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GLOBAL WATER NEWS



THE BONN DECLARATION ON GLOBAL WATER SECURITY

HUMAN BEINGS ARE UNDERMINING OUR OWN
WATER SECURITY. THAT MUCH WE KNOW –
DO WE KNOW ENOUGH TO AVOID DISASTER?



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Editorial

by Anik Bhaduri

This year in July the Global Water System Project (GWSP) completed its tenth year of global water research in understanding the complex global water system, and how human activities with natural interaction change the way water moves around the globe. This last decade has been transformational with respect to our thinking and research on the water systems of the planet from global to regional scales. We find that uncoordinated local human actions can add up and lead to large regional, continental and even global changes and affect the global water system on which the welfare of current and future generations depends.

Recently, GWSP organized the international conference entitled “Water in the Anthropocene: Challenges for Science and Governance” in May in Bonn, with 60 exciting sessions and more than 350 participants. During the conference the major achievements in global water research as well as regional perspectives of worldwide experiences were presented. The conference was successful in linking science, policy and practice in the area of water resource management and governance, relate institutional and technological innovations and identify how research can assist policy and practice of sustainable freshwater management.

As an output from this international event the water community made a set of core recommendations to institutions and individuals focused on science, governance, management and decision-making relevant to water resources on Earth in the form of a declaration called “The Bonn Declaration on Global Water Security”. The declaration sets the stage for the next step in the evolution of the global water research agenda, that is, to more formally connect research to improved decision making. This issue of Global Water News highlights The Bonn Water Declaration, major findings, and interviews of key note speakers of the conference. There has been wide media coverage for this event also. We have included in this issue an op-ed written by Charles Vörösmarty and Claudia Pahl-Wostl which was published in International Herald Tribune earlier.

The Bonn Conference was also dedicated to young professionals and researchers, and this conference brought together

the future generation of “water leaders” from all over the world; among them Hita Unnikrishnan and Owen Horwood, both GWSP scholars for the conference. They have written two exciting articles on the socio- and ecological, and the governance challenges in the Anthropocene in this issue.

Following the Bonn Conference, GWSP was also active in organizing several workshops. GWSP with other partners organized two sessions on water quality and urban water management in the Water Research Horizon Conference

held in June in Berlin. The objective was to share experiences of the members of the panel, obtain feedback from the audience and thus enrich our ongoing efforts to conceptualize water quality threats and urban water security challenges.

In the next few days, the Stockholm World Water Week is forthcoming as well as the Budapest Water Summit in October. In the Stockholm World

Water Week, GWSP is co-organizing two special sessions. You will find details about these event in this issue. GWSP is also playing an important role in the upcoming Budapest Water Summit in bringing the scientific perspective in different forums with several members of the community as key note speakers and moderators. In this regard, the GWSP conference in Bonn on “Water in the Anthropocene” was a scientific prelude to this summit, and the major findings and messages of GWSP research feed into this event, which will play an important role in framing the SDGs.

We believe that such synergies between such events will facilitate to shape Future Water Agenda, which is relevant for both policy and practice.



Uncoordinated local human actions lead to global changes and affect the global water system



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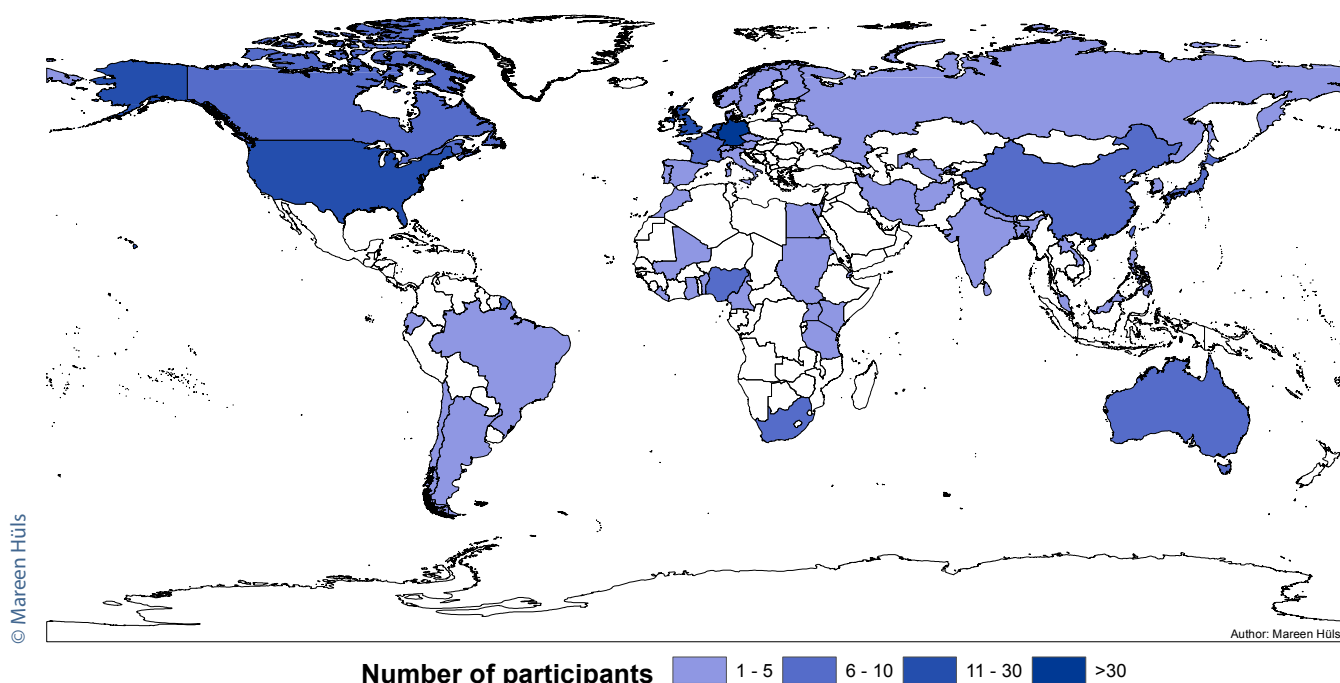
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GWSP Conference on “Water in the Anthropocene: Challenges for Science and Governance”

The Global Water System Project and its International Project Office organized an international conference on ‘Water in the Anthropocene: Challenges for Science and Governance. Indicators, Thresholds and Uncertainties of the Global Water System’ held at Maritim Hotel Bonn, Germany, 21-24 May 2013. The conference was supported by the German Federal Ministry of Education and Research (BMBF), the German Research Foundation (DFG) and the Foundation of International Dialogue of the Savings Bank in Bonn. Over 350 participants from all over the world dealing with various water-related problems attended this conference.

The water community assembled in Bonn for this conference made a set of core recommendations to institutions and individuals focused on science, governance, management and decision-making relevant to water resources on Earth: The Bonn Declaration on Global Water Security. During the closing ceremony the Bonn Declaration on Global Water Security was issued by the Lord Mayor of Bonn, Mr. Jürgen Nimptsch on behalf of the water community. In a following speech Mr. Reinhold Ollig, Head of Division “Resources and Sustainability” of the Federal Ministry of Education and Research (BMBF), supported the declaration.



350 participants from all over the world attended the GWSP Conference

The conference provided a platform to present global and regional perspectives of world wide experiences on the responses of water management to global change in order to address issues such as variability in supply, increasing demand for water, environmental flows, and land use change. It successfully linked science and policy and practice in the area of water resources management and governance, related institutional and technological innovations and identified ways in which research can assist policy and practice in the field of sustainable freshwater management. The conference highlighted the fact that human activities impact the global water system as part of the Earth system, and change the way water moves around the globe like never before.

Key messages from the conference based on the feedback of all session chairs:

- Freshwater biodiversity is under extreme threat, but virtually absent from the water agenda
- Uncertainties can be seen as a problem but also as a chance to focus on integrated solutions & adaptation strategies
- Water quality critically affects water security
- Direct human actions will likely continue to dominate future patterns of water scarcity
- Links between knowledge generation and policy framing as well as between knowledge generation and a translation of findings into rules and legal frameworks are missing
- Biodiversity issues need to be linked to ecosystem

- services in order to increase its policy-relevance
- Dialogue between science and policy needs to be improved
- Co-development of knowledge which includes building capacities amongst scientists to better communicate research results to non-scientists is needed
- Include local communities in conservation efforts
- New approaches in monitoring combining satellite-based and ground observation are needed
- Wise combinations of land and water management strategies for sustainable management of resources are needed
- Understand Nexus challenges as an opportunity for integration
- Benefit-Sharing through cooperation on water, land and energy issues is not only feasible, it is necessary
- Focus more on the history of water research in a country or region to help identify future need in research and water expertise
- Scenarios development and decision-making have

- to be matched, i.e. scenarios should involve the users and make assumptions and methods transparent
- Water governance as a young and emerging research field requires strengthening to actively support governance reforms towards sustainability.

The results of the conference clearly underline the fact that we have to reinforce both explicitly disciplinary and truly interdisciplinary approaches to understand the complexities of the global water system at all relevant scales to meet the challenges ahead.

INFO:

All keynotes of the opening plenary, interviews with scientists and policy makers as well as conference presentations are to be found online under:

<http://conference2013.gwsp.org>



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Charles Vörösmarty, GWSP Co-Chair, gave a keynote speech during the Opening Plenary



Bonn Declaration on Global Water Security

In the short span of one or two generations, the majority of the 9 billion people on Earth will be living under the handicap of severe pressure on fresh water, an absolutely essential natural resource for which there is no substitute. This handicap will be self-inflicted and is, we believe, entirely avoidable.

After years of observations and a decade of integrative research convened under the Earth System Science Partnership (ESSP) and other initiatives, water scientists are more than ever convinced that fresh water systems across the planet are in a precarious state. Mismanagement, overuse and climate change pose long-term threats to human well-being, and evaluating and responding to those threats constitutes a major challenge to water researchers and managers alike. Countless millions of individual local human actions add up and reverberate into larger regional, continental and global changes that have drastically changed water flows and storage, impaired water quality, and damaged aquatic ecosystems.

Human activity thus plays a central role in the behaviour of the global water system.

Since 2004, the Global Water System Project (GWSP) has spearheaded a broad research agenda and new ways of thinking about water as a complex global system, emphasizing the links that bind its natural and human components. Research carried out by GWSP and its partners has produced several important results that inform a better global understanding of fresh water today:

- ▶ Humans are a key feature of the global water system, influencing prodigious quantities of water: stored in reservoirs, taken from rivers and groundwater and lost in various ways. Additional deterioration through pollution, now detectable on a global scale, further limits an already-stressed resource base, and negatively affects the health of aquatic life forms and human beings.
- ▶ At a time of impending water challenges, it remains a struggle to secure the basic environmental and social observations needed to obtain an accurate picture of the state of the resource. We need to know about the availability, condition and use of water as part of a global system through sustained environmental surveillance. History teaches us that failure to obtain this basic information will be costly and dangerous.
- ▶ Humans typically achieve water security through short-term and often costly engineering solutions, which can

create long-lived impacts on social-ecological systems. Faced with a choice of water for short-term economic gain or for the more general health of aquatic ecosystems, society overwhelmingly chooses development, often with deleterious consequences on the very water systems that provide the resource.

- ▶ Traditional approaches to development are counter-productive, destroying the services that healthy water systems provide, such as flood protection, habitat for fisheries and pollution control. Loss of these services will adversely affect current and future generations.
- ▶ Sustainable development requires both technological and institutional innovation. At present, the formulation of effective institutions for the management of water lags behind engineering technologies in many regions.
- ▶ Research from the GWSP and elsewhere confirms that current increases in the use of water and impairment of the water system are on an unsustainable trajectory. However, current scientific knowledge cannot predict exactly how or precisely when a planetary-scale boundary will be breached. Such a tipping point could trigger irreversible change with potentially catastrophic consequences.

The existing focus on water supply, sanitation and hygiene has delivered undoubted benefits to people around the world, but equally, we need to consider wider Sustainable Development Goals in the context of the global water system. Ecosystem-based sustainable water management, a pressing need that was reaffirmed at the Rio+20 Earth Summit, requires that solving water problems must be a joint obligation of environmental scientists, social scientists, engineers, policy-makers, and a wide range of stakeholders.

These realities motivate the water community assembled in Bonn for the Global Water System Project Conference "Water in the Anthropocene" to make a set of core recommendations to institutions and individuals focused on science, governance, management and decision-making relevant to water resources on earth. Given the development imperatives associated with all natural resources at the dawn of the 21st century, we urge a united front to form a strategic partnership of scientists, public stakeholders, decision-makers and the private sector. This partnership should develop a broad, community-consensus blueprint for a reality-based, multi-perspective, and multi-scale knowledge-to-action water agenda, based on these recommendations:

1) Make a renewed commitment to adopt a multi-scale and interdisciplinary approach to water science in order to understand the complex and interlinked nature of the global water system and how it may change now and in future.

2) Execute state-of-the-art synthesis studies of knowledge about fresh water that can inform risk assessments and be used to develop strategies to better promote the protection of water systems.

3) Train the next generation of water scientists and practitioners in global change research and management, making use of cross-scale analysis and integrated system design.

4) Expand monitoring, through traditional landbased environmental observation networks and state-of-the-art earth-observation satellite systems, to provide detailed observations of water system state.

5) Consider ecosystem-based alternatives to costly structural solutions for climate proofing, such that the design of the built environment in future includes both traditional and green infrastructure.

6) Stimulate innovation in water institutions, with a balance of technical- and governance-based solutions and taking heed of value systems and equity. A failure to adopt a more inclusive approach will make it impossible to design effective green growth strategies or policies.

The recommendations above, taken collectively, can constitute the centrepiece of a blueprint to promote the adoption of science-based evidence into the formulation of goals for sustainable development. Stewardship requires balancing the needs of humankind and the needs of nature through the protection of ecosystems and the services that they provide. Without such a design framework, we anticipate highly fragmented decision-making and the persistence of maladaptive approaches to water management.

+++ Sign the Bonn Water Declaration online under www.gwsp.org +++



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Conference Participants signing the Bonn Declaration on Global Water Security after the Closing Ceremony

Launch of a Data Visualisation on Water in the Anthropocene

(<http://www.gwsp.org/products/archive/video-water-in-the-anthropocene.html>)

A data visualisation on “Water in the Anthropocene” has been launched at the Opening Plenary of the GWSP Conference “Water in the Anthropocene: Challenges for Science and Governance” held in Bonn. It depicts the massive influence of humankind on the global water system of our Planet Earth.

Evidence is growing that our global footprint is now so significant we have driven Earth into a new geological epoch — the Anthropocene. The global water cycle has undergone significant changes in the last two centuries. Human activities such as damming and agriculture are changing the global water cycle in significant ways.

As datasets build upon one another, the film charts Earth’s changing global water cycle, why it is changing, and what this means for the future. The vertical spikes that appear in the film represent the 48,000 large dams that have been built. The 3-minute film was commissioned by the Global Water Systems Project for the international conference on “Water in the Anthropocene”. It has been produced and directed by the International Geosphere-Biosphere Programme (IGBP) and animated by Globaia. (globaia.org // igbp.net)

The scientific sponsors of this data visualization are CSIRO, IGBP, DIVERSITAS, IHDP, WCRP, Stockholm Resilience Centre and Future Earth.

“The list of human activities and their impact on the water systems of Planet Earth is long and important” said Anik Bhaduri, Executive Officer of the Global Water System Project (GWSP).

For example:

- Humanity uses an area the size of South America to grow its crops and an area the size of Africa for raising livestock
- Due to groundwater pumping in low lying coastal areas, 2/3 of major river deltas are sinking
- More rock and sediment is now moved by human activities such as shoreline in-filling, damming and mining than by the natural erosive forces of ice, wind and water combined
- Many river floods today have links to human activities, including the Indus flood of 2010 (which killed 2,000 people), and the Bangkok flood of 2011 (815 deaths)
- On average, humanity has built one large dam every day for the last 130 years. Tens of thousands of large dams now distort natural river flows to which ecosystems and aquatic life adapted over millennia



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During the 3-minute film vertical spikes appear representing 48,000 large dams that have been built

Interviews with Scientists and Policy Makers on the Conference

Conducted by Alma van der Veen & Sebastian Eckert (ZEF)

Interview with JOSEPH ALCAMO, UNEP, Nairobi, Kenya:

Can conferences like this help to convey messages from the scientific community to policy makers?

For sure it can. If we manage to distill down the big messages coming from this conference into some clear messages, which is not always easy for scientists. On the other hand it would be even better, if we invite the policy makers to these conferences, that we can actually have a face to face dialogue with them.



Joseph Alcamo during the interview

What is the role of water research in the upcoming initiative "Future Earth"?

Future Earth is a very exciting development on behalf of the science community, in which the global change research organization are now re-organizing themselves to make themselves more policy relevant. Water has to play an important role in there. If you would have asked me which topic should be on top of the agenda I would say Global Water Research as part of Future Earth needs to address development issues, because we still have the situation where 20 % of the world is holding 75 % of the world's riches. And I think those other 80 %, and they for sure think so, that they deserve their part of the world's riches. So I think a huge task for the science community has to work with that 80 % and show them how can they get their fair share of water and not destroy the global water system.

Interview with JAMES SYVITZKI, University of Colorado Boulder, USA:

What is the role of water in the Anthropocene?

The Anthropocene is a measure of the permanent record

of the footprint of humanity. If somebody came to Earth from another planet a million years from now would they see evidence of humanity, and is it big enough to be equivalent to how the ice ages changed the landscape, as an example? That is the concept of the Anthropocene. The role of water in it is that humans have been manipulating the water flows. One of the footprints of humanity is how we have changed the river systems, how we created lakes; we call them reservoirs behind dams. But we have done this all over the world. We have done it to such an extent that we have build one large dam every day for the last 132 years. We are changing where rivers flow, many rivers no longer flow to the coastal ocean, we use the water for irrigation and it goes up into the sky and rains on the ocean. We have changed the hydrological cycle and that is an example of how humanity's footprint is showing up in the water flows.

How can science contribute to a more sustainable water use?

Science is the backbone of how we learn about physics and how physics and biology manifests itself on the planet. We need a good fundamental understanding of the water cycle and how the water cycle interacts with the species called humans and how humanity is changing that cycle. In terms of sustainability we are able to make adequate measurements from space, we are able to make adequate ground base measurements. And all of this with a good fundamental background in science allows us to make useful decisions for whether we are overusing water,



James Syvitzki during the interview

whether the quality of water is good or not and whether we are doing something that could be harmful on the long run such as pump too much water out of the ground from the groundwater supplies at a rate that cannot be replaced say by rainfall. All of this is science based and you need good grounding in science to do sustainable science.

Why are deltas so important in the Anthropocene?

Deltas are to some extent – not completely- a byproduct of humanity in the first place. We have cut forest down, we have done huge amounts of mining in the hinterlands. All of this has moved a lot of sediment from the uplands to the low lands and these deltas have grown. They are very flat, they are very fertile, we grow crops there. Because of that a lot of people like living there close by the sea. We have right now at least half a billion people live on deltas. Unfortunately these deltas are sinking four times faster than sea level is rising, because of subsidence: We are mining water, gas, oil from the deposits that the deltas are consisting of. That causes these flatlands to be lowered. There is now a problem between humanity wanting to live there and making use of them (i.e. shrimp farms). Basically there are going to disappear in the next one hundred years. That is a problem, a migratory problem. Where are these people going to live when deltas are below water?

How can science-based information transform into policy action?

Policies are the ideas that at their very basics, taken into account governance, cultures, how we interact with each other, how rich people interact with poor people, how one country interacts with another country. Water at the very basis is one of these cross- cultural, cross- boundary issues. To make good water policy decisions we really need to understand our civil society. Science can play a very important role in making sure that we do not recommend something that will ultimately provide a very positive benefit to one part of our society or country and not to another. I think that science can definitely inform policy and it should inform policy and it should be a political.

Interview JOHAN ROCKSTRÖM, Stockholm Resilience Center, Stockholm, Sweden:

Why do you think politicians will follow the advice of scientists when it comes to planetary boundaries?

The science of planetary boundaries, which defines a safe operating space for humanity in the Anthropocene, has an opportunity to be picked up by policy, society and business for the three following reasons: The first one is that we are starting to see more and more empirical evidence that we are about to hit the ceiling the planet can cope with, we are starting to see real impacts on the economy today, which is understood. The second issue, which is interesting, we are starting to focus on benefits of action rather than the big costs of protecting the environment. We are starting to

understand that the biosphere, the environment at large from freshwater to biodiversity, is actually the basis for our economy, and that good business good development, good welfare originates from a very wise stewardship of the biosphere. The third reason is that we are living in an era where everyone understands that we are in the globalized phase of the economy, the globalized phase of communication and increased understanding has developed that we are in the



Johan Rockström during the interview

globalized phase of environmental implications. The whole notion of the Anthropocene is sinking in. And once you are in a globaliz for global partnerships, what we call planetary stewardship. But of course we are not there yet. But at least there is the trend towards this direction. One example is that the United Nations work on going from the Millennium Development Goals to the Sustainable Development Goals, where there is a genuine discussion on setting global sustainability criteria including freshwater within which you can have growth and prosperity. This is a totally new discourse compared to the old discourse, which has been growth and development while reducing environmental impacts as far as we can.

How can local improvements lead to positive change on a global scale?

The local-global interactions are today at the heart of necessary focus and solution. Up until recently we have been mostly preoccupied by investing in local improvements of freshwater use, of agricultural productivity, energy supply etc. We have not had to consider the fact that the global scale is now impacting on the local scale. We have now come to a point where global drivers of change, climate change affecting freshwater supply, affect the local scale. Now suddenly global sustainability is a prerequisite even for a farmer's livelihood in Burkina Faso or the economic development in a country anywhere in Europe. The global hits the local, but of course the trick is that success at the local scale has to add

up to meeting at the global scale. We now have come to a point where you need to have innovations at the local scale, scaling up and aggregating to positive change at the global scale. We do not have any good examples of that so far, this is the dilemma we are facing. Despite success on islands the curves are still moving in the wrong direction at the global scale. My conclusion is that we need much more global leadership. We need to have a political leadership that regulates the playing field by putting a carbon tax in place, a clear restriction on how we expand agriculture in the world, a clear restriction how we use freshwater, not as a way of putting hold on development but to create a space for growth and development. It is this magic of linking local innovation and growth with policy and support which can guide a transition to a more safe and desired future. This is often considered as utopia but I often try to remind everyone that we do that for example in global trade. We have mechanisms to work together as a global community when we have risks which we cannot accept. But for some reason when it comes to the environment it is always considered as being more or less impossible to solve at the global scale. There is an interesting opportunity to learn from other sectors in terms of now joining forces how to get to local improvements through global collaboration.

What does it mean if the tipping point for freshwater is reached?

We concluded that freshwater use is one of the nine planetary boundaries. Why is it one of the planetary boundaries? Well, this is because freshwater is, to put it simple, the bloodstream of the biosphere. It is the factor that determines the resilience of the entire terrestrial ecosystems, it is behind all biomass growth, it is behind all biodiversity, it is behind all agriculture in the world, and therefore it is the regulating factor behind carbon sinks, nitrogen flows, phosphorous flows, so it is the very mechanism behind the scenes under the hood of the earth system machinery to regulate the stability of the earth system. We concluded that you can empty your rivers in the world to a certain point beyond which you may start seeing threshold effects in terms of that regulatory capacity. We concluded that the boundary for that is in the order of 4000 km³ per year of maximum consumptive use. We are today using almost 3000 km³, so we are withdrawing much more, in the order of 6000 km³, but we are only consuming 3000 km³ as some of it flows through agricultural systems etc.. So we have some degrees of freedom at the global scale but we are rapidly moving towards the ceiling because we know that just to feed a world of 9 billion people will exceed the boundary. It is an interesting time right now: it is not as if we have pushed water so far that

we are in a global crisis, but we are certainly heading in the wrong direction and we have hotspots in the world where things are already in the red, so to say. The solution must be to be much more clever in terms of productive water use, basically to produce more human well being per drop of water. There is an enormous potential in using rainfall much smarter. In the end remember that it is only 10 – 20% of the rainfall which becomes runoff, 80% infiltrates in the soil and becomes green water which evaporates back to the atmosphere. This enormous amount of water can be used much more cleverly. We can manage our landscapes in ways that it maintains particular diversity of ecosystems which are not just there for the sake of preserving species, but for the sake of having much better flow of water through landscapes and therefore a much more stable supply and a

much more resilient supply so you can avoid shockwaves of floods, for example, when we have straightened out rivers to much but instead having meandering systems. It is the question of getting a much more clever, integrated stewardship for productive water use and for securing rainfall in the future. Then of course, we need to collaborate again as nations in the world. We have regions in the world that grow so fast and have so little water that their only solution for the future will be through virtual water trade; it will be through collaborative trading of freshwater via food produced in other parts of the world. So again, we need democracy and stability in the world to operate in order to share the finite freshwater we have. To conclude, the growth of demand of freshwater is tremendous, it is growing exponentially and will continue to grow exponentially as the world becomes richer and more populous but still the conclusion is: we can solve it. It is interesting that we have so much technology and so many management impacts and so much untapped potential. There is no scientific evidence that will suggest that we cannot sustain to feed a world population of 9 billion people, for example. I am emphasizing food because 90% of your and my freshwater need is for food after all, so this is the bulk of the freshwater we are using. 3000 – 4000 liter per person per day is for our diet. This is a challenge but also an area where we can move quite successfully into the future.



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“Freshwater use is one of the nine planetary boundaries”

Lakes in the Anthropocene

by Hita Unnikrishnan - Stipend of the GWSP Conference "Water in the Anthropocene"

Cities constitute complex urban social-ecological systems, whose integrity and resilience are dependent on the ecological and social interactions instrumental in their constitution.

The South Indian megapolis of Bangalore famously known as the Garden City of India and the country's Information Technology Capital represents an interesting landscape where change is an integral part of the system and where the past melds into the present and sometimes exists alongside what may be termed the trappings of modernity. Nowhere is this more true than in the interconnected lake system that has been an important part of the city's ecology – a system at once very ancient and yet the site of many ongoing physical and ideological struggles around the meaning of a water resource and the rights to access over them.

The city of Bangalore located on the Deccan Plateau is India's third most populous city and with a decadal growth rate of 46.68%. The city has figured prominently in historical records as an economic hotspot for well over a thousand years, despite being away from an abundant water source such as a river. Tributaries of the Kaveri namely the Arkavathy and the Vrishabhavathi do flow close to the city and as such transport much of the city's sewage. The city stands on ridges delineated by four watersheds, namely the Vrishabhavathi, Koramangala, Challaghatta and Hebbal watersheds providing it with a naturally undulating terrain. This undulating terrain was made use of in the construction of the lake system of Bangalore – a series of tanks that flow into each other across the watersheds and in the past provided a much needed water source for the city.

Lakes in Bangalore have traditionally served as common pool resources and provided important ecosystem services – provisioning, regulating, cultural and supportive to the various communities that have resided in and around their vicinity. Some of them belonging to as ancient a period as 200 AD, they have formed an indispensable part of the landscape for many centuries. Once numbering more than 250, today they stand reduced to a mere fraction of their original numbers with some reports stating that there are a total of only 17 lakes in living condition. Many of the lakes of the city have given way to the pressures of urbanization and development, being converted into malls, stadiums and housing complexes. Yet others have been encroached upon illegally. While they no longer provide water to the city, these tanks have also been important in flood regulation and heat mitigation services. Further, they have also been hotspots of traditional cultural practices for a long time most notably because they

have been managed as urban commons for a long period of time.

Lake systems in Bangalore are representative of complex coupled social ecological systems. One sees the existence of traditional agrarian communities along with migrant labourers, slums as well as posh housing settlements and apartments. This immediately brings to mind that populations around the lake are not homogenous. Neither can they be expected to have homogenous relations with the resource system – the lake, rather the system is likely to operate out of different norms, values and perceptions of the utility of the lake. Heterogeneity implies unequal power struggles and political explanations of resource dynamics. This heterogeneity in the social context is also likely to produce novelty in dealing with change, a marked diversity as well as the removal or restoration of land cover or land use types through competition and selection as has been witnessed in this landscape for a long period of time. There also exists a gradient between the rural and the urban between the newly incorporated wards of the city and Greater Bangalore, which is interesting in the context of how environmental variables may play a role in shaping the landscape. The presence of state control over the commons adds a further dimension to the scenario – that of artificial boundaries that constrain local interactions, further creating a potential for non linearities and thresholds.

This social ecological system that I am attempting to study is a characteristic representative of ecosystems in the Anthropocene – the age where humans influence and are influenced by changes in the environment. The conference "Water in the Anthropocene" has helped me to understand better this complex landscape. As a student embarking upon my PhD Research, this conference helped me develop fresh perspectives and am hoping to demonstrate that nuance in my work ahead. I thank GWSP and Water in the Anthropocene for providing me the opportunity to participate and share my research with my seniors and peers and receive their valuable feedback.



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The Challenge of Change: Water in the Anthropocene

by Owen Horwood - Stipend of the GWSP Conference "Water in the Anthropocene"

The management of natural resources can be conceptualised as a complex, long-term multi-stakeholder issue in which many players at many different levels have to assume responsibilities and account for this to others. Water is emblematic of the connectedness of nature and society, and its management essentially embraces two interacting decision-making systems: an ecological system and a human activity system. The former system may be described as the complex interaction between land, water and other biophysical components within a given geographical space and timeframe, whereas the latter system may be described as a complex network consisting of different levels of actors, from local stakeholders to governments. All these actors have their own roles, rights, responsibilities and often conflicting interests. This leads to a view of the two interacting systems as an overall decision-making-in-conflict system. Each level (element of the system) will interact with other levels. Through their activities actors influence and interfere with the very conditions they are taking into account when decisions are being made. The outcomes of such interactions can be either positive or negative, depending upon their impact on the sustainability of water resource management.

The interconnectedness of social and ecological systems described above gives rise to a central challenge in water management – namely, finding ways to deal with the uncertainty and complexity characteristic of ‘wicked’ problems. Wicked problems, alternatively termed meta-problems, are clusters of interrelated problems, characterised by high levels of uncertainty and a diversity of competing values and decision stakes. Remarkably, wicked problems cannot be solved by individuals or organisations acting alone and are inherently intractable, since what constitutes a solution for one group of people entails the generation of a new problem for another. Because wicked problems involve competing perceptions and values, and often also power disparities, they enter the realm of politics, understood here broadly as the forum for choosing between values and the process through which relations of power are constituted, negotiated and reproduced. As has been pointed out, water is frequently a contested resource: a contest with unpredictable and unstable outcomes and diverging pathways to alternative futures. There are thus no straightforward or ‘one size fits all’ solutions to water problems and each issue has to be dealt with in the context of its local setting.

While there is global concern about freshwater resources, developing countries in particular face complex challenges in realising effective water management. Indeed,

for most people, water scarcity is exacerbated by competition between users and by political, social and economic barriers that limit their access to water. In addressing inequities in the control over water and tensions between different water uses, existing institutional structures and governance arrangements are usually deemed inappropriate and a major constraint to achieving sustainable water utilisation. Based on principles of decentralisation, many policy-makers and practitioners alike have advocated managing water at the level of river basins and increasing stakeholder participation. This emphasis on territoriality in water management has led to water reforms in a number of countries, focussing on new national policies, instruments and institutions for managing river basins. These reforms are complex and problematic, posing profound political and institutional challenges, not least because river basin boundaries seldom coincide with administrative boundaries. Although substantive stakeholder participation is frequently advocated, it has proven elusive to achieve in practice. More often than not, participation is little more than token consultation, with no decision-making power in the hands of the people concerned. As water resource management devolves to the river basin level, serious thought needs to be given to how conventional social and political rights are assured in the river basin domain. In other words, to what extent is actual control over water exercised by users as well as citizens. Of special interest in this regard are the dynamics of knowledge production, dissemination and application. The role and influence of knowledge is important because differential access to and use of knowledge either empowers or marginalises certain stakeholders, with significant implications for decentralised decision-making at basin level and the promotion of more innovative and cooperative co-learning between water users. It is clear that such ‘knowledge-power’ asymmetries need to be addressed as particular knowledge-based discourses are able to bring to the fore particular policies or actions.



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Towards a New Water Ethic

by David Groenfeldt

If the term “anthropocene” is an acknowledgement of human power over nature, what is it that holds that power in check so it does not destroy the nature on which we ultimately depend? The cynic might respond that this is precisely the problem; global warming, and our failure to respond effectively, is evidence that we humans are incapable of limiting our power to alter nature. In this article I suggest another view: There are important counteracting forces, in the form of ethics, which guide human action away from the abyss of “ecocide”.

Within the domain of water management we have to look very carefully to find the underlying ethics that are mitigating the damage that humans would otherwise be inflicting on our water ecosystems. Decisions about allocating water or setting water quality standards are ostensibly based on legal requirements or economic cost/benefit analysis. This is the “real” world described in rational choice theory. But if we look more closely at the laws, and at the actual practice of economic analysis, we can find nascent ethics, like Spring sprouts poking through the soil. What is the basis for the US laws protecting endangered species and mandating minimal water quality standards? What is the basis for the EU requirement that rivers maintain “good ecological status” or that river basin committees reflect the diversity of stakeholder interests? It is because of ethics, I would argue, that our rivers and lakes and aquifers are not in much worse shape than they are already in!

The point of this article is not merely to express gratitude for the ethics that are already incorporated, unintentionally, into our water policies, but to suggest that we make a concerted and very intentional effort to incorporate more and stronger ethics into those policies. If a little bit of ethics is good, a lot more ethics could be much better. But for that to happen, we need to know more about the ethics we already have and then give serious thought to the additional ethics we would like to adopt.

Understanding the Ethics We Have

There is already a very clear consensus that we want water management that is sustainable, that does not continually “chip away” at natural systems, leaving us with lifeless rivers and dried up lakes and aquifers. There is also a consensus, articulated into a UN Resolution in 2010, that everyone on the planet has a right to clean water and sanitation. Further, there is a general commitment to participatory forms of water governance. These “macro ethics” provide a frame within which debates about operational specifics can take place. The macro ethics which

guide water policies are an outgrowth of the concept of Integrated Water Resources Management (IWRM), which incorporates a holistic view of water which gives particular recognition to environmental sustainability, social welfare, and governance arrangements. Embedded in the IWRM concept are four important principles with together constitute a surprisingly progressive water ethic:

1. Keeping nature alive. IWRM assumes that ecosystem services have value, and healthier ecosystems generally have more of those values than unhealthy ones. The overwhelming consensus, whether from businesses, governments, or environmentalists, is that functioning natural ecosystems must be part of the solution. The principle of “functioning natural ecosystems are indispensable” is not quite the same order as “rivers have a right to exist” but the two concepts are logically linked, and an exploration of the former principle can lead, I believe, to eventual support for the latter principle as well.

2. Human right to water and sanitation. Providing water and sanitation to everyone has been a key part of IWRM principles at least since the Dublin Statement in 1992. The crowning moment for endorsing the human right to water and sanitation was its adoption as a UN Resolution in 2010. This event solidified the stature of the human right to water as having a basis in international law, even though there is no provision for enforcing the standard.

3. Responsible Use. The intuitive concept of using water carefully was given an economic interpretation in the Dublin Principle that “Water has an economic value in all its competing uses.” According to the GWP “Water must be used with maximum possible efficiency”. While the economic language of IWRM has been criticized for its lack of social compassion, the underlying principle is straightforward: Water has an economic value and should not be wasted.

4. Participatory Water Governance. The Dublin Principles also contained some socially progressive language about governance, advocating a participatory approach “at the lowest appropriate level”. The importance of stakeholder participation, local community consultations, and especially the inclusion of women in all phases and aspects of water planning (Dublin Principle 3) clearly define an ethic of participatory governance.

These four generally accepted principles constitute an ethical baseline that we can use as a conceptual foundation for envisioning a broader set of water ethics, and at a more localized and operational scale. How can we get there?

Defining the Ethics We Want

Can we build on these shared principles, pull in some of the not-so-widely-shared ethics from specific cases, and then add some additional principles, and come up with a new, sustainable water ethic for the 21st century and beyond? In my view, designing and implementing that ethic is the critical challenge that water stakeholders -- all of us -- must address. All the behavioral changes implied by the challenge of sustainable water management depend on getting the ethics right first. Let's consider what those new ethics are starting to look like, and how they are already being operationalized.

1. **Managing Water Ecosystems.** Managing rivers for ecological health is a promising application of the economic principle of ecosystem services, and it is also an ethical development. This is seen in the EU's Water Framework Directive, which requires keeping rivers in good ecological status. It is also seen in the movement to remove some of the least useful dams, to re-naturalize rivers, and to make "room for rivers" to flood safely. The term "management" has already replaced "control" in discussions of flood strategies.

2. **Water for Food.** Of all the uses of water, none is as quantitatively important as agriculture, which uses about 3/4 of total supplies. Of course, agriculture is also part of the environment, and has the potential for providing ecosystem services on par with natural ecosystems. When a broad set of ecological, social, and cultural functions, and not only short-term economic returns, are incorporated into the valuation, the greatest returns per drop of water are likely to come from small-scale, agro-ecological farming strategies. That implies a very different ethic from that prevailing in industrialized food production.

3. **Water for People.** The formal UN decision in 2010 to recognize water as a human right, has spawned a huge response from the international community and local governments and NGOs. There is a strong underlay of ethical principles motivating these efforts. The significance of the global movement to ensure safe drinking water is its embrace of an expanded community of ethical concern, and offers hope to extend that ethical concern to environmental and cultural justice as well.

4. **Water for Industry.** Corporate water ethics falls into the relatively new category of Corporate Social Responsibility (CSR), and the triple bottom-line of economic, social, and environmental "profit". A promising new development is the concept of "water stewardship" defined by the Alliance

for Water Stewardship in the form of standards that individual companies can commit to following.

5. **Water Rights of Indigenous Peoples.** The concept of "free, prior, and informed consent" emerged from the World Commission on Dams and has become an international standard of ethical conduct between outsiders' proposals and Indigenous Peoples' interests. This standard is written into the UN Declaration on the Rights of Indigenous Peoples, and has been adopted by some of the major development agencies (e.g., Asian Development Bank) and even some transnational corporations.

6. **Water Governance.** Two important trends, which together offer an opening for applying a new set of ethical principles, are (1) legitimizing a governance role for everyone within a water basin and (2) applying a broad ecological frame to water use and management. Both trends were stimulated by the concept of IWRM but go further, fuelled by new ideas from feminist studies and deep ecology, as well as corporate social responsibility. The tangible expression of both trends is the establishment of new governance institutions at the basin level whether legally mandated or optional.

Taken together, these ethical trends suggest that at least some of the water ethics that we need are already emerging. How can there be any objection to participatory governance, or healthy rivers? This is where the topic of ethics take on practical importance. When maintaining a healthy river is viewed as an ethic which we choose to honor, for the sake of our grandchildren and for Nature herself, it becomes difficult to justify lax pollution standards. By making the ethics explicit we can compare competing ethical paradigms. Do we prefer to allow polluters to pay a fee so they can continue polluting? Or would we like those polluters to adopt new technologies and protect river health? Relying only on laws or economics will not result in the outcomes we need to thrive in the Anthropocene. We need to discover the power of ethics -- the ethics we already have, and emerging ethics which we can choose to adopt. Whatever choices we make about water will involve ethics implicitly or explicitly. Let's adopt the policy of "free, prior and informed consent" about our water ethics!



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Delivering Water From Disaster

by Charles Vörösmarty and Claudia Pahl-Wostl

If one incident best highlights the perilous state of the world's fresh waters, it's the "pig spill" in China last March. After the slaughter and illegal dumping of a diseased herd, the authorities in Shanghai went fishing for 16,000 bloated carcasses in the Huangpu River, which flows through the city. Hardly the thing you wish to hear about if you use the Huangpu for drinking water.

On the other side of the world, Greg Lyons tends a stretch of the Merrimack River in Massachusetts as a citizen volunteer. One by one, Lyons collects some of the 8 million plastic treatment disks released by a wastewater plant that malfunctioned in March 2011. The disks, two-inch wafers caked with sewage, today serve as a reminder of how massive public waterworks designed to protect the environment can sometimes go haywire. Lyons's catch by October 2011: 16,000 disks. The situation would have shocked 19th-century Transcendentalists who used the Merrimack to inspire a modern philosophy of humans in kinship with nature.

And then there is the Ganges, arguably the most polluted large river in the world. Each year it carries 16,000 tons of ash from cremated bodies along with a cocktail of sewage and toxic chemicals produced by a dense population and rapidly developing economy. This is no way to treat the goddess Ganga.

A panorama of our conflicted relationship with water is unfolding not only with the sensational fishing expedition for pigs or sewage disks, but with the countless decades of neglect and millions of misguided decisions we make daily regarding this essential resource. This was a chief finding of 350 water experts who recently issued the Bonn Declaration on Global Water Security.

And yet waterborne threats remain under the radar. Exposure to unsafe drinking water and inadequate sanitation results in 3.4 million deaths, mostly poor children, each year from diarrhea, yet this fact never makes the news. Threats also are rising in rich countries like Australia. In January, after drenching rains, residents of Brisbane were asked to restrict water use after the city's drinking water dwindled to just a six-hour supply. This occurred after the city's main treatment plant became clogged with sediment washing down from poorly managed land upstream. Across the United States, despite advanced pollution controls, more than 200 million people live within 10 miles of degraded fresh water. Europe is a global hotspot of aquatic biodiversity loss.

It is ironic that many of today's water problems arise from

the very solutions we administer. Proliferation of costly, so-called hard-path engineering, like centralized sewers and large dams, provide undeniable benefits, such as improved hygiene and stable water supply. But they also degrade waters with pollution, obliterate natural flow cycles and block the migration routes of fish and other aquatic life. By throwing concrete, pipes, pumps and chemicals at our water problems, to the tune of a half trillion dollars a year worldwide, we've hung a huge technological curtain between the clean water flowing through our faucets and the background array of problems in our rivers, lakes and groundwater. It is no surprise that the public is largely unaware of this or its growing costs.



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And virtually unknown to most is the collateral damage to freshwater biodiversity arising from mismanaged watersheds and waterways. Despite overuse and contami-

nation, freshwater ecosystems host a trove of diverse life, almost 10 percent of all known species and one-third of all vertebrates. The 20,000 aquatic species now extinct or imperiled are sending us an important message about our stewardship of fresh water.

Although water has figured prominently in the U.N. development agenda for decades, the world is at a critical juncture as the Rio+20 Sustainable Development Goals take shape over the coming 12 months. In the wings looms a hastily designed and politically motivated post-2015 development agenda. The developing world argues for autonomy in pursuing whatever water-related goals it deems necessary for growth, with a more or less singular focus on the basics of clean drinking water and sanitation. In contrast, the developed world argues for all nations to adopt a broader perspective emphasizing environmental protection, yet is retreating from financial support for the poor to help realize this outcome.

These two perspectives can be reconciled. While it is imperative that we meet the water and sanitation needs of all people, it would be wildly counterproductive if success were achieved at the expense of nature. In a financially strapped world, it is hard to imagine how preservation and sensible use of the rivers, lakes and wetlands would not be a valued component of any long-term development plan. And with the specter of climate change, the very water systems we today abuse, if better managed, could climate-proof society, for example by employing wetlands as natural shock absorbers against floods.

The price tag and environmental damage of poor stewardship and hard-path water management strategies mean that we need to design solutions that deliver basic water services while preserving freshwater ecosystems for future generations.

We are not against sensible deployment of water engineering. But by exporting to poor countries identical versions of the developed world's model for water management, we risk locking the development agenda into a vicious cycle of capital-hungry and energy-intensive solutions, resource degradation and overuse, and an expanding reliance on costly remediation. We advocate instead a do-no-harm strategy in lieu of emergency care and endless rehabilitation of damaged water systems.

If we fail, we will still have development — but not the sustainable kind.

Source:

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GWSP nodal office in China: The Research Institute for Water Security (RIWS), Wuhan University

by Jun Xia

China is facing increasingly significant challenges in terms of wisely managing water resources to support rapidly socio-economic development in 2020 and beyond. With a vast area of 9.6 million km² and relatively abundant water resources, China ranks sixth in the world after Brazil, the Russian Federation, Canada, the United States and Indonesia in terms of the absolute amount of annual runoff. However, given its large population of over 1.3 billion, China has a very low per capita amount of water resources (around one quarter of the world average), and thus faces one of the most severe water shortages in the world.

In China, the major basins, such as the Yangtze River, Yellow River, Pearl River, Hai River and Huai River basins, are facing different degrees of flood and drought, degradation of water ecosystems, and serious urban water problems such as water shortages and water pollution. Solving the above water issues and the protection of ecology and water security are the key to achieve strategic development goals in these regions. Regional water security especially emphasizes the need for sustainable use of water, harmony between humans and water, regional flood and drought control, water pollution control and water environment protection.

From October 18 – 22, 2013, the International Symposium on Ecohydrology and Water Security sponsored by Wuhan University, the International Water Resources Association (IWRA), the International Association of Hydrological Sciences (IAHS) and the Global Water System Project (GWSP) will take place in Wuhan and Yichang,

China. The topics of the symposium include modeling water cycle and eco-hydrological processes, forming mechanisms and control for flood and drought disasters, water quality management and water pollution control, and water security for ecological civilization construction and governance. In collaboration with its Chinese node, GWSP will organize a session on enhancing water security to the benefits of humans and nature. The session will focus on challenges that fast growing economies face in terms of water security and trade-offs between human and environmental water needs. While elaborating on and comparing experiences from different countries, priorities for research and policy can be identified.



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GWSP nodal office in Africa: The Centre for Water Resources Research (CWRR), University of KwaZulu-Natal, South Africa

by Graham Jewitt

Global change and its impact on Africa's water resources is a critical concern. Africa has many of the world's natural resources and societies most vulnerable to climate change and is currently experiencing rapid changes in land use and a corresponding degradation of its soil and water resources. Change is a consequence of its own economic development needs, as well as a strong demand from international role-players intent on securing land for future production of food, fuel, fibre and fodder. Whilst the imperative for development is clear, it is equally clear that Africa needs to develop its soil, land and water resources in a sustainable way and that this requires rigorous scientific input to inform policy, strong governance systems to ensure sound decision making and enhanced human capacity.

Africa's science institutions have been challenged to provide the education and training of individuals and the innovation and technological advances to achieve this. Furthermore, science interaction across disciplines is seen as an opportunity to provide innovative solutions needed to drive the transformation and development of its water resources. In response to this challenge, the Centre for Water Resources Research (CWRR) at the University of KwaZulu-Natal was established in October 2012.

With a focus on water resources related research in sub-Saharan Africa, the CWRR consists of staff, students and associates active in a variety of research projects in the region. Projects are funded by the European Union, DFID, USAID-NSF as well the Water Research Commission, National Research Foundation and various others, both internationally and in South Africa.

The activities of the Centre were recently highlighted through a special session at the GWSP conference "Water in the Anthropocene" held in Bonn in May 2013 entitled "Global Change in Southern African Watersheds: Vulnerabilities, Responses and Opportunities". Invited discussant for the session, Prof. Johan Rockström highlighted the way that cutting edge research was being undertaken in a transdisciplinary way. He was particularly impressed by the CWRR research approach where the collection of data in the field remains a focus in a time where internationally primary data sources are being dismantled. He commented that, due to the vulnerabilities the region faces in its social-ecological systems and in understanding their complexities and interplays, this is an absolutely critical need. He commented that the CWRR research in downscaling global change to the regional level and the findings and recommendations regarding water governance and management interventions for adapting to

and mainstreaming climate change were particularly useful.

A wide variety of research, capacity building and outreach activities will form a leverage point to enhance the recognition and relevance of the African GWSP Node. Activities include real catchments as research laboratories with a strong focus on these as "living laboratories" for the training of students; the ongoing development, maintenance and application of the ACRU Agrohydrological Modelling System; the development of innovative research niches such as remote sensing for water resources management, land-water-soil interactions, water harvesting studies and water governance; the hosting of a specialisation in "Earth Observation" of the regional WaterNet IWRM Masters course; a strong involvement of members in advising on local, national and regional governmental policies as well as participation in different national and regional Think Tank activities and a strong connection to regional scientific activities. It is envisaged that the CWRR will champion the regional case study for sub-Saharan Africa of the World Water Scenarios. The CWRR is likely to be confirmed as a UNESCO Category II centre at the UNESCO General Conference in November 2013, having already been approved by the South African cabinet and UNESCO Bureau.



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Impacts of Water Supply Uncertainty and Storage on Efficient Irrigation Technology Adoption

Summary by Talin Holtermann

Factors influencing the adoption of efficient irrigation technologies

As the demand for water continues to increase while at the same time climate change puts pressure on existing hydrological systems, efficient usage of water gains importance. Efficient water usage is especially crucial in the agricultural sector which typically uses up to 70% of water resources. Modern irrigation technologies which improve the efficiency of irrigation may form part of the solution towards sustainable water management and climate change adaptation at a farm level.

In order to encourage farmers to adopt efficient irrigation technologies, it is essential to understand the factors which influence this decision. Bhaduri and Manna use a dynamic analytical framework to explain a farmer's decision on the timing of adoption of efficient irrigation technology. They investigate the impact of water supply uncertainty stemming from climate change and water storage capacity at a farm level on the decision of farmers to invest in efficient irrigation technology under a flexible water price regime.

Impact of water storage capacity

In many regions water storage helps to mitigate the effects of scarce and unreliable water supply. The opportunity to store water raises the value of efficient irrigation technology to farmers and thus may induce them to improve their water-use efficiency. The study by Bhaduri and Manna explores if investment in water storage capacity at farm level could induce farmers to adopt efficient irrigation technology under variable water supply. Results imply that a complementary relationship between storage capacity at a farm level and investments in efficient irrigation exists. This relationship becomes stronger when variance in water supply increases. The opportunity of water storage encourages the adoption of efficient irrigation technology when water supply is unreliable. However, if farmers invest in water storage facilities, they also reduce their monetary resources available for investments in efficient irrigation technology. An analysis of expected technology adoption over time shows that the rate of adoption of efficient irrigation will first be lower than in a scenario without water storage opportunities, due to investments in storage capacity, and increase in later years. When given the opportunity to invest in water storage capacity, farmers will be motivated to use water more efficiently.

A flexible water pricing regime

Water pricing has often been argued to provide incen-

tives for more efficient water usage by establishing a recognized water value. The study investigates whether water pricing alone can guarantee higher adoption of efficient irrigation technologies given the uncertainty in water supply. A flexible water price system is assumed in which the water price depends on the excess demand of water. The theoretical results of the study indicate that the presence of a flexible water price alone cannot guarantee an increase in the adoption rate of efficient irrigation technology under increasing uncertainty in water supply. However, when examining expected adoption rates over time, the authors find that a flexible water price plays a significant role in inducing the adoption of efficient irrigation technology. In contrast to fixed water pricing schemes, flexible water pricing may encourage farmers to adopt efficient technology at a faster rate.

Policy implications

The results of the study indicate that flexible water price regimes as opposed to fixed, administratively determined pricing schemes may be more appropriate to promote the adoption of efficient irrigation technology among farmers. Although even flexible water pricing cannot guarantee higher adoption under increasing variance of water supply, it is a valid alternative for increasing the efficiency of water use. If farmers additionally have the opportunity to invest in water storage capacity, the rate of adoption of efficient irrigation technology will be significantly higher. Any approach which encourages investments in storage capacity, however, needs to consider the fact that the majority of farmers especially in poor countries have limited investment abilities.

Source:

Bhaduri, Anik, and Utpal Manna. (2013) "Impacts of Water Supply Uncertainty and Storage on Efficient Irrigation Technology Adoption." *Natural Resource Modeling*. DOI: 10.1111/nrm.12016

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The project “International Water Quality Guidelines for Ecosystems” (IWQGES) is successfully on its way

by Nike Sommerwerk and Janos Bogardi

On behalf of UNEP, the United Nations University Institute for Environment and Human Security (UNU-EHS) and the Global Water System Project (GWSP) will jointly manage the scientific process towards the International Water Quality Guidelines for Ecosystems (IWQGES). IWQGES will focus on water quality conditions that sustain healthy aquatic ecosystems and their functions.

Alarming water quality trends and existing guidelines

Human population growth, accelerating economic activities, land use alterations, and climate change increase pressures on the quality and quantity of global water resources, and threaten freshwaters as well as ecosystems. Declining water quality has become a global issue of concern threatening to cause major alterations in water use, ecosystem health, functioning and biodiversity it underpins. The Millennium Ecosystem Assessment (2005) notes that aquatic ecosystems are deteriorating faster than many other natural systems. Biodiversity loss, for example, is highest amongst aquatic species.

While international guidelines already exist for drinking water, recreational use, irrigation, livestock, and water reuse, among others, comparable international water quality guidelines for ecosystems are still missing.

UNEP priority area & international mandate

In recognition of the increasing challenges caused by

deteriorating water quality, UN-Water established the Thematic Priority Area (TPA) on Water Quality in 2010 and entrusted UNEP to coordinate it. Moreover have the UNEP member states, represented by the Governing Council in February 2013, adopted a decision to “[...] develop International Water Quality Guidelines for Ecosystems [...]”.

The project “Developing International Water Quality Guidelines”, IWQGES, has been set up together with three other UNEP activities to implement and fulfill the requirements of the decision of the UNEP Governing Council. The activities in response to the decision of the Governing Council thus have the mandate of the UNEP member states. As the flagship output, IWQGES’ progress is tracked with great interest.

Rationale & principles of IWQGES; scope of work

The aim of the IWQGES project is to develop a set of scientifically-based policy guidelines, enabling transnational, national, sub-national authorities to improve the sustainable management of their water resources and aquatic ecosystems. The guidelines will focus on water quality conditions that sustain healthy aquatic ecosystems and their functions. It is additionally aimed to draw linkages between the provisioned services and respective uses. These guidelines are intended to be global in scope and relevance, although a strong focus will be in assisting developing countries in their efforts toward im-



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proved protection of their aquatic resource base. Therefore primary emphasis will be given to the environmental, hydrological and climatic factors, as well as to the potential water uses, prevalent in these countries.

While water quality related problems threaten the health and functionality of aquatic ecosystems, these guidelines will not be restricted to chemical, biological and biodiversity related aspects. Water quantity, its adequate spatial availability, its temporal distribution, the morphology of water bodies, and the maintenance of environmental flows are critical factors co-determining the health of aquatic ecosystems to sustain biodiversity and their potential to provide and support essential ecosystem processes and services. Therefore, issues of water quantity will be also addressed in the guidelines to-be.

The IWQGES are aimed to be based on sound scientific evidence and to have global scope. They will however not be a substitute for standards to be established and enforced by sovereign state authorities, by intergovernmental bodies or through international conventions to be observed within their respective jurisdictions.

Although the guidelines will be global in scope, different spatial scales and ecosystem levels may need to be utilized to define regionally-relevant thresholds. However, due to limited baseline data about the health and functioning of ecosystems, and due to the lack of, or sparse, monitoring networks in some remote areas in some regions, it is expected that some recommendations may have to be based on best professional judgment, rather than on observational data. In this context, it is also expected that the guidelines will identify the need for more comprehensive and targeted monitoring programmes and further research.

Organization & IWQGES project team

Within the first phase of the project, until June 2014, a team of 8 internationally recognized scientists will develop the first draft of the guidelines. An International Review Committee as well as stakeholder consultations will support the work of the Drafting Team. Scientific communities and institutions are invited to contribute. The work on the guidelines is further aided by a local IWQGES project team in Bonn (UNU-EHS) and the Global Water System Project (GWSP). UNEP has the overall coordination and facilitation.

Important dates

In May 2013 a first meeting of the Drafting Team, the UNEP project partners as well as the local IWQGES team took place at the ZEF (Centre for Development Research) in Bonn. Important decisions on principles and the way forward were made; a second drafting meeting is already scheduled for October 2013. The official launch of the project will take place October 10th, 2013, in the frame of the Budapest Water Summit.

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Workshop on Future Scenarios on Water Security Threats

19-20 May 2013 in Bonn, Germany

On 19 – 20 May, 2013, GWSP hosted the second meeting of the Joint Research Team on Future Scenarios on Water Security Threats at the Centre for Development Research in Bonn, Germany. The project is lead by GWSP co-chair Charles Vörösmarty (City University of New York) and is a component of a larger International Institute for Applied Systems Analysis (IIASA) - UNESCO World Water Scenarios Initiative.

The focus of the project is on human water security, with the aim of improving the current understanding of the geography of water-related ecosystem services, accounting for both biophysical and economic controls on services, and assessing how new management strategies can enhance the resiliency of the global water system over a 100-year time horizon. Addressing this hypothesis forces a substantial advancement in current capabilities, namely to extend analysis into the 21st century through scenarios, develop explicit links to freshwater ecosystem services, assess how the condition of ecosystem services influences the world economy through individual sectors (e.g., food, energy, domestic water supply, fisheries), and global trade, identify critical thresholds, constraints, and feedbacks, and consider tradeoffs that could reduce emerging water resource constraints, preserve ecosystem services, and yield economic benefits in the future economy.

A series of future scenario projections of the stressors pro-

ducing human water security threats and prompting engineering, economic response and/or governance interventions will be formulated. Analysis will include sensitivity tests to identify which variables, parameters, and regions are most sensitive to the state of freshwater resources, which produce the greatest feedbacks and exhibit the most sensitive thresholds. Scenarios will include existing scenarios (e.g. Millennium Assessment, Intergovernmental Panel on Climate Change Assessment Report 5 (IPCC AR5)), as well as those generated by the Joint Working Team.

The next meeting of the GWSP-IIASA Joint Research Team will be hosted by the International Institute for Applied Systems Analysis in Laxenburg, Austria, 3 – 4 October, 2013.

The joint research team is formed by Charles Vörösmarty (City University of New York), Anik Bhaduri (GWSP Executive Officer), Ben Stewart-Koster (Griffith University), Bill Cosgrove (IIASA), Martina Flörke (University of Kassel), Michelle van Vliet (Alterra Wageningen UR), Pamela Green (The City College of New York City University (CCNY/CUNY)), Balazs Fekete (CCNY/CUNY), Günther Fischer (IIASA), K.C Samir (IIASA), Riahi Keywan (IIASA), Hester Biemans (Wageningen UR), Reinhard Mechler (IIASA), Piotr Magnuszewski (IIASA), Sylvia Prieler (IIASA), Paul Yillia (IIASA), Marijn van der Velde (IIASA) and Yan Xu (University of Groningen).





Water Research Horizon Conference

25 - 26 June 2013 in Berlin, Germany

The Water Research Horizon Conference acts as a platform of dialogue on the Grand Challenges in water research. In its frame, the water science community meets annually to discuss among the various disciplines of water research on the major challenges to be met by integrated water science. At the Water Research Horizon Conference 2013, organized by the Helmholtz Centre for Environmental Research (UFZ) and DFG Kommission Wasserforschung, two workshops were held by GWSP.

Workshop: Quality is Scarcity

by Lynn Schüller

The Open Space Workshop 'Quality is Scarcity' was organized by Anik Bhaduri (GWSP), Nike Sommerwerk (UNU-EHS), Claudia Pahl-Wostl (GWSP), Martin Pusch (Leibniz-Institute of Freshwater Ecology and Inland Fisheries (IGB)), and Dietrich Borchardt (UFZ).

Speakers	Title
Anik Bhaduri (GWSP)	Introduction - Quality is Scarcity
Dietrich Borchardt (UFZ)	WWQA- Basic Concepts and Roadmap
Nike Sommerwerk (UNU-EHS)	International Water Quality Guidelines
Martin Pusch (IGB)	Linking water quality with water quantity
Claudia Pahl-Wostl, (University of Osnabrück, GWSP)	Water Quality Governance

Human population growth, accelerating economic activities, land use alterations, and climate change increase pressures on the quality and quantity of global water resources, and threaten freshwater ecosystems. It is beyond doubt that the human water security has often been achieved in the short term at the expense of the environment with negative impacts on the resilience of social-ecological systems. Declining water quality, for instance with harmful implications in the long run for social-ecological systems as a whole, has become a global issue of concern.

There is a need to understand and reduce trade-offs between competing water demands (both quantity and quality) and to build capacity for a holistic approach to enhance and sustain water security and the resilience of social-ecological systems. The concept of environmental flows in combination with the ecosystem services concept can serve as such a guiding principle; and allow to understand better the nexus among water 'quality and quantity' attributes, identify tipping points and threshold values and thereby determine the potential to provide essential ecosystem processes and services.

The objective of the session was to raise awareness of the fact that water scarcity is even more a quality than a quantity problem. The discussion included the development of scientifically-sound regulatory guidelines that can help to improve the sustainable management of water resources and aquatic ecosystems. Further, the workshop discussed the requirements for governance systems and management to implement such guidelines, how societal learning and decision making processes can be supported to promote change towards following such guidelines, and how to enhance water security and the resilience of social-ecological systems.

The workshop also focused on the following questions, in particular, under these themes: Process understanding, system analysis and modeling, data issues, and societal themes.

What influences the tradeoff between water quantity and quality?

The workshop recognized the important relationship bet-



ween quality and quantity of water. Lower quality of water, for instance, can have a direct impact on the quantity of water if the polluted water cannot be used for various purposes where quality matters. Here, one has to take into consideration that the purpose of water use is important as the required criteria for water quality vary according to different purposes, for example domestic purposes or watering fields.

Martin Pusch, in his presentation, emphasized that such tradeoff between quantity and quality exists. He referred to a study which shows that a river might need less minimum ecological flows if the quality of water is good and the river morphology is intact. The resilience of water systems, however, depends on the sensitivity of the respective water systems as different water systems response differently to stress factors and tipping points, and hence the characteristics of the tradeoff will vary according to different river systems.

The tradeoff between water quantity and quality is also influenced by governance, for instance legislation to ensure standard quality water may not ensure the same quality of water in abundance.

How to promote behavioral change and induce action necessary for informed understanding of the effects of human activities on water quality?

The workshop recognized that the absence of a communication platform between polluters and users may negatively affect water quality. Often pressure induced by the public may trigger changes in laws and penalties for polluters. However, in many instances polluters unknowingly pollute; and hence a warning system is needed and education needs to be strengthened to increase the awareness of society. High costs of polluted water such as loss of biodiversity and degradation of health triggers people to think differently and change their behavior, and thus may induce changes in laws and penalties. Further the workshop addressed that water should be seen as a human need rather than a human right in terms of enhancing water quality. This results in water being valued in economic terms and encourages sustainable investments in water systems which enhance and maintain water quality.

Which kind of system analysis do we need in water quality research to ensure sustainability for the environment and society?

The workshop highlighted the problem of data availability in performing appropriate system analysis. The monitoring of water quality and quantity on a regular basis is needed and goals need to be defined in order to ensure adequate outcomes. Moreover, transparency of monitoring processes needs to be ensured by making results available for the public. While this is currently being done in developed countries, monitoring processes in developing countries need to be strengthened and skills need to be enhanced for that purpose. The implementation of water quality guidelines is a helpful tool for improving water quality and quantity. These guidelines are not binding, but implement a standard in establishing and maintaining water quality. Their implementation depends on governments and institutions which provide guidelines for water quality on a national and global level. However, standards need to be adapted to individual cases in terms of physical characteristics and value to suit regional and local needs especially in developing countries. The workshop highlighted the work of the ongoing projects “International Water Quality Guidelines for Aquatic Ecosystems” of the Global Water System Project and the United Nations University Institute for Environment and Human Security as well as “World Water Quality Assessment” of the Centre for Environmental Research - UFZ and the University of Kassel for UNEP.

Workshop: Urban Water System and Human Well-Being

by Saravanan Subramanian

The session was organized as an ‘open-space’ workshop with a goal to bring together experts to share and deliberate issues from different parts of the world to understand the urban water systems for meeting the growing challenge from rapid urbanization worldwide. In addition, it will build together a consortium on urban water systems in Germany.

Speakers	Title
Anik Bhaduri (GWSP)	Introduction
Timothy Moss (IRS Berlin)	Urban Water Research at IRS
Claudia Pohl-Wostl (University of Osnabrück, GWSP)	Urban Water Governance
Saravanan Subramanian (ZEF)	Water Security and Urbanization



Urbanization is emerging as a growing public health concern in developed and developing countries. Nearly half the world's population now lives in urban settlements (UN, 2010). The urban water system takes a systems view by integrating drinking water, sanitation, sewerage water and storm water drainage to ensure effective use and management of urban water. Recognizing the urban water cycle in its totality can enhance environmental and social sustainability for human well-being. Human well-being is understood in a broader sense.



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The session was attended by about 12 participants with two breakout group discussions on the following: (i) to identify the factors for effective monitoring and evaluation of the water infrastructure. (ii) to identify the policies and tools to improve the integration of existing information on water and to facilitate the urban water flows. (iii) to identify types of research to enhance urban water infrastructure.

The participants identified some of the key factors hampering urban water system: (i) Cultivated invisibility of infrastructure by service providers and aversion to innovation in developed countries has seriously hampered infrastructure in developed countries. (ii) Lack of financial and human resources capacity, inadequate information, and poor urban planning has seriously made infrastructure inefficient in developing countries. (iii) Inflexibility of regulation, centralized systems, non-transparency of decision-making process, inefficient under-pricing and lack of coordinated approaches in both developed and developing countries.

The participants called for strengthening research in the following areas: (i) Analyze the incentives to improve the infrastructure and to adopt innovative options. (ii) Comparative analysis of different governance arrangements. (iii) Analyzing the linkage between infrastructure design and infrastructure governance. (iv) Develop an assessment framework for different types of technologies considering its implications for governance and finance.

From the list of participants attended, the organizers plan to initiate a consortium of urban water group in Germany, with a follow-up for the next Water Research Horizon Conference in 2014.

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GWSP Co-Chair Claudia Pahl - Wostl receives Water Resources Award 2012

During the Water Research Horizon Conference 2013 GWSP Co-Chair Claudia Pahl-Wostl (University of Osnabrück, Institute of Environmental Systems Research) has been honored with the "Water Resources Award 2012" which has been awarded for the first time by the Rüdiger Kurt Bode-Foundation.

Claudia Pahl- Wostl is considered an exceptional researcher. Her integrative and innovative approaches in the field of adaptive water resources management at the interface of social sciences are outstanding. Her work includes scientific, technical and societal approaches. The award also honors her team building spirit and her ability in bringing together and raising the interest of young professionals from all over the world. The award is endowed with €100.000 which is designated for further research activities in water resources management.

Global Water Needs Initiative (GWNI) Workshop

30 September – 1 October 2013 in Bonn, Germany

This workshop organized by GWSP Co- Chair Claudia Pahl- Wostl will take place at the Center of Development Research (ZEF) in Bonn, Germany. It will be sponsored by the International Water Management Institute (IWMI).

The workshop follows the 1st GWNI workshop which took place in Bonn in November 2011. During the 1st GWNI workshop, world leading scientists in the fields of environmental flows and water governance and practitioners with professional backgrounds in ecology, hydrology, economics and governance developed ideas for joint activities. These joint activities lead to the construction of a conceptual framework and to the derivation of a universally applicable classification system for sustainable environmental flow requirements (EFR). The classification system will help to determine the limitations as well as the potential of the transferability of EFR from one case study to another. It will improve the representation of EFR in global models and help to analyze already existing empirical evidences. The conceptual framework and the classification system will be tested on regional case

studies and will be compared, analyzed and validated in shared research protocol.

The joint research team is formed by Graham Jewitt (University of KwaZulu-Natal), Elena Nikitina (EcoPolicy), Stuart Bunn (Griffith University), Rebecca Tharme (Nature Conservancy), Keith Richards (University of Cambridge), Maja Schlüter (Stockholm Resilience Centre), Louis Lebel (Chiang Mai University, Thailand), Anik Bhaduri (GWSP), Matthew McCartney (IWMI), Christian Knieper (University of Osnabrück).

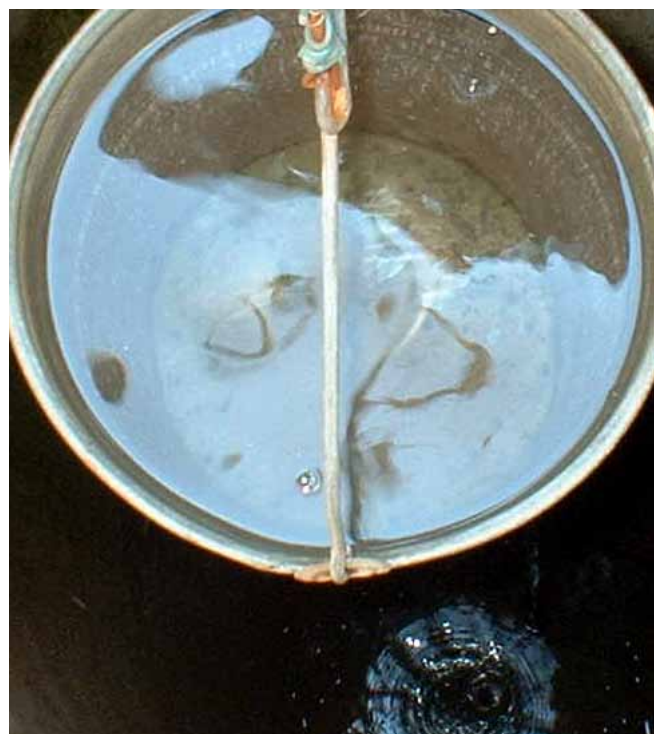
The upcoming 2nd GWNI workshop will start with the development of alternative funding sources to realize joint activities. Moreover, the establishing of an inventory of data that could be used a synthesis will be discussed as no new data collections are available, but the need for standardization is given. Another important topic of the upcoming workshop will be the detailed, more accurate elaboration of the EFR classification system and framework.

Workshop on Future Scenarios on Water Security Threats

3 – 4 October 2013 in Laxenburg, Austria

The next meeting of the GWSP-IIASA Joint Research Team on Future Scenarios on Water Security Threats will be hosted by the International Institute for Applied Systems Analysis (IIASA) in Laxenburg, Austria, 3 – 4 October 2013.

The joint research team is formed by Charles Vörösmarty (City University of New York), Anik Bhaduri (GWSP Executive Officer), Ben Stewart-Koster (Griffith University), Bill Cosgrove (IIASA), Martina Flörke (University of Kassel), Michelle van Vliet (Alterra Wageningen UR), Pamela Green (The City College of New York City University (CCNY/CUNY)), Balazs Fekete (CCNY/CUNY), Günther Fischer (IIASA), K.C Samir (IIASA), Riahi Keywan (IIASA), Hester Biemans (Wageningen UR), Reinhard Mechler (IIASA), Piotr Magnuszewski (IIASA), Sylvia Prieler (IIASA), Paul Yillia (IIASA), Marijn van der Velde (IIASA) and Yan Xu (University of Groningen).



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GWSP at World Water Week

1- 6 September 2013 in Stockholm, Sweden

Each year the World Water Week (WWW) addresses a particular theme to enable a deeper examination of a specific water-related topic. 2013 theme is "Water Cooperation - Building Partnerships". GWSP is co-convenor of the following WWW events:

► Cooperation to address the complexities of water management

September 1, 09:00-12:30, Room B7

The session is organized jointly with International Institute of Applied System Analysis (IIASA), Global and Calouste Gulbenkian Foundation, focuses on the critical role of cooperation among decision-makers in water resource management at different levels in the public and private economic and social sectors. GWSP considers water as the preeminent building block of the earth system and of critical necessity to human prosperity. At the same time, humans are rapidly embedding themselves into the basic character of the water cycle without full knowledge of the consequences.

Representatives of the Global Water System Project will discuss water threats and water security and how to make future scenarios more policy relevant.

Speaker	Title
Janos Bogardi (GWSP)	Opening Comments and Welcome Speech
Luis Veiga da Cunha (Universidade Nova de Lisboa)	Water and the Future of Humanity: An Initiative of the Calouste Gulbenkian Foundation
Jan Lundqvist (SIWI)	Water and the Future of Humanity: Key Messages
Charles Vörösmarty (University of New York, GWSP)	Water Threats, Water Security and a Hippocratic Oath for Water
Claudia Pahl-Wostl (University of Osnabrück, GWSP)	Making Scenarios more Policy Relevant: Addressing Governance and Involving Stakeholders.
Olcay Unver (WWAP)	World Water Scenarios Initiative: Background and Partnership Base
David Wiberg (IIASA)	Water Futures and Solutions Initiative
Janos Bogardi (GWSP)	Discussion Panel: How Cooperation will Facilitate and Enrich Way Forward

► Cooperation towards Quality Standards for Aquatic Ecosystems

September 2, 17:45-18:45, Room B7

Under the aegis of UN Water Thematic Priority Area "Water Quality", an international project is launched to develop comprehensive international water quality guidelines for various aquatic ecosystems worldwide. The concept will be introduced, including its emphasis on aquatic ecosystems prevailing in developing countries. The event will start with outlining the scientific challenge to establish these guidelines and will then address the issues of implementation and sustainability. It is expected that the subsequent discussion will provide important additional insights and will facilitate to form partnerships for project implementation. The event is convened by GWSP and co-convened by United Nations Environment Programme and United Nations University Institute for Environment and Human Security.

Speaker	Title
Janos Bogardi, GWSP	Opening and Welcome
Thomas Chiramba (UNEP)	UNEP's Initiatives in the Area of Water Quality and the International Water Quality Guidelines for Ecosystems Project
Nike Sommerwerk (UNU-EHS)	Concept and Implementation of IWQGES
Rebecca Tharme (TNC)	Water Quality Guidelines and Ecosystem Flow Requirements
Janos Bogardi (GWSP)	Discussion and Summary

GWSP will have an information booth in the exhibition hall.

For more information please visit:

<http://www.worldwaterweek.org/programme>

WORLD
in Stockholm,
September 1-6, 2013
WATER
WEEK

GWSP at Budapest Water Summit

8-11 October 2013 in Budapest, Hungary



To move forward the post-Rio water agenda the President of Hungary announced 2012 in Rio de Janeiro Hungary's intention to organize an international conference under the auspices of the United Nations in October 2013 in Budapest. This conference – the 2013 Budapest Water Summit – forms part of the events of the UN International Year of Water Cooperation led by UNESCO. With the participation of UN Member States, competent UN agencies and bodies as well as all concerned economic and social partners the Summit aims to contribute to the elaboration of the water-related Sustainable Development Goals and provide concrete guidance on the most pressing water issues – drinking water, sanitation, waste water treatment, integrated water management, international water cooperation, innovative water technologies – with a view to defining the priorities of global development policy post 2015.

The water community assembled in Bonn for the Global Water System Project Conference on “Water in the Anthropocene”, 21-24 May 2013, to make a set of core recommen-

dations to institutions and individuals focused on science, governance, management and decision- making relevant to water resources on Earth. These recommendations have been summarized in the “Bonn Declaration on Global Water Security” and can be understood as a contribution in shaping the SDGs: “The existing focus on water supply, sanitation and hygiene has delivered undoubted benefits to people around the world, but equally, we need to consider wider Sustainable Development Goals in the context of the global water system. Ecosystem based sustainable water management, a pressing need that was reaffirmed at the Rio+20 Earth Summit, requires that solving water problems must be a joint obligation of environmental scientists, social scientists, engineers, policy-makers, and a wide range of stakeholders”. The GWSP conference on “Water in the Anthropocene” has been the scientific preparation of the Budapest Summit: The Bonn Declaration on Global Water Security was considered while drafting the Budapest Declaration (in process).

GWSP involvement in Budapest is as follows: Janos Bogardi, GWSP Senior Advisor, will moderate a panel on IWRM to provide water for a growing population in the political part. In the same session Charles Vörösmarty, GWSP Co-Chair, is keynote speaker. Joyeeta Gupta, GWSP SSC member, is rapporteur of the political segment on water governance. Anik Bhaduri, GWSP Executive Officer, and Claudia Pahl-Wostl, GWSP Co-Chair, will be part of the Science Forum being organized within the Water Summit. During the Summit the GWSP led (coimplemented) project of International Water Quality Guidelines for Ecosystems will be officially launched.





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ORGANIZATIONAL FRAMEWORK

The Global Water System Project (GWSP)

- GWSP is a Joint Project of the four Global Environmental Change Programmes: the International Geosphere- Biosphere Programme (IGBP), the International Human Dimensions Programme on Global Environmental Change (IHDP), the World Climate Research Programme (WCRP) and DIVERSITAS, the international programme of biodiversity science.
- The mission of GWSP is to understand the ways in which humans use the resources and influence the dynamics of the global water system and to advise decision-makers on how environmental and social consequences can be mitigated.

GWSP MISSION

