and regional risk management. Extreme floods and landslides beyond expectation that may result from typhoons, earthquakes, tsunamis, storm surges and other extreme events should be fully incorporated into the field of flood management.
- ***Methods of Assessing "unexpected, extreme event" and Cascading Effects.*** The assessment methodology on the impacts of very rare, difficult to identify the probability of, and extremely high consequent events (black swan events) and cascading events should be more fully focused and developed.
- ***Scientific Advancement of Prediction.*** Unlike earthquakes, floods are largely predictable and to some extent controllable. Disasters of hydro-meteorological origin can be far better managed through the applied use of science and technology. Research and knowledge-based decision making should be greatly promoted in the flood management field.
- ***Floodplain Protection.*** A large number of concentrated populations throughout the world are living in floodplains and utilizing seasonal flooding water as a heavenly gift for their agriculture, fishery, transportation, etc. Flood management should not destroy nor neglect, but rather protect such ecological health and lifestyle of living with nature.

3. AGREE:

- ***Implementation of HLEP/UNSGAB Action Plan.*** UNSGAB/HLEP's Action Plan on Water and Disaster is unique in its commitment to implementation. The national and international organizations that participated in this Conference should make strong commitments to the important items discussed during ICFM5, including early warning systems, preparedness indices, climate change adaptation and mega-delta protection.
- ***Spreading the Word.*** The participants agree to distribute this statement at other key related international events, such as the 1st Integrated Research on Disaster Risk Conference (Beijing, 2011), the 6th World Water Forum (Marseille, 2012), Rio+20 (Rio de Janeiro, 2012), Flood risk 2012 Conference in Rotterdam and the 3rd World Conference on Disaster Reduction (Japan, 2015).
- ***Sharing Knowledge and Experience.*** Information sharing on the local, regional, national and international scales is an essential element of the flood risk management process.
- ***Education and Training.*** The participants recognize the huge need to enhance education and training related to the field of Integrated Flood Management (IFM). Furthermore, the education needs to be revised to train effective experts in IFM with a strong interdisciplinary background. A system thinking, that considers the different components of the system in relation to each other and tries to understand the whole systems in a holistic way, is pivotal to improve IFM and has to be introduced to students and practitioners. The importance of live long learning in an IFM context is essential.

This conference was sponsored by the UNESCO and supported by the International Flood Initiative (IFI). IAHR is partner of IFI
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OPPORTUNITY

PEOPLE & PLACES

Newly Elected Leadership Team of the Committee on Coastal and Maritime Hydraulics

For more information visit IAHR website www.iahr.org

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Vice-Chair
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IAHR Marine Renewable Energy Working Group

The WG (part of the Coastal and Maritime Hydraulics Committee) is chaired by Martin Wosnik (University of New Hampshire, USA) and vicechaired by Michael Hartnett (National University of Ireland).
The WG has held recently a meeting coinciding with the Fourth Coastlab Teaching School – Wave and Tidal Energy in Porto in January 2012
IAHR is sponsoring a special session on Marine Hydrokinetic Technologies at the next International Conference on Hydroscience & Engineering "http://iche2012.org/index.html"l(ICHE in Orlando, Florida on November 4-7, 2012. The scope of this session includes advances in research of hydro-kinetic turbines and approaches for the harvesting of wave, tidal, current, and ocean thermal energy; laboratory studies, and small scale or pilot applications and demonstrations; scaling-up of new technologies.
For more information contact Martin Wosnik Martin.Wosnik@unh.edu http://sites.google.com/site/iahrmrewg/

Cemagref (IAHR Institute Member) changes its name to Irstea

From 2012, Cemagref has become Irstea, the National Research Institute of Science and Technology for Environment and Agriculture.
Irstea is a research institute that, for more than 30 years, has studied major stakes for the water management, the ecosystems and biodiversity, the management of agriculture and rural territories. Irstea combines a multidisciplinary research with expertise and support to public authorities. Irstea was labelized "Institut Carnot" for its actions of partnership with private companies.
In the domain of IAHR, Irstea deals with climate change effects and river management focussing on such topics as droughts, floods, transport of pollutants and sediments, water treatment plants, etc.
For more information http://www.irstea.fr/linstitut/presentation

PEOPLE & PLACES

Convocation of IAHR 2012 General Members Assembly

All IAHR Members are cordially invited to attend the Annual General Members Assembly which will be held in Costa Rica.

Venue: Hotel Ramada Plaza, Costa Rica
Date: 9th September
Time: 14:30

AGENDA

- Approval of Minutes of the GMA held in Brisbane 2011
- Announcement of Division Changes
- Council Election Results

- Financial Statement, Report on IAHR Activities

Members wishing to propose topics for inclusion in the GMA agenda should contact the Executive Director, Dr. Christopher George, by May 31st 2012.

New Membership Categories: Lifetime Membership

In order to recognize long term dedication to retired members, the IAHR Council has recently agreed to establish a Lifetime membership grade set at three years the normal fee, after 30 years membership and a minimum age of 60.
For more information, contact Ms. Elsa Incio (membership@iahr.org)

IAHR President, Roger Falconer visited the IAHR Secretariat in Madrid

In order to know directly the functions of the IAHR Secretariat, Roger Falconer recently visited the IAHR offices in Madrid. Jean-Paul Chabard, Vice-President and Ramon Gutierrez, Secretary General were also involved in the discussions.
Prof. Falconer took the opportunity to visit the IAHR sponsor CEDEX (the Spanish Public Works Ministry) and meet with the Senior Manager, Mariano Navas.

Gerhard Jirka Summer School on

Environmental Fluid Mechanics – from theory to applications

June 11–20, 2012, Eawag Horw, Switzerland

Environmental Fluid Mechanics (EFM) is concerned with the fluid motions and associated mass, heat and momentum transport processes that occur at various scales of the earth's hydrosphere and atmosphere. The interaction of flows and reactions between the natural and built environments is at the centre of EFM. The School will follow closely the aims and objectives established successfully at the foregoing events held at the Universities of Karls-ruhe in 1999 and 2006, Dundee in 2001, Budapest in 2004 and Santiago de Chile in 2009. It will cover the basic theoretical principles underlying a range of environmental flows and their mathematical description.

From theory to applications will be a core element of this edition of the School. Selected computational simulation models and examples of engineering design and environmental applications will be demonstrated. The relation to the environmental concerns will be more intensively highlighted than in former courses.

The course is intended for postgraduate students (MSc or PhD candidates), engi-neers and scientists in industry, government or research institutions involved in environmental engineering, planning or impact prediction.

Details and contact for application: www.eawag.ch/lehre/schools/kb2012/index
Application deadline: March 30th, 2012

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ICSU appoints new Executive Director

The International Council for Science (ICSU) welcomes Dr. Steven Wilson as Executive Director. Dr. Wilson will provide important leadership as ICSU seeks to implement its newly approved second Strategic Plan 2012–2017. Dr. Wilson will take up his duties on 1 April 2012. The President of ICSU, Professor Yuan-Tseh Lee, is delighted by Dr. Wilson's acceptance of the post of Executive Director. Prof. Lee said: 'It is a pleasure to welcome Dr. Wilson as the new Executive Director. His experience as the interim Chief Executive and a Director at the UK Natural Environment Research Council (NERC), which has been a supporter and partner of ICSU, means that he will bring the perspective and dynamism of a Research Council leader to us. His close involvement with a number of international research programmes over the years will help him in his new role.' IAHR is a Scientific Association of ICSU.

Executive Director at Stockholm International Water Institute takes on a new position in Washington

Mr. Anders Berntell, Executive Director at Stockholm International Water Institute (SIWI), will be leaving SIWI after ten successful years for a position as Executive Director of 2030 Water Resources Group at the International Finance Corporation within the World Bank Group.

Mr Anders Berntell took over as Executive Director at SIWI in February 2002. Under his management SIWI has grown from 10 to 50 employees by the end of 2011. He has developed SIWIs well-known brands, World Water Week and Stockholm Water Prize and has also focused on developing SIWIs Knowledge Services. By offering advisory services, applied research and capacity building the Knowledge Services aims to support water management and development initiatives worldwide, helping clients from all sectors improve their decisions and strategies related to water, land and sustainable development.

For more information www.siwi.org

A sad moment

Jean Jacques 'Jacky' Peters (Ghent, 1941) has passed away on January 22, 2012
Professor Emeritus of the Vrije Universiteit Brussel and the Université Catholique de Louvain and Consultant in hydraulics and morphology of rivers, hydraulic structures. Jacky Peters was the first Chair of the IAHR Europe Division.

Detailed information on www.iahr.org under obituaries section.

UNESCO- IHE, Delft The Netherlands (IAHR Institute Member) announces a major re-organisation

UNESCO-IHE has announced plans to move the Institute towards a global campus, pursuing enhanced and effective international academic collaboration and intensifying existing relations with partners and institutes in international learning alliances.

The global campus will be an interdisciplinary environment in which a new generation of water professionals is able to explore insights into water problems from many different perspectives, and contribute to the development of creative, integrated and sustainable solutions.

Following these internal reforms, the Institute now has three academic departments, that are in line with the global developments in scientific research and education in the field of water and environment. These departments are sufficiently distinct in academic orientation and approaches to water systems, and are as follows:

- **Water Science and Engineering**
  Head of Department: Prof. Arthur Mynett
  Deputy Head of Department: Dr. Erik de Ruyter van Steveninck
- **Environmental Engineering and Water Technology**
  Head of Department: Prof. Damir Brdanovic
  Deputy Head of Department: Dr. Saroj Sharma
- **Integrated Water Systems and Governance**
  Head of Department: Prof. Pieter van der Zaag
  Deputy Head of Department: Dr. Ioana Popescu

http://www.unesco-ihe.org/About/News/ UNESCO-IHE-2020-Paving-the-road-toward-a-Global-Campus

Prof. Arthur Mynett appointed Head of Water Science and Engineering Department, UNESCO-IHE
Arthur Mynett is Professor of Hydraulic Engineering at UNESCO IHE in Delft, The Netherlands. He is a Council Member of IAHR and is Chair of the IAHR Standing Committee on Global Water issues. Prof Mynett is also responsible for organising the IAHR World Congress in The Hague, The Netherlands in 2015.

Dr. Ioana Popescu, appointed Deputy Head of Integrated Water Systems and Governance Department, UNESCO IHE
Dr. Popescu is Chair of the IAHR Committee on Education and Professional Development and Senior lecturer in hydroinformtics at UNESCO IHE.

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