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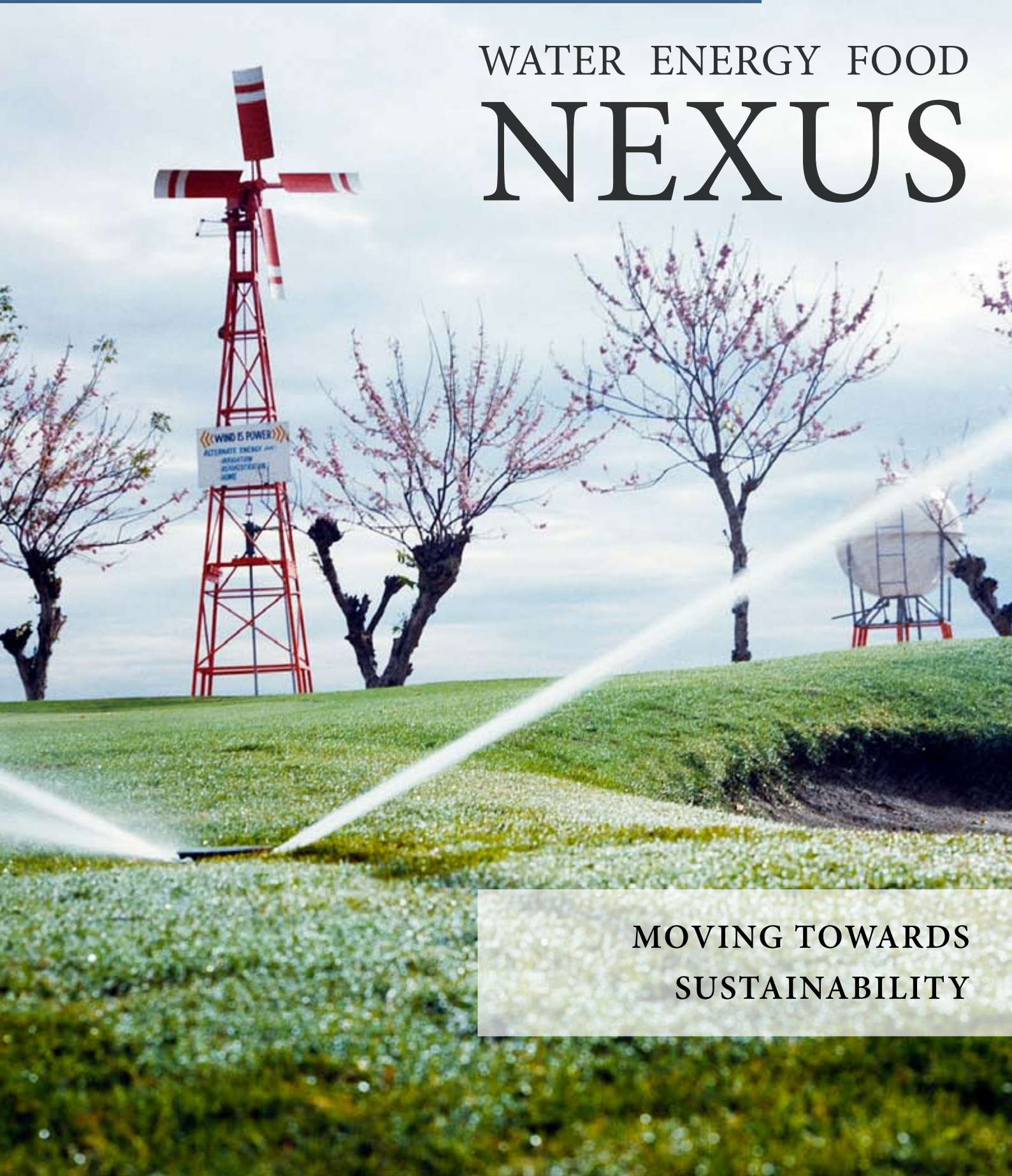
GLOBAL WATER NEWS



WATER ENERGY FOOD
NEXUS

MOVING TOWARDS SUSTAINABILITY

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Editorial

by Anik Bhaduri

Today, we observe an alteration in our environmental and wellbeing conditions which has been the result of multiple rapid interconnected changes, in particularly in the water, energy and food sectors. As a result of growing natural resource scarcity, such interconnectedness of sectors has become more apparent and evident. The situation calls for science-based policy- and decision-making towards cross sectoral resource efficiency. This is a joint global responsibility which necessitates cooperation among scientists and policy makers. It requires an approach that reduces tradeoffs, builds synergy across sectors, and helps to reduce costs and increase benefits for humans and nature compared to independent approaches to the management of water, energy, food and the environment. Now it is quite widely accepted that that we have little options other than following a nexus approach to address sustainable development, however we still have a wide knowledge gap on how to implement such a nexus approach.

Since the past few years, the Global Water System Project (GWSP) has been actively involved in collecting and collating information on the Water-Energy-Food (W-E-F) nexus in large, usually transboundary basins. GWSP's initiative investigates how the W-E-F nexus can be best considered and addressed in the governance and management of large river basins from different parts of the world under the influence of global change. GWSP research also explores different tools in order to accelerate the development of an enabling environment for integrated water, energy, and food planning, and actively reviews the information needs of resource-managers and policy-makers dealing with efficient policies and programmes related to water, energy and food security. The recently held workshop on the role of earth observation in the W-E-F nexus, jointly organized by GWSP, the Food and Agriculture Organization of the United Nations (FAO) and the European Space Agency (ESA) is one such instance to improve nexus assessments and to inform users on how to address issues related to water, energy and food security.

This month, GWSP along with the United Nations Environment Programme (UNEP), the German Development Institute / Deutsches Institut für Entwicklungspolitik (DIE), the Center for Development Research (ZEF) and the Water Land Ecosystem Program (WLE) of CGIAR, and with the kind support of the German Federal Ministry of Education and Research (BMBF) is organizing an international conference on "Sustainability in the Water-Energy-Food Nexus" to be held in Bonn, Germany. The conference will address the sustainability of the Water-Energy-Food nexus as a key research-for-action initiative and aims to develop ideas, ways and solutions to inform, influence, and catalyse necessary action by key stakeholder groups such as policymakers, non-governmental organizations, the private sector, educators and researchers. As part of this conference, a summer academy is also organized to bring together young scientists and leading experts to identify key water issues and environmental problems in the W-E-F nexus and improve communication of research findings to scientific and political communities.

This newsletter sets the stage for the conference and summer academy by featuring several articles, interviews, and viewpoints on the W-E-F nexus. Implementation of the nexus is often considered predominantly a governance problem. GWSP Co-Chair Claudia Pahl-Wostl along with Joyeeta Gupta and Sina Marx write the lead article on governance of the nexus and provide insights about institutional settings, and capacity which are required for a successful implementation of a nexus approach. Other than the article on governance, the newsletter summarizes two recent articles on the nexus, led by Claudia Ringler and Richard Lawford respectively, which were published in a GWSP-organized special issue of the journal "Current Opinion in Environmental Sustainability". The special issue on "Water in the Anthropocene. New Perspectives for Global Sustainability" was published in December last year and is a key product of last year's GWSP conference "Water in the Anthropocene".

Recognizing water and land as crucial contributors to food security, GWSP in collaboration with the Global Land Project (GLP) and the International Human Dimension Programme on Global Environmental Change (IHDP) came out with a Summary for Decision-Makers (SDM) on the topic of land degradation, floods and droughts and their impact on issues relevant to the policy agenda. The newsletter brings in some key elements of the SDM with a background article by Janos Bogardi on why water and land cannot be separated. The newsletter also features a summary of a recently published article by Pahl-Wostl et al in the journal "Current Opinion in Environmental Sustainability" which highlights the fact that a global water research agenda needs to focus not only on basic research but also on solutions through the co-production of knowledge. Water is and will remain a crucial factor of adaptation to the multifold challenges that human kind is facing today. With a clear objective of promoting the adoption of science-based evidence into the formulation, implementation and monitoring of goals for sustainable development, the GWSP team led by Claudia Pahl-Wostl has prepared a blueprint for a Sustainable Water Future initiative, arguing for the necessity of a strong water programme during the next decade of global water research. GWSP's envisaged "Water Visions Lab Network (WVLN)" which aims at integrating research with practical solutions is a step forward in attaining such an agenda.

Before I close, I want to invite you to actively participate in the upcoming Conference on "Sustainability in the Water-Energy-Food Nexus", an event that will help to identify research and funding gaps for nexus policy-making and research on a global level.

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Governance of the Water-Energy-Food Nexus

by Claudia Pahl-Wostl, Joyeeta Gupta and Sina Marx

The interconnectedness of hydrological processes and water resource management has long been known at local and basin scales. IWRM (Integrated Water Resource Management), as the name suggests, is an environmental stewardship paradigm recognizing explicitly the complex nature of the water system and its interdependencies, simultaneously seeking to avoid unintended and undesirable consequences engendered by isolated management interventions. Other sectors have also adopted similar integrative paradigms: the food sector has adopted integrated pesticide management; the energy sector struggled to adopt an integrated energy planning and management paradigm; and the waste sector has adopted the integrated waste management paradigm.

However, these paradigms developed from within each sector, and were unable to engage other sectors. This was because each sector/issue operated governance in isolation within line ministries. At the same time, the integration objectives stated by these paradigms cannot be achieved without cross-sectoral collaboration that recognizes and respects the objectives, constraints, and possibilities of the other sectors. Resulting policies on and tools for coherence, coordination, and mainstreaming at national to global level were largely technocratic without paying sufficient attention to, and thus unable to bypass the politics of sectoral decision-making.
In recent years, the concept of the water-energy-food (W-E-F) nexus has moved to center stage, a response to the need for integration of sectoral policies. A key question is whether the nexus approach is able to better deal with the politics of mandate and turf battles than the other approaches. We argue that adopting a W-E-F nexus perspective may indeed be a game-changer since it implies an entire reframing of the problem perspective. The nexus should be governed with a focus on interaction between policy fields and not on policy fields in isolation. It would create a "level playing field" with an equal balance of interests between sectors and an increase of benefits of the nexus as a whole with identification and recognition of synergies and trade-offs. But it is also evident that implementing a nexus perspective is predominantly a governance problem. There is a huge lack of institutional capacity to govern across sectoral boundaries.
The coordination challenge is manifold. Barriers to cross-sectoral coordination reside in entrenched domain interests and power structures, rigid regulatory sectoral frameworks and planning and implementation procedures, established sectoral communication structures and line hierarchies, where bureaucrats are accountable to their bosses and not to the common goal. Coordination entails first of all additional costs and the risk that overly bureaucratic procedures may block effective negotiation and implementation. Perceived benefits need to exceed transaction cost which requires communication and dialogue and a transformation of incentive structures for personnel. The questions of what should be coordinated at which level and which governance settings and policy instruments are appropriate, need to be addressed.
To date no policy framework exists that explicitly addresses coordination of the W-E-F nexus. However, some provisions are already in place at different levels to coordinate across sectoral boundaries.
At global level UN Water was established in 2003 to coordinate UN activities on water and also encourage participation of non-UN actors. It was conceived as an interagency mechanism to coordinate action for achieving water-related targets set by the UN Millennium Declaration (MDGs) and implementing decisions concerning water that were made at the 2002 World Summit on Sustainable Development. Given its mandate and formal embedding in the UN-process UN-Water cannot and does not play the role of a powerful leader and reformer of the global water governance system. It rather operates in the background and expert networks. UN-Water has managed though to improve the often missing or weak link between knowledge production and politics. Despite its coordination function across a wide range of agencies UN-water focuses on water related targets and not on a nexus perspective. The current process to formulate Sustainable Development Goals (SDGs) provides a unique opportunity to make a quantum leap towards more integration. Security of water, energy and food cannot be achieved in isolation but only when a nexus perspective is adopted and when corresponding coordination structures are put in place.
Implications of coordination failure are illustrated for a case which is quite symptomatic and representative for problem constellations encountered in many regions of the world. Northwest Lower Saxony is a German region which owes its prosperity to intense agriculture. The intensification process was supported by the European Common Agricultural Policy. High livestock densities and excessive manure production have led to severe nitrate pollution of freshwater bodies. Attempts to regulate livestock densities and nutrient flows (e.g. upper limit of livestock per land unit or liquid manure markets) have not yet led to satisfactory improvement. The situation is aggravated by a boom in growing energy crops for renewable energy production. Initially this was triggered by European subsidies supporting farmers to stop food production to avoid overproduction. Since these subsidies were not tied to any environmental target, farmers replacing food by energy plants were still eligible to receive them. In recent years national subsidies supporting electricity production from renewables promoted a steep increase in production. The implications are increased groundwater pollution and a skyrocketing of prices for agricultural land. The latter has generated in particular pressure on smaller farmers which are being replaced by large investment companies. It does not need analytical rigor but only common sense to recognize that such developments are neither economically, environmentally nor socially sustainable. It is also evident that such developments could have been anticipated – at least to some extent. They arise from a lack of coordination of the water-energy-food nexus.
Water targets for the environment are often determined by scientific analysis and expert judgement (e.g., the natural reference states and quality indicators defined by the European Water Framework Directive). Increasingly, the concept of ecosystem services is used to represent the benefits of sustainable water use for the environment both through the effect of the concept on policy discourse, and the introduction of a financial metric based on valuation of ecosystem services. The ecosystem services approach can also be an important communication tool to raise the awareness for the need to adopt a systemic and holistic nexus approach. Such increased awareness is a necessary but not sufficient condition for triggering the transformation towards governance from a nexus perspective.
The nexus poses institutional capacity challenges to govern across sectoral boundaries such as the different negotiations that take place in each sector in terms of institutionalizing rules regarding who gets what, when and where. If new science-based knowledge on the ecosystem services provided by land, land cover and water leads to the adoption of sustainable development goals for the water, food and energy sectors this can create new implementation problems.
The nexus approach will need to understand the multiple challenges of glocal governance in a globalizing world if it is to be successful. As yet, there is scarce literature on this paradigm, and much work needs to be done to co-design and co-produce knowledge in this field.
What are appropriate governance settings to identify and negotiate trade-offs and synergies inherent in cross-sectoral interactions? At which administrative level should and could policies be coordinated? How much can and should be coordinated during policy development and how much during policy implementation?
These are the questions that need to be addressed in a partnership between science and policy.

United Nations General Assembly's thematic debate, „Water, Sanitation and Sustainable Energy in the Post-2015 Development Agenda".

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The Nexus Across Water, Energy, Land and Food (WELF): Potential for Improved Resource Use Efficiency?

by Claudia Ringler, Anik Bhaduri and Richard Lawford

A major development in recent years has been the understanding of the interconnectedness and dependency of water and energy, food, and land issues and problems. One example for the strong interdependencies of different sectors is in the Energy-Food nexus, illustrated by a strong correlation of oil and food prices over the last decade (Figure 1).

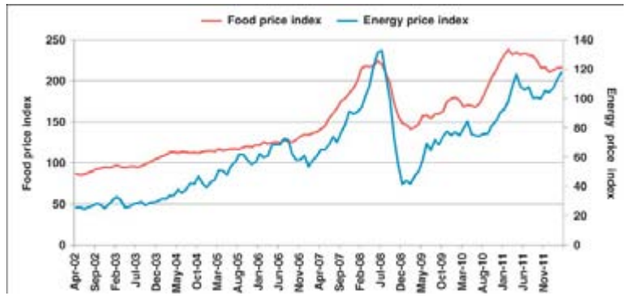

Fig.1.: Correlation of oil and food prices (Ringler et al 2013: 618)

However, the authors point out that two sector nexus thinking is not new particularly linking water with food, water with land, and land with food, while the land-energy, energy-land, energy-water, and energy-food linkages have been investigated much less. For the water sector the development Integrated Water Resources Management (IWRM) intended to incorporate nexus thinking. However, IWRM was never adopted on a broad scale. The authors identify various reasons for this:

- >> vested interests in existing water (mis)- management
- >> generally weak price signals and market development for water
- >> IWRM requires cooperative behavior among actors

To achieve resource use efficiency and to reduce the ambiguity of tradeoffs across the nexus the authors suggest the following:

- >> Develop an enabling environment to enhance equity in natural resource access
- >> Abandon silo thinking and vested interests: To maximize food, energy, and water security, mechanisms must be created to raise policymakers' awareness of these issues and promote greater collaboration among ministries as well as communities, civil society, and the private sector in policy design and implementation.
- >> Provide relevant, quantified information and tools across the nexus: Courses, training programs, international collaborative projects related to earth observations, and new multidisciplinary science approaches are all needed to engage and intellectually prepare for a future integrated decision making process.
- >> Develop and disseminate resource-use efficient technologies for enhanced sustainability
- >> Reduce distortionary subsidies: Subsidies for water, food, and energy have many known adverse impacts for the poor and the environment; for the former, because they are largely by-passed from receiving subsidies, and the latter because subsidies distort the comparative advantage of using and producing resources where conditions to do so are optimal
- >> Optimize market and trade solutions: Market solutions, which encourage behavior through market signals, can support resource use efficiency across the WELF nexus.

The authors conclude with stating that a WELF-nexus approach will reduce costs and increase benefits for both humans and nature and could advance the human development and environmental sustainability agenda much further. However, concerted action from all sectors, ranging from the government to the private sector, is required to achieve major progress.

Source

Summary by Anna Schürkmann, full reference of article:
Ringler C., Bhaduri, A., Lawford, R., 2013, The nexus across water, energy, land and food (WELF): potential for improved resource use efficiency, Current Opinion in Environmental Sustainability (5): 617-624

Basin Perspectives on the Water–Energy–Food Security Nexus

by Richard Lawford, Janos Bogardi, Sina Marx, Sharad Jain, Claudia Pahl-Wostl, Kathrin Knüppe, Claudia Ringler, Felino Lansigan and Francisco Meza

The Global Catchment Initiative (GCI) as part of the Global Water System Project (GWSP) undertook a comparative survey, exploring the implementation of the Water-Energy-Food security nexus in national and transboundary basins in three different countries: Canada, India and the USA. Together with a review of relevant literature the article identifies research needs for better understanding of basin development that are necessary for including a W-E-F security nexus perspective. Based on their survey the authors identify seven main factors that impact the status and trends of water management in the different basins:

- >> **Level of cooperation**
  Basins that cover different administrative entities are impacted by a lack of data-sharing, discussion, and collaboration on balancing the different needs for food, water, and energy across administrative boundaries.

- >> **Level of integration**
  Integrated Water and Resource Management (IWRM) implementation remains limited in many basins and depends largely on the integration of different organization to enact different integrated plans and policies.
- >> **Benefits of earth observations**
  The level to which earth observation data, such as data on precipitation, evapotranspiration, runoff, groundwater, and water quality is available throughout an entire basin and can be used for transboundary assessments of the state of the basin.
- >> **Capacity development**
  The degree to which local communities are educated on the topics to be included in the governance process.
- >> **The changing role of rivers**
  The degree to which the role of rivers for human societies and the perception of rivers has changed over time.
- >> **Data for basin management**
  The degree to which quantitative and qualitative data on ground- and surface water is available and can be used for water management planning.
- >> **Assessment of change in the basins**
  Assessments of the level to which basins are affected by global change, climate change and land use change as a basis for water/basin management decisions.

Based on the above factors the authors conclude with the following recommendations for water management to achieve W-E-F security:

- >> Extensive research, including demonstration projects, to validate the findings of the present study and develop feasible governance approaches using earth observations.
- >> Development of a database, which includes physical and socio-economic data for each basin. This database should provide a breakdown of the data for portions of a basin in different countries.
- >> Detailed studies of the impacts of climate change on basins to assess aggregate effects.
- >> Establishing quantitative W-E-F nexus targets within a UN framework for different river basins, together with monitoring programs and the extensive use of earth observations. The framework of the Sustainable Development Goals and emerging water security strategies are recommended as useful avenues for discussing these options.

Source

Summary by Anna Schürkmann, full reference of article:
Lawford, R., Bogardi, J.J., Marx, S., Jain, S., Pahl Wostl, C., Knüppe, K., Ringler, C., Lansigan, F., Meza, F., 2013, Basin perspectives on the Water–Energy–Food Security nexus, Current Opinion in Environmental Sustainability (5): 607–616

An Opportunity to address the Water-Energy-Food Security Nexus with Earth Observations

by Richard Lawford

Introduction

Water, energy, and food are critical needs for humanity but not every country has an equitable and adequate supply. Many semi-arid and arid countries have energy but lack water and domestic food production capabilities. Some African countries have water but lack food production infrastructure, while other countries have the capability to produce food but lack access to adequate energy. Other countries without natural reserves of fossil fuels are compelled to purchase costly oil and gas and need to produce food for export to maintain their balance of payments. These differences result in significant geopolitical tensions in some regions.

Energy and food play critical roles in most national economies. Access to water is a human right according to the United Nations but debate continues elsewhere about water's ownership and price. These issues become even more critical and complex when the needs for and availability of water, energy, and food resources and their interdependencies are considered together. According to the 2011 Economic Forum Report, there is an urgent requirement to address this Water-Energy-Food (W-E-F) security nexus issue and its interdependencies since instabilities in this nexus could put the global economy at risk.

Governance Issues

The governance of W-E-F issues rests primarily with national governments, which are motivated to take full advantage of the water, energy, and food resources within their territories. However, in some cases, their decisions can give rise to questions of social justice and fairness, especially when one sector's goals take precedence over those of other sectors (e.g. maximizing food production for export at the expense of water-based environmental goods and services). Disparities and conflicts are more frequently observed in transnational boundary basins, where countries with different policies and economic development goals each struggle to maximize the benefits from the resource base in their part of the basin.

Scale Issues

Scale effects add complexity to the W-E-F security nexus. Agricultural production systems are influenced by the scale of water cycle processes and the distribution of arable land. For fossil fuels, extraction efforts depend on the scale of the geological formation that holds the oil and gas. Hydropower production depends on the basin size and the distribution of precipitation in the basin. Food is generally produced by many small producers, while the consumption of that food can either be local or distributed regionally and internationally. Energy production is often provided by a few large companies and energy distribution can either be domestic or international. The scales of importance are further fragmented by political borders within which different management policies and resource laws are implemented and different water supply infrastructures exist. To effectively manage the W–E–F security nexus, interactions between water, energy, and food must be understood on all of these scales, including the global scale, because the global trade of food and energy may develop man-made links between remote basins.

Climate and Environmental Issues

Climate variability and change increase uncertainties in long-term water availability and agricultural productivity. Although the greenhouse gases (GHG) problem could be mitigated by increased use of renewable energy, the agricultural industry needs a major initiative to facilitate the use of these new energy sources. Within river basins, the impacts of climate change are often mingled with the effects of land use change and other developments. Scenarios of climate change impacts and environmental water needs have been developed for many parts of the world. For example, in the Yellow River Basin in China, it is anticipated that climate change, declining irrigation water availability, and policies calling for enhanced restoration of the delta ecosystems could adversely impact wheat and maize production [1]. Furthermore, the sustainability of water availability is becoming increasingly difficult due to increasing water demands arising from population and industrial growth and uncertainties due to the effects of climate change on the global water cycle. The effects of climate change on the joint W–E–F security nexus need to be studied because it is possible that the aggregate effect of climate change may be different than impacts on the individual sectors. Earth observations can inform policies and scenarios to better reflect the interactions in these three sectors.

The Global Water System Project (GWSP) has studied interactions between basin-scale processes and global influences, such as climate change, as part of its Global Catchment Initiative (GCI). GCI comparative catchment studies have assessed expert views of W-E-F issues in ten large transboundary and national basins [2]. Factors considered include climate change, economic development, and land use change, among others. Based on this survey, water managers and basin experts indicated that changes in water availability and food and energy production arising from regional and economic development associated with shifts in investments are the main cause of change in the basins. For basins within one country, water, energy, and food policies tend to be more coherent than they are for transboundary basins. Furthermore, the developments and policies in the different parts of a transboundary basin may lead to tensions between countries.

Satellite dish, facing the East River, on the snow-covered grounds of UN Headquarters

The surveys carried out by the GWSP provide a general indication of existing problems, but more in-depth studies are required to fully understand the causes of these perceived relationships. For example, an extensive and rigorous research project is needed to examine W-E-F issues in a number of transboundary and national river basins. These studies could include demonstration projects to show how earth observations and alternative governance approaches could improve collaboration, planning, and management. The physical aspects of basins can be detailed through the use of existing Earth observation and information systems, and hydrologic models. These analyses would be facilitated by digital maps showing the spatial distribution of socio-economic and demographic data at the township scale.

The Benefits of Earth Observations

Earth observations, which include satellite and in-situ data and model-derived estimates, provide information for monitoring W-E-F issues at basin, national, and global scales. These data, which include precipitation, evapotranspiration, vegetation cover, crop productivity, runoff, groundwater, and water quality, among others, enable monitoring across national boundaries and the prediction of climate anomalies and their impacts. Satellites are particularly powerful in providing geospatially consistent datasets that are not constrained by national boundaries. Satellite data are being used in some areas to determine appropriate water allocations for irrigation, the water available for crop growth, and the potential production of hydropower.

Earth observations can make decision-making more transparent because they help to define the trade-offs among W-E-F sectors and countries, thereby facilitating improved planning and management. The Group on Earth Observations (GEO) has been coordinating international observational information systems in order to provide these benefits at basin and national scales. Capacity development is needed in local communities to enable decision-makers to access and utilize Earth observations to make timely decisions regarding farm operations, conservation programs, and demand management and other policy-related solutions.

The recently published GEOSS Water Strategy report [3] has identified the W-E-F security nexus as one of its new focus areas for demonstrating the value of Earth observations. GEO has initiated a call for proposals to develop integrated data systems that will support monitoring W-E-F activities. This system will develop and test the trans-sector interoperability for priority variables of concern to the EO and W-E-F security nexus enterprise. In cases where different sectors operate their own networks, this project

will explore ways to make data and information services interoperable. Earth observations are also important for monitoring change and the consequences of policy interventions. Traditional energy resources are being consumed, resulting in continually increasing energy prices and an accelerated search for renewable energy resources.

Arable land is a constraint for agriculture, although new lands at northern latitudes may open as the climate there becomes more conducive to agricultural production. Benchmark statistics, such as the frequency of extremes, are very useful for examining the extent to which global change has affected current conditions. The effects of climate change and land use changes need to be benchmarked in river basins so that the relative importance of global trends and local changes can be assessed, compared, and factored into decision-making. Data-sharing among countries is a fundamental tenant of GEO. Many transboundary basins would benefit from cross-border data-sharing, discussion, and collaboration in balancing the needs among nations in the basin for food, water, and energy. Although river basins are logical units for managing water, there are strong incentives in the food and energy sectors for keeping control at the national level. That said, there would still be many benefits in sharing data and carrying out planning exercises related to W-E-F interactions in transboundary basins.

Summary

National policies and river basin management strategies strongly influence interactions between the water, energy, and food sectors in a particular region. Local, national, and regional governance is critical for ensuring secure access to these resources.

There is reason to believe that more extensive use of Earth observations would improve the efficiency and productivity of these sectors. GEO is looking for demonstration projects to show how Earth observations can be used in W-E-F nexus. The Earth observation community needs to consult decision-makers in these communities regarding needs for specific variables observed at specific frequencies and spatial and temporal resolutions, and the degree to which these needs could be met with existing systems. To support good governance, Earth observations should be shared among all stakeholders. Satellites can be particularly effective because they provide geospatially consistent data across national boundaries. The W-E-F security nexus requires quantitative targets, possibly with links to Sustainable Development Goals and emerging water security strategies, so that its progress benefits larger policy frameworks such as Integrated Water Resources Management. These goals should be articulated in an objective way that would facilitate the use of Earth observations in monitoring basin scale and national progress in attaining them and in measuring the overall improvements to efficiency in the W-E-F security nexus.

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Land, Water, and People
From Cascading Effects to Integrated Flood and Drought Responses

adapted by Anna Schürkmann from the UNU-IHDP Summary for Decision-Makers

"Land, water, and people. It is the most basic and traditional of relationships, yet today the relationship has become so complex that we find ourselves ill-equipped to understand all of its interconnections and to plan a future that is sustainable."

The Summary for Decision-Makers titled "*Land, Water, and People – From Cascading effects to Integrated Flood and Drought Responses*" which was recently published by the International Human Dimensions Programme on Global Environmental Change (IHDP), the Global Land Project (GLP), and the Global Water System Project (GWSP) gives a concise overview of the current state of understanding and management of droughts and floods in different regions and under various circumstances.

The first section lists a number of examples and research from recent years that illustrate the impact on human well-being as well as the economic impacts of such events. It becomes clear that managing floods and droughts is one of the major current and future challenges.

The second part of the document addresses four key questions that are discussed based on recent scientific findings and illustrated with examples:

>> "What is the relationship among land, water, and people?"

>> "How did land and water policy become so separate and how can integration be advanced?"

>> "How could an ecosystem services approach contribute to effective flood and drought prevention, management, and adaptation? How can we scale up effectively?"

>> "What are the institutional and knowledge gaps and opportunities for moving forward?"

The section closes with the following conclusion:

"Integrated land and water management is absolutely essential in regions stressed by both floods and droughts. Without integrated management, achieving development progress in these regions will be similar to walking up a downward moving escalator. In other words, the majority of public and private investment will be consumed by continual and costly repairs to existing infrastructure, leaving little to no fiscal resources for advancing human well-being and sustaining ecosystems for current and future generations."

The third section depicts five key findings and gives recommendations on how to address each of the issues raised.

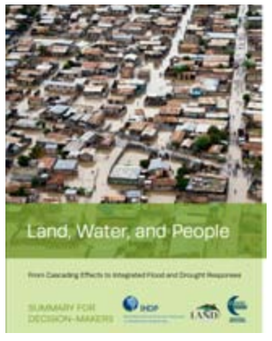
1. "An urgent need for integrated flood and drought policy" can be addressed by "[…] quantifying ecosystem services and identifying trade-offs and interactions in landscapes to derive optimum land and water management strategies."

2. To address "An urgent need for improved ca pacities to assess integrated flood and drought issues and to identify actions with co-benefits […]Decision support systems that can effectively communicate across scientific, policy, and civil society communities and incorporate scientific-technical as well as traditional knowledge are needed and must orientate towards the needs and demands of the user"

3. "An ecosystem services approach must take into account multiple perspectives."

4. "Engagement of communities, civic groups, and the private sector can be useful to stimulate innovation and promote investment" but should be accompanied by "[…] adequate monitoring capacity by local governments to ensure the accessibility to benefits by all, including the poorest and most vulnerable."

5. "Institutional infrastructure is required at all scales" which can be achieved by "A shift in focus […] from project-based assessment to place-based integrated and cumulative assessment of land and water investment, along with a shift in focus from sector-based high-altitude governance to localized place-based planning and management that involves local communities, and promotes cooperation and coherence across scales."



Source

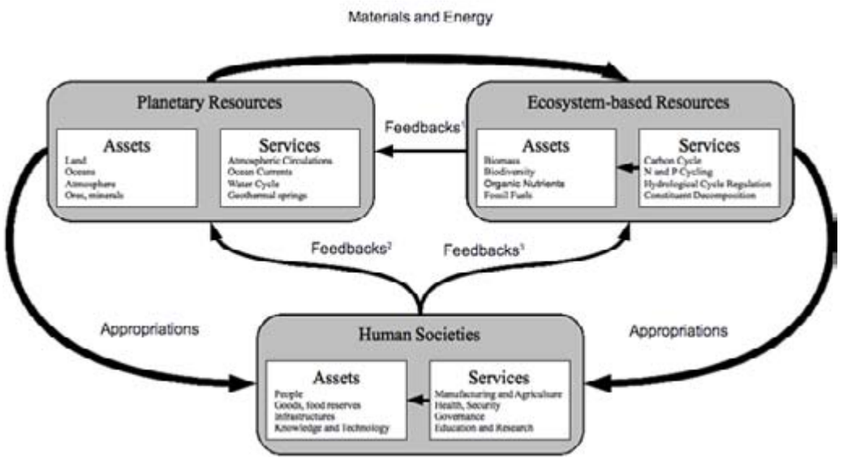
UNU-IHDP. (2014). Land, Water, and People From Cascading Effects to Integrated Flood and Drought Responses. Summary for Decision-Makers. Bonn: UNU-IHDP.

Interlinked Resource Stocks and Cycles: Why Water and Land Cannot be Separated

by Janos Bogardi

The recognition of the limits of Earth resources is a key to understanding the capacity of our planet to support a large and expanding human population with aspirations for improvements in well-being. The degree of human appropriation of abiotic planetary and biotic ecosystem-based resources offers a useful framework to define sustainability, once societal aspirations and technology are taken into account as shown in Fig. 1.

Because these linkages can be influenced by decisions this approach is suited to support policymaking for sustainability. The utility of this approach will be demonstrated on the human appropriation of water in the food production, one of the key forms of land use. A significant intensification of human appropriation of water will be necessary to support anticipated basic services and wealth generation over the coming decades. Furthermore, a major expansion of degraded water systems will be needed unless conscious preventive investments or costly remediation of impaired water quality are implemented in due course.



1 Earth system abiotic component interactions with the Biosphere

2 Depletion of non-renewables, use of renewable energy and mass, degradation

3 Overuse of ecosystem assets and services, depletion of biodiversity, pollution

Fig. 1 Balanced Triangle of planetary and ecosystem-based resources and human societies. Modern human society emerged as a dominating force in appropriating both planetary and ecosystem services and putting feedback pressures on these domains. Achieving sustainable human development will require a balance between the three services: provisioning planetary to ecosystem, planetary to human societies and ecosystems to human societies) and their impacts. (Assets and services listed are illustrative examples without the claim of completeness).

All terrestrial biomes depend on freshwater provided by a water cycle that is, by definition, a planetary service. In the terrestrial phase the water cycle is supported by land, a planetary stock (or asset). Land incorporates the solid surface including all type of land uses, but also the subsurface soil matrix which holds moisture and the aquifers. Soils support crop production, animal husbandry and natural ecosystems. The productive potential of land relies heavily on the natural water cycle and to a lesser degree also on its man-made modifications (storage, irrigation etc). Among other functions the water cycle moves and recycles moisture over land. Trenberth et al (2007) estimated that from the 113,000 km^3yr-1 total precipitation 73,000 km^3yr-1 return to the atmosphere via evapotranspiration (green water) without being further part of the terrestrial water cycle of stream flow and groundwater recharge (blue water) which is an estimated 40,000 km^3 annually. The 73,000 km^3yr-1 translates into an average evapotranspiration of 490 mm yr-1 from the aggregate landmass of 150 million km^2. Jasechko et al (2013) estimate that 80-90% of the total evapotranspiration is transpired through plants that can be considered as a central feedback in Fig. 1 of ecosystems onto the Planetary Resource base. Productivity of land can be estimated by the global net primary plant production (NPP) which is highly dependent on this biotically mediated interaction with the abiotic planetary hydrological resource. At the global scale NPP of 53.6 Pg yr-1 is remarkably steady with ~1 Pg yr-1 annual variation (Running 2012). An estimated 38 % (20 Pg) of NPP is already appropriated by humans. Out of this, 6 Pg NPP is attributed to crop production. How much water is appropriated from the above estimated blue and green water fluxes to ensure the global land productivity of 53.6 Pg yr-1 ?

Since evapotranspiration occurs irrespective of human appropriation, the global annual evapotranspiration of 490 mm yr-1 may be called the global "background water footprint" of terrestrial ecosystems. As a global average this component should not be considered in estimating human appropriation of green water. Defining green water as the evapotranspiration from cultivated lands and pastures is somewhat arbitrary. Hoekstra and Mekkonen (2012), for example estimated evapotranspiration from crops and pastures, as 5,771 and 993 km3yr-1, respectively (without deducting the background evaporation). One could alternatively argue that evapotranspiration from the entire biosphere producing the 20 Pg NPP appropriated by humans should be included in the calculation of human appropriation yielding ~27,000 km^3yr-1 green water use. The rational to only consider the most intensively used lands in calculating the water footprint was motivated by the realization that non-cultivated land (which could include pastures) can still support potentially diverse ecosystems. Therefore the degree to which human appropriation and ecosystems can co-exist does matter (Phalan et al 2011).

Consumptive blue water use (primarily for irrigation) is estimated between 1000-1800 km3yr-1 (Döll 2002, Vörösmarty et al 2005, Wisser et al 2008, Wisser et al 2010), which is only a fraction of the 2500-3200 km3yr-1 that is withdrawn since sizeable portion is delivered to the irrigated fields inefficiently, with much returned to surface and groundwater. Rockström et al. (2007) estimated that additional 1930 km3yr-1 green (for rain-fed agriculture) and 270 km3yr-1 blue water (for irrigation) would be needed to alleviate present-day hunger and further 2545 km3yr-1 green and 455 km3yr-1 blue water expansion (totaling 4475 km3yr-1 green and 725 km3yr-1 blue water with respect to contemporary levels) will be necessary by 2050. Although, the freshwater withdrawal is currently under 8 % of the continental runoff and even if in the future it will likely stay under 10 %, it is typically extracted in regions, where freshwaters are scarcer than the global average. Uneven spatial and temporal distributions of continental runoff are the primary reasons why available land in water scarce regions cannot be as productive as its potential would allow.

How large is the land appropriation for crop production? Ausubel et al (2012) argue that humanity is likely to have reached "peak cropland use" at 15 million km2, (which is about 10 % of the continental land and remarkably corresponds with the ~10 % NPP appropriation for crops) suggesting that feeding a growing population will be possible without further increase of land use for agriculture. Instead of expanding croplands they anticipate the intensification of agriculture. In the following this suggested cropping area of 15 million km^2 will be considered in assessing whether the water-land resource interaction-based world would be sustainable under conditions likely to prevail in 2050. This scenario estimate implies the same annual water footprint as Germans had in 2000, namely 1,930 m^3 per capita annually as estimated by Hoekstra and Mekonnen (2012).

By aspiring to offer the same standard of living for the entire world population which is expected to peak at 10 billion people (UN 2011), the aggregate blue and green water use (footprint) of humanity may reach 16,370 km^3yr-1. This estimate is at the high end. It does not consider technological innovation, shifts in value systems, which may gradually reduce water use. None of the internationally formulated sets of objectives (like the MDGs, the "Future We Want" declaration, or the recently forming SDGs) imply this lifestyle and consumption pattern as the targeted goal for the coming decades. By assuming the same partitioning between green and blue components as in year 2000), the corresponding "green" and "blue" water use could grow to 14,200 km^3yr-1 and 2,170 km^3yr-1 respectively. It is important to point out that this high green water footprint includes the background evapotranspiration. Thus the green water footprint should be mitigated accordingly.

This would imply that instead of the 14,200 km^3yr-1 green water use as calculated according to Hoekstra and Mekonnen (2012) the human green water appropriation over of 15 million km^2 cropped area is obtained by subtracting the background evapotranspiration of 490 mm: 7,350 km3yr-1. Thus the human appropriation of green water may be estimated as 6,850 km^3yr-1. For 2050, we compute the human appropriation of the green water resources to be less than 10% of the global evapotranspiration of 73,000 km^3yr-1 (Trenberth et al 2007). The estimated blue water footprint of about 2,170 km^3yr-1 would be slightly above 5% of the annual renewable water resources of the planet. This simple calculation indicates that achieving "human water security" for 10 billion people at the level of Germany's consumption and technological abilities around the year 2000 would imply considerable water stress at the global level, and the certain transgression of the limits set by the availability of freshwater resources in water scarce regions. Thus 'business as usual' in water resources management, while pursuing high social aspirations universally is clearly not an option.

Reducing the water use by modifying lifestyle, improving water use efficiency, innovative technologies will be necessary to give room for those who have no access to water services, and improved governance could keep the world

afloat “water and land-wise” with a population of 10 billion people.The critical challenge of water and land resources management is twofold. Both refer predominantly to the water constraint: Within a well conceived, trust-based and sustainable task distribution the human NPP and water appropriation should focus on regions well endowed with abundant water and fertile land resources.

The second challenge refers to maintaining and/or restoring water quality. The consumptive use of blue water could only be kept globally around 2,200 km^3yr-1 of the renewable blue water resource if waste waters discharged into recipient freshwater bodies are treated to a degree that no appropriation of water for dilution would be needed.

Given the present reluctance to consider payments for ecosystem services this is a high order of political challenge. Ultimately land and water degradation have to be addressed and the time left to take up this challenge forcefully is precariously short. Even if humanity would subscribe to a “global partnership” to use land and water where they are available for the benefit for all, the main issue, in the case of land-use-related water management (either green or blue, rain fed and irrigated agriculture) would still be water quality.

Feeding 10 billion people, while keeping the agricultural land appropriation virtually constant as argued by Ausubel et al (2012), implies steady improvement of productivity. It is hardly imaginable that this would happen without intensive use of nutrients, agrichemicals and other inputs. All these have already been identified as major pollutants for freshwater systems.

The balance of the triangle of satisfying societal needs while keeping ecosystem and planetary services below their respective (though unknown) tipping points implies nutrient recycling, drainage, salinity- and pollution control of effluents. All these come at a price. Thus population growth, willingness to pay, changing lifestyles, innovation and use of “greener” technologies are the main factors societies have to focus on.

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Challenges to Water Management

Interview with Claudia Pahl-Wostl, Co-Chair of the Global Water System Project

What do you see as the currently major political and societal challenges regarding water management?

» Enhancing and sustaining human water security in the face of increasing uncertainties of global and climate change without increasing damage to aquatic ecosystems. This is a particular challenge for threshold economies where the question needs to be posed if development balancing economic, social and environmental dimensions of sustainability is possible.

» Globally the awareness for the need to improve water governance and management has increased. An understanding has developed that water management problems cannot be solved with technical solutions and that complex problems cannot be solved with simplistic panaceas (technical or institutional). The recognition for the global dimension of water management problems has increased tremendously. Also, climate change has triggered an increase in the awareness for uncertainties and the need to find robust and flexible management strategies.

How can these challenges be addressed and what role do organizations, such as GWPS and events like the upcoming conference “Sustainability in the Water-Energy-Food nexus” play?

» We need to adopt holistic and integrated perspectives which take into account complexities of water systems and the dependence of human water security on ecosystem services which can only be provided by functional ecosystems. GWSP (which is a network rather than an organization) should support evidence based decision making and should communicate complexities and interdependencies between human well-being and environmental integrity.

From a governance perspective, do you consider the nexus approach a useful concept and what do you see as the biggest challenges for its implementation?

» The nexus approach puts more emphasis on interaction between policy fields and not on policy fields in isolation. This could help to identify synergies and trade-offs of more sectoral integration. However, there is a huge lack of institutional capacity to govern across sectoral boundaries. It is a huge challenge to find flexible, effective and efficient governance mechanisms for cross-sectoral coordination.

»It is a huge challenge to find flexible, effective and efficient governance mechanisms for cross-sectoral coordination.«

Do you think that environmental concerns are sufficiently addressed in political and public debates and why do you think that?

» Environmental concerns enter political and public debates predominantly when there is a real crisis (e.g. disastrous floods, severe droughts). This cannot be judged satisfactory. Negative implications are not immediately visible and obvious and may even become effective with a time lag. We have no institutions supporting long-term perspectives and planning for the future.

How has, in your experience, the perception of water management problems in the political community/politics changed over the last years and what do you expect or hope for in the future?

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» The interview was conducted by Anna Schürkmann, Research Associate with the International Project Office of GWSP in Bonn, Germany.

Business as Usual?

Interview with Joppe Cramwinckel, Director of the World Business Council for Sustainable Development`s Water Programme

Can you explain how companies are affected by the interconnectedness of water, energy and food security? What are the current and future challenges, risks and opportunities for the private sector with respect to the W-E-F nexus?

» The first thing is that in the broader context, the business community has realized that there are serious challenges which we face collectively in society and which we have to start to deal with. Otherwise, as a society we cannot survive. We call them the nine challenges or priority areas: Climate change; release of nutrient elements; ecosystems; exposure to harmful substances; water; basic needs and rights; skills and employment; sustainable lifestyles; food, feed, fiber and biofuels. Based on these priority areas we built the action program "Action 2020" (http://action2020.org/) asking the question: If these are the challenges, what do we collectively need to do? Even though the obvious link between energy and food, feed, fiber, fuel, and water is recognized by us, we do not necessarily have the understanding of how these areas are interrelated. The nexus project we started primarily aims at understanding how these relationships manifest themselves: Can we quantify them better? Can we identify regions where these challenges are most pressing? A better understanding of these relationships will give us the opportunity to manage them better and create business, innovation, and implementation opportunities; to drive solutions at an appropriate scale, to ensure that there is enough water, food, and energy for all within the natural constrains of our environment.

How do you assist companies in implementing action in the nexus?

» We are currently in the phase of selecting themes which we are going to articulate. Based on these themes, tools and Key Performance Indicators (KPIs) will be formulated. Currently we are focusing on three main sets of tools that assist companies in implementing the nexus: Precision agriculture, reduction of food waste, and optimization of soil management.We have now reached the point of going "outside" with this and share what we are planning to do, to get feedback. We will then identify two or three of the themes which we as a business organization can drive action around. We believe that as a community of businesses which are active in this space, we can drive some of the solutions which we believe are impactful at a much larger scale. Certain things will have to be done by companies, by universities, and by governments. Specifically on the water-energy-food footprint, a lot of individual action is already happening. What is now needed is to scale this action up to a really impactful level. If we collectively work on this, we can move a lot faster towards our goal of having enough water, energy and food security for all.

Which private sector activities contribute to finding solutions in the W-E-F nexus?

» There are many case studies of companies which are increasingly aware that they must provide services which take the three challenges into account. They address these challenges by developing novel products and services which, for example, focus on reducing the amount of irrigation water while increasing the productivity of agriculture, by bringing management practices and input use in line with tested best practices, or by closing loops and reusing water, nutrients and other resources for increased resource efficiency. There is also great opportunity for businesses to work together all along the value chain – connecting input suppliers, producers, commodity traders, processors and retailers. These forward-thinking companies are aware of the challenges and develop products solutions which collectively help us to address them.

»Identifying feasible solutions is a collective effort by the public, science, policy and business sector.«

Can private and public interests concerning water, energy and food security be aligned?

» The alignment comes when we really understand the relationships between sectors. The starting point is to ask the questions: Which of the portfolio solutions that we have identified would be most beneficial for addressing the challenges? Which policy measures could be set into place to drive solutions? Not only the business community benefits from that, but ultimately it is a win-win for everybody. Understanding these relationships and identifying feasible solutions and policy endeavors is a collective effort by the public, science, policy and business sector. Addressing the challenges of providing food and fiber to a growing population that lives well while staying within the boundaries of the planet in terms of water, energy and climate impact will require change and initiative. That is how we and the companies we work with see it.

What are your expectations from the upcoming conference in Bonn and what will the WBCSD session focus on?

» We have chosen the conference to launch our paper on food co-optimization solutions "Water and energy for food, feed and fiber". At the conference we would like other participants to critically review what we are doing to help us shape our action plans in the agriculture area. Our session will be centered on the following questions: What are the challenges? Which solutions are most beneficial in different geographical environments and agricultural sectors? We will share our thoughts about the three solution areas on which we are focusing: The reduction of food waste, the increase of water productivity and the optimization of soil management. We will be happy to identify other areas on the basis of the discussion.

Which impact will nexus conferences have on the implementation of the nexus?

» You really have to see these conferences as a further exploring of solutions which are on the market in the energy, food and water sector and which can be scaled up. The conferences help each sector (water, food, and energy) understand the others' challenges in order to develop solutions, possibly integrated in order to reinforce each other. During the last nexus conference in Berlin we were really clear about our perspective: We want to drive a better understanding of nexus relationships so that the individual sectors can develop products and services in a way that helps us to master the challenges across all sectors.

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» The interview was conducted by Talin Holtermann, Research Assistant with the International Project Office of GWSP in Bonn, Germany.

A Nexus Approach for Humans and Nature?

Interview with Imme Scholz, Deputy Director of the German Development Institute / Deutsches Institut für Entwicklungspolitik (DIE)

Why do we need a nexus approach for the management of water, energy and food?

» I think there are two reasons: The first reason is the many linkages between the use of one resource and the implications it has for another one. If we think about water and land as resources and consider their productive functions in terms of producing food or generating energy, an expansion of these functions may have negative implications for their productive use in other areas. There are, of course, also second order or third order consequences like climate change as an impact of fossil fuel-based energy generation which has implications for the future productivity of land and water. Linkages appear on different levels, and sometimes they are direct and sometimes indirect. All this requires a nexus approach. The second reason I would give is the nexus between environmental, economic and social functions of resource use, and that policies in the water, agricultural and energy sector reflect these so-to-say internal nexus linkages to a different extent. In water policies we have the Integrated Water Resources Management concept. This approach is integrated in the sense that it refers to economic, social and environmental purposes of water resource management. The combination of these three objectives means, for example, that it is more likely that water policy makers look at impacts of water use on other areas. However, this is less the case in energy or agricultural policies. Not all agricultural policies have a proactive environmental component, and energy policies only started to include this very recently. The social and economic objectives which are reflected in different policies also do not consider the nexus in the same way.

Can the nexus approach increase human well-being and environmental sustainability?

» I think this is the idea. Of course, you could say: "I look at the linkages but I have priorities only in the economic area" or you could say "I have priorities only in the environmental sector and the economic area, but I do not care about the social implications", so it really needs to be made explicit: What are the objectives you pursue and what is the priority you assign to each of these three dimensions? The nexus is not automatically good for human well-being in the comprehensive approach. When I talk about human well-being I mean both present and future generations. The future perspective also includes the environmental dimension. I think that nexus approaches should not be taken as a given. Not everyone who talks about the nexus assigns the same importance to the three dimensions in the present and in the future.

What are the challenges with respect to the implementation of the nexus approach?

» It is about having a balance between these different objectives within each area and about understanding the linkages at the interfaces. It is also about time: Which objectives do you want to achieve in the short-term and which implications are you willing to accept in the long term? That sounds simple, but I think it is quite complex because it is a big difference to how policies are made today.

»We need more knowledge about what is needed to make integrated concepts work.«

Which challenges are developing countries facing in particular?

» I think that developing countries have a high degree of urgency in universalizing access to energy and clean drinking water, and in improving their own food production potentials. At the same time, they often have fewer resources in terms of technologies, finances and capacities in administration. If we require developing countries to make nexus-informed policies, we need quite well-trained public administrations for that. This is ambitious. How to reconcile all these demands in the short term? How to achieve them? How to integrate concerns for future generations? How to consider nexus requirements? It is very ambitious and it is obvious that they need support in doing that. It also means that the way we implement or translate the nexus in Europe, for example, is not necessarily a blueprint for what other countries would do. Another point is that in developing countries large proportions of the population exist on a very low income level and either do not have resource rights or have them, but they are not respected. These are things that also have to be taken into account. The public is not always able to have its rights respected.

Which governance structures and mechanisms are needed to make the nexus reality?

» What we would probably need is enough staff to work at the interfaces in water, agricultural and energy administrations, so that they do not only pursue policies in their own field. A certain amount of redundancy is needed so that people have capacities for engaging in work at the interfaces. These people also need to be trained for understanding the logic of the other sides so they can develop compromises and integrated proposals. You also have to consider private sector activities. How privatized are the different sectors? Are there strong economic actors which have to be integrated and which also may have more resources than public administration for influencing the way policies are designed? Then, of course, public administration exists at different levels. Besides national policies and national actors, the local situation is extremely important for resource management. Are the consequences of national policies for the local population taken into consideration or are they simply subordinated to some national objectives? Another issue is foreign direct investment in land, energy, and water. When foreign investors buy large shares of land or acquire concessions, the consequences for local peasants in terms of water use rights, for example, are often not considered. Local resource rights of weaker actors are an important aspect to take into account when designing policies. It is also important to agree on how to measure improvement. Do you measure it by external revenue generated, in economic terms? Do you measure it by improvements in access to water and land, or in ecological regeneration capacities? I think it is important that the multiple functions of resources are taken into consideration when designing policies, but also when measuring their impacts.

Which role does the nexus approach play with respect to the formulation of Sustainable Development Goals?

» There is a long debate on how to cluster the SDGs and on what to put at the level of goals and what to put at the level of targets. A year ago we published a short briefing paper (http://www.die-gdi.de/en/briefing-paper/article/post-2015-reconsidering-sustainable-development-goals-is-the-environment-merely-a-dimension/) in which we argued in favor of one goal on food and nutrition, one on water, and one on energy, while trying to design the targets and indicators in a way that they reflect the linkages between these three goals. Alternatively, there could be a nexus goal on sustainable and inclusive management of natural resources, stating that implications for other resources should always be taken into consideration (http://www.die-gdi.de/en/briefing-paper/article/post-2015-why-is-the-water-energy-land-nexus-important-for-the-future-development-agenda/). This is open to debate. The ongoing debate on the water goal is centered around the question whether there should be a stand-alone goal on water or whether water use should be integrated in a goal on food, in a goal on resource management, in a goal on sustainable cities. I have also heard people in the water community saying: "Maybe the best solution is not having a stand-alone goal on water, but really make sure that targets on water use are integrated in all other goal areas where it is important". You could apply the same, for example, to an energy goal, saying "renewable energies need to respect other functions of the natural resources they are based on". There are different ways of achieving the same goal, the same objective.

What are your experiences from previous nexus conferences and what are your expectations from the upcoming conference "Sustainability in the W-E-F Nexus" in May?

» What I realized is that the nexus thinking came very much from the water sector. My impression of the first nexus conference was, for example, that the costs and benefits of a nexus approach were very much termed with regards to what it means for water use. However, if you have a fully-fledged nexus approach you could also say: "What are the implications in terms of land use or in terms of energy generation? Why is water the central reference?" As a non-water person you could ask that question. I think it was extremely beneficial to raise the issue of interconnected and integrated thinking. It was a very good starting point to say that we need this connected thinking when we analyze problems, define policies, and define objectives to reach. However, I think we need to gain more knowledge about what is needed to make integrated concepts work. We have to understand that some problems are complex and that we will not solve them if we decide to ignore this complexity.

» The interview was conducted by Talin Holtermann, Research Assistant with the International Project Office of GWSP in Bonn, Germany.

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Resource Efficiency in a Changing World

Interview with Claudia Ringler, Deputy Division Director of the Environment and Production Technology Division of the International Food Policy Research Institute (IFPRI)

What is the connection between climate change and the Water-Energy-Food nexus?

» Climate change is a key direct driver affecting the Water-Energy-Food (W-E-F) nexus. Without climate change, we might not even talk about the W-E-F nexus today! Climate change has increased fluctuations in water availability, or, stated more directly, the frequency and intensity of floods and droughts. Floods and more so droughts are causing local and sometimes national food shortages and thus contribute to growing food price variability, making the link between water and food more apparent than it would be otherwise. Similarly, the 2005 US Energy Policy Act that supports the use of maize as biofuel in the United States, originally envisioned to increase US energy security, aimed at technologies that would reduce greenhouse gas emissions, that is, mitigate climate change. This policy singularly changed the face of maize markets and was possibly the most direct contributor to the 2007/08 food price spikes. As a result of this policy, harvested area dedicated to maize in the US increased by 10% between 2000 and 2009; and by 2009 around 40% of US maize harvests were processed into biofuels; driving prices for cereals and meat up, the latter as most of this maize was earlier fed to livestock; thus describing a clear link between energy policy and food outcomes.

»IFPRI has worked on water-food linkages and tradeoffs for almost 20 years. The important addition in the nexus concept for us is energy.«

How can the implementation of the nexus approach support climate change mitigation and adaptation?

» Implementation of the nexus approach can support both climate change mitigation and adaptation through the identification of policies, institutions and technologies that reduce the inherent resource inefficiency in single-sector strategies; resource use inefficiency that hinders adaptation and increases greenhouse gas emissions! As an example, we could again look at the 2005 US Energy Security Act: Would biofuels have achieved the prominence they did or should they have obtained the level of subsidies they did if a water-energy-food nexus assessment around this policy would have been undertaken? Biofuels are possibly the most water-consuming climate mitigation instrument available today (both rain-fed and irrigated crops consume large amounts of water). Biofuels also make it more costly to access food by the poorest. Energy use for maize production is very high. The mitigation role of maize remains hotly debated. Adverse environmental impacts of biofuel policies, such as the increase of the Gulf of Mexico Hypoxia, conversion of land slated for conservation to agricultural production, or deforestation for biodiesel production in Southeast Asia have been widely reported.

How important is the nexus approach for the research carried out at IFPRI and how has its importance changed over the last years?

» The nexus approach is a useful concept encapsulating key tradeoffs of importance to food security. While the core tradeoffs relate to water, energy and food; land aspects are important (such as the so-called "land grabs") as are linkages to environmental outcomes. IFPRI has worked on water-food linkages and tradeoffs for almost 20 years; the important and useful addition in the nexus concept for us is energy. Energy intensity in agriculture increases sharply as countries develop. In 2005 an average US farm spent 15% of total farm expenditures on energy, 47% on fertilizers, 41% on fuels and oils and 12% for electricity. Though energy efficiency, the ratio of energy use to agricultural output has dramatically improved, that is declined, in that country. As farm machinery moves into developing countries, electricity access becomes available and fertilizer use becomes more widespread, similar or higher cost shares and lower efficiency levels are expected there with substantial tradeoffs and impacts for food security. The CGIAR Research Program on Water, Land and Ecosystems therefore has dedicated an entire research cluster to the W-E-F topic (wle.cgiar.org). Moreover, a cluster under the CGIAR Research Program on Policies, Institutions and Market (pim.cgiar.org) focuses on tradeoff analyses under sustainable intensification.

Do you think the nexus approach is a useful tool to achieve food security, particularly in developing countries?

» I do believe that the nexus approach is of great relevance to food security globally. Increased cross-sectoral resource use efficiency is essential in a world with growing natural resource scarcity. The nexus approach has more "teeth" compared to the earlier Integrated Water Resource Management concept as it is not based on the premise of water-focused cooperation, but supports tradeoff analyses across all sectors with cross-sector benefits.

»Nexus implementation requires political will toward sustainable development; which could be reflected in a commitment to the Sustainable Development Goals.«

Food security strategies, for example, should assess water, land and energy requirements and environmental outcomes. This should help ensure that energy, land and water resources are not overly taxed when food production expands. A nexus 'no-brainer' would be to review and identify candidates for the phase-out of subsidies on water, energy and food. For example, free electricity access for groundwater irrigators in parts of India has led to severe groundwater depletion; and a high budgetary burden for the government from large energy bills. Nexus thinking would have considered the consequences of this food security strategy and might have identified other food security strategies. Importantly, the poorest farmers and other energy and water users are generally excluded from such subsidies that lead to poor management and overuse of scarce natural resources.

What role do ecosystems and ecosystem services play in the nexus and how are environmental concerns integrated into in the nexus approach?

» Ecosystems and the services they provide would be major beneficiaries from a nexus in action, but it is important to assess environmental outcomes of any nexus strategies. Enhanced resource use efficiency will increase outputs per unit of natural resource inputs. For example, energy efficiency in the United States has improved significantly over the last four decades. Increased land, water, energy and food production efficiency can help to conserve remaining forest areas that are under severe threat of degradation and deforestation. It will help to protect in-stream flows and the quality of water bodies and also contribute to enhanced air quality and reduced greenhouse gas emissions.

What are the different challenges regarding the implementation of the nexus at different scales (e.g. national to farm level)?

» Agents and agencies at all scales tend to have vested interests and want to protect their turf. The nexus approach at a minimum requires dialogue across sectors, and that sectors are willing to make changes in their strategies to avoid adverse outcomes for other sectors or to achieve jointly enhanced benefits. Will a hydropower agent or agency be interested to talk to the water sector to ensure that not only energy interests are met, but that water outcomes are also improved? Not necessarily. Thus, to be successful, nexus implementation requires political will toward sustainable development; which could be reflected, for example, in a commitment to the Sustainable Development Goals, which will be presented later this year.

What are your expectations from the upcoming conference "Sustainability in the Water-Energy-Food Nexus" in Bonn?

» I look forward to the W-E-F conference in Bonn. I hope to meet academia, policy people and practitioners and hear their points of view on why the nexus matters to them and how they have started to tackle nexus challenges. Regional insights will be particularly interesting, but also the combination of case studies at different scales - nexus solutions in an irrigation system will differ from those in urban areas and again from those at the national levels. I am sure I will come away from the conference with lots of new ideas for how to move the nexus concept forward through research and practical applications for a more sustainable future for everybody.

» The interview was conducted by Anna Schürkmann, Research Associate with the International Project Office of GWSP in Bonn, Germany.

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Systems and Fluxes - Connecting the Nexus

Interview with Reza Ardakanian, Director of the United Nations University Institute for Integrated Management of Material Fluxes and of Resources (UNU -FLORES)

How does the Water-Soil-Waste nexus relate to the Water-Energy-Food nexus?

» When looking at the nexus of water, energy and food security, the question arises which environmental resources have to be managed in an integrated way to achieve the sought integrated and sustainable management. For UNU-FLORES, these environmental resources are: Water, soil and waste. The production of food relies on water and soil, with waste being an important factor for the provision of nutrients and organic material. The same is true for the production of biofuel and energy from biomass. Additional links to energy exist for water (hydropower, conversion from heat to energy, cooling water) and waste (biogas or thermal energy from waste). The nexus approach to the sustainable management of water, soil and waste promoted by UNU-FLORES is thus closely related to the water, energy and food security nexus, looking at it from an environmental resources perspective.

»Adopting a nexus approach will be instrumental for sustainable development and for adapting and building resilience to impacts of global change.«

Which major initiatives are ongoing through UNU-FLORES and how do they integrate the nexus approach?

» Major initiatives include: Establishing the research programme, e.g. joint research projects in Africa. Establishing an Operating Unit (OU) of UNU-FLORES in Maputo, Mozambique. The OU will work close with partners in Mozambique (Ministry of Science and Technology, University Eduardo Mondane), but also with universities, institutions and ministries from other African countries, thus acting as a regional hub for integrated management of water, soil and waste. Launch of a joint PhD programme with our partner university TU Dresden in October 2014: Designed as a structured programme, including course work specifically addressing nexus topics, but mostly focusing on research, it will help UNU-FLORES to fulfil its mandate to act as a think tank on integrated resources management for the UN system and member states. Preparing for the Dresden Nexus Conference, which will be a bi-annual international event, the first one taking place on 25-27 March 2015. The UNU-FLORES nexus observatory will play an important role as an incubator of policy relevant research questions and help identify triggers for policy and institutional reforms in developing and emerging economies.

How can the nexus approach be addressed in research, teaching and capacity development? Which topics need special attention?

» For a nexus research programme it is crucial to define inter-disciplinary topics, focusing on the interfaces and interconnections of water, soil and waste management. The upcoming PhD programme will provide a perfect opportunity to perform nexus-relevant research while at the same time including an element of individual capacity development. As a UNU institute we have to pay special attention to institutional capacity development, thus addressing the question how a nexus approach can be implemented. The Dresden Nexus Conference aims to provide and develop the link between science and policy by involving the scientific community, UN agencies, NGOs and governmental stakeholders from member states.

How can the nexus approach be implemented effectively in environmental management and planning?

» There is no blue print solution, since institutional arrangements, resource availability and resource use, challenges of demography, urbanization and climate etc. are different in every country and have to be taken into account. For sure much can be learned from initiatives related to the implementation of IWRM and transboundary water management, which would need to be "upscaled" to address also soil and waste.

How can awareness about the nexus approach be raised in politics and the public?

» For sure there has to be a general public aware for environmental issues, for the value of the resources water and soil, and for the importance of proper waste management (recycling and re-use). What might be even more important, however, is that governments set the "right" incentives for a sustainable use of environmental resources. This, as well as the planning of infrastructure projects such as dams and irrigation schemes, promotion of hydropower and other sorts of renewable energy (e.g. from biomass), waste and wastewater collection and treatment etc., requires that the responsible stakeholders have a nexus mind-set. They have to be aware of trade-offs, but also of potential synergies which can be unlocked when managing water, soil and waste in an integrative way.The best way to raise awareness and, even more important, acceptance for a nexus approach is to show and tell examples which demonstrate the benefits of the approach.

How relevant is the nexus approach for the post-2015 development agenda?

» We believe it is highly relevant, since only a nexus approach will ultimately result in sustainable management outcomes, securing water and soil resources and close cycles of other vital, non-renewable resources such as Phosphorus. Adopting a nexus approach will be instrumental for sustainable development and for adapting and building resilience to impacts of global change.

Which topics will be addressed during the session which you are organizing for the upcoming conference "Sustainability in the Water-Energy-Food Nexus" in Bonn and why did you choose these topics?

» The session will highlight the relation of the nexus approach to water, soil and waste management to the water, energy and food security nexus. It will also emphasize the need for systems and flux analysis approaches as prerequisite for integrated and sustainable management. It will provide examples for nexus-relevant research from the perspective of water, soil and waste management and elaborate on institutional arrangements and governance structures facilitating the adoption of a nexus approach.

What are your expectations from the Bonn conference? How does this conference relate to the conference which UNU- FLORES is planning for March 2015?

» The conference will help to raise awareness for the nexus approach and help to foster the nexus initiative in research, capacity development and governance. Drawing on the aims of the conference to "bring together available information, identify knowledge and action gaps, share lessons on viable instruments and approaches, facilitate networks, and contribute to consensus on priorities for appropriate investment and action by different actors and stakeholders for moving toward action on the W-E-F nexus" it will also help UNU-FLORES to shape the topics of the upcoming Dresden Nexus Conference, which will be the first of a regular bi-annual conference series.

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» The interview was conducted by Talin Holtermann, Research Assistant with the International Project Office of GWSP in Bonn, Germany.

Implementing the Nexus in the MENA Region

Interview with Holger Hoff, Senior Research Fellow at the Stockholm Environment Institute (SEI) and the Potsdam Institute for Climate Impact Research (PIK)

Why do we need a nexus approach and how can the nexus approach integrate trade-offs between sectors?

» In a world of increasing pressures on environment and natural resources, yet with a persistently high number of people lacking water, food and energy security, a nexus approach can lead to sustainable intensification for improved human securities and more resilient social-ecological systems. A nexus approach, supported by sound scientific knowledge and dialogue platforms, can integrate tradeoffs into policy and decision making by assessing overall costs and benefits of new policies, strategies, interventions and investments.

How has the perception and implementation of the nexus approach changed over the last years and what is needed to make it more popular among politicians and the public?

» A nexus or integrated or systemic approach has been applied in science for quite some time. However its implementation in policy and decision making is still lagging behind. Given that a nexus approach adds complexity and requires to look beyond disciplinary boundaries, it requires more incentives (despite the enormous current "popularity" of the nexus). Positive examples, best practices and opportunities for transfer and upscaling need to be publicized and economic incentives need to be developed.

What are the linkages between climate change and the nexus approach? Can nexus thinking be a tool to mitigate climate change and support adaptation?

» Robust adaptation has to address the various interacting pressures, ranging from climate to resource degradation and increasing demand due to population and economic development. Hence climate adaptation (primarily addressing water, agriculture and ecosystems) and climate mitigation (primarily addressing energy systems and land use) provide well-established building blocks for a nexus approach. The ongoing integration of climate adaptation and mitigation in several countries provides an excellent entry point for the development of a nexus approach. Also bringing together stakeholders from climate adaptation and mitigation presents a good starting point for nexus stakeholder dialogues.

How can the nexus approach support sustainable development and what are your experiences with implementing the nexus approach in the MENA countries? What are the biggest successes/benefits and where are the biggest problems encountered?

» The MENA region is possibly more in need of a nexus approach than any other world region, given its enormous pressure on resources such as water and land and severe climate risks. Only by improving the efficiency of using these resources and more systematic resource allocations can these enormous challenges be met. The MENA region is at the same time one of the world's richest regions in terms of renewable energy, in particular solar and also wind. A nexus approach can help to exploit this potential for wider benefits, e.g. by using renewable energy for desalination. Given the enormous diversity of the MENA countries in the Maghreb, Mashreq and Gulf regions, there is also large potential for sharing of experience, knowledge, data and technologies from more to less advanced countries. However the region is also faced with an enormous implementation gap of existing good approaches, policies and strategies.

»Integrated scientific assessments can help stakeholders to better understand nexus benefits and tradeoffs.«

How can the nexus approach be translated into practice? For example, what are farming techniques that integrate nexus thinking and what are the challenges for implementation on a local or national/international scale?

» Integrated assessments from science provide a quantitative baseline for a nexus approach. Participatory nexus scenarios, as developed e.g. by SEI in its regional nexus projects help stakeholders to better understand benefits and tradeoffs. One promising way of practical implementation is by way of multi-functional systems (e.g. agro-forestry, crop-livestock systems, integrated agriculture-aquaculture systems etc.), in which by-products are recycled and waste products are reduced or eliminated. Again, challenges are largely related to the need for new approaches and deviation from standard practice. Translation into practice also requires "bridging institutions" which have the mandate, capacity and authority to address several resources or sectors, such as for example river basin commissions or inter-ministerial committees.

How can events, such as the upcoming conference on "Sustainability in the W-E-F Nexus", support the implementation of the nexus-approach and what do you think is needed in the future to further support nexus implementation?

» Bringing together scientists and policy and decision makers is a good starting point. If the summer academy "Communicating Science on the Water-Energy-Food Nexus" is well prepared, moderated and followed up, it can provide an excellent proof-of-concept for bridging from science to decision and policy making. Regional dialogues and platforms such as the one for the MENA region that will be kicked-off at the Bonn conference, provide another important ingredient for implementation.

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» The interview was conducted by Anna Schürkmann, Research Associate with the International Project Office of GWSP in Bonn, Germany.

Developing Nexus Knowledge for a Green Economy

Interview with Richard Lawford, GWSP Executive Committee

Morgan State University, Baltimore, USA

What role do earth observations play regarding understanding and implementing the nexus approach?

» The Water-Energy-Food nexus provides a "learning space" for understanding and mapping a strategy for how we can achieve different economic, social and environmental goals with the same limited resources of water, energy, land, and food production capability. Data and analyses are critical components for developing and communicating this understanding. Earth observations, which include satellite observations, in situ measurements, Earth system model outputs and indirect information obtained through surveys, have a role to play in developing our common understanding of the nature and extent of the nexus issues and in evaluating options for addressing these issues. Observations allow us to quantify the aspects of the water cycle that are certain and those which are highly variable on a range of different time scales. With this information we can develop risk assessment approaches for different scenarios and build risk tolerant W-E-F systems that will be less vulnerability to climate extremes such as droughts.

Where do you see major gaps in the knowledge base and why would it be important to address them?

» There are several gaps that we need to address in order to develop a better capability to inform the nexus. These gaps are generally more apparent if we assume that we that we wish to coordinate the W-E-F issues at regional and global scales as well as at local scales. Some of the technical challenges include:

Data Coverage issues: Spatially continuous data coverage is provided by satellite data. However to ensure regular continuous coverage in cloudy areas we must improve our measurement capabilities for variables that are derived from observations in the optical wavelengths where clouds prevent measurements. This deficiency could be overcome by making more extensive use of radar measurements from space. Furthermore, we need to ensure we have a system that can provide global mapping capabilities in spite of the reluctance of some countries to share their in-situ data with neighboring countries. These data are needed to calibrate and validate satellite data and models and to provide reliable analysis of fields such as precipitation, evapotranspiration and crop yield. This problem could be solved by a stronger commitment to data sharing between nations and more capable and accessible central data assimilation and prediction systems that would provide stronger incentives for collaboration.

The integration challenge: In order to deal with the W-E-F nexus at the regional and global scales, we need to be able to integrate data, information and perspectives coming from the water, energy and food sectors. This ability is lacking at present and only limited efforts have been made to integrate across the W-E-F sectors. The gaps that need to be addressed include interoperable data systems between the three sectors and integrated models that will represent the processes affecting all three sectors in a consistent way.

»The nexus approach is an important step towards achieving a green economy.«

Supporting the optimization of governance approaches through data services: Clearly, governance is a central issue in W-E-F issues. Governance issues include cross sector planning and management of the nexus, the role of the private sector in governing the W-E-F nexus, the challenges of governance on a basin scale (similar to Integrated Water Resources Management?) and polycentric governance approaches. Until one or more bases for governance is agreed upon, the best approach for organizing data and information services to support governance will remain obscure. On the other hand, interoperable and integrated information systems could be developed to encourage the implementation of integrated governance structures within the W-E-F nexus.

In developed countries, trends appear to be favouring large agricultural operations. There will be different expectations and requirements for information systems that address the needs of large corporations versus those that support local family farms. The information needs of corporate producers need to be determined and systems for addressing those needs should be developed in parallel with services for more localized users.

What role does the implementation of the nexus approach play for the transformation to a green economy?

» Based on my naive understanding, the concept of the green economy has a variety of definitions sometimes tweaked to meet the objectives of a company that wishes to benefit in some way by associating their product with the concept. Based on this working level definition, the green economy is used to refer to any part of the economy where a renewable product is being substituted for a conventional, resource-intensive product. Clearly, the W-E-F nexus approach will provide many green economy innovations and add to the number of green economy innovations that society has made. On the other hand, UNEP and other UN agencies had a higher level definition of the green economy that was discussed at Rio+20. The W-E-F nexus will also contribute to these goals as well, but a full economic analysis would be needed to determine the extent and most significant contributions arising from the nexus approach. Independent of the definition used, the W-E-F nexus approach is an important step towards achieving a green economy and the important sustainability goals associated with it. The W-E-F nexus is important because it provides a framework for bringing together many initiatives related to water, energy and food and allows for their evaluation against a set of relevant criteria. This evaluation would be much broader than the assessment of a "green" initiative within a narrow part of a single economic sector. The W-E-F assessment process will be informative and insightful, and could serve as a flagship for the green economy approach. The most successful aspects of the assessment procedure using an integrated framework will certainly strengthen the capabilities to undertake "green economy" assessments. It could also be informative for other integrated management approaches such as Integrated Water Resources Management whose implementation has been slowed by practical complexities, national imperatives, and inter-sector competition. Discussions of initiatives within a W-E-F evaluation framework would have to move beyond concepts of performance and efficiency to deal with long-term sustainability. Inevitably, expanding the debate in this way will advance general interest in a green economy approach.

What progress has been made since the "Water-Energy-Food Security: New Challenges and New Solutions for Water Management" Conference held in Canada in 2012 and what are your expectations from the upcoming "Sustainability in the Water-Energy-Food nexus" conference which will take place in Bonn, Germany this year?

» There has been significant progress since the GWSP/IISD conference in Winnipeg, Canada in 2012; some arising from that meeting or the actions of GWSP and IISD after the meeting. For example IISD has developed a report on ways to address W-E-F issues by looking at innovative approaches to managing water on the landscape. However, the majority of advances on the nexus have come through high-level discussions which have been helpful in understanding the water resource issues involved and how those who manage water often bring different perspectives, priorities and modus operandi than those who manage food production and energy supply. Needless to say, expanding the factors considered in these discussions draws in a larger community concerned with ecosystems and biodiversity who see their constituencies impacted by the way in which water is supplied to and used in agriculture. The Food and Agriculture Organization (FAO) has taken this opportunity very seriously and launched a W-E-F program in 2013 where they are considering the energy and water components of the food production system in different regions of the world.

I am optimistic that the meeting in Bonn in May, 2014 will allow us to make another major step forward on the nexus issue. It is assembling members of key organizations and intellectual leaders from academia to discuss W-E-F issues based on a variety of perspectives. For example, it will provide an opportunity for those concerned about measurements, monitoring, predictions and scenarios to dialogue with those who deal with governance, policy, and management and who must be concerned with the interconnectedness of issues, the challenges of sustainability, and the role of governance, including new governance paradigms, in meeting these challenges.

» The interview was conducted by Anna Schürkmann, Research Associate with the International Project Office of GWSP in Bonn, Germany.

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Towards a sustainable water future: shaping the next decade of global water research

by Claudia Pahl-Wostl, Charles Vörösmarty, Anik Bhaduri, Janos Bogardi, Johan Rockström and Joseph Alcamo

Looking back on a decade of water related research under the aegis of the Earth System Science Partnership the authors lay out the vision for a new program as part of the Future Earth initiative: the Sustainable Water Future Program (SWFP). The SWFP can built on the research and findings from past integration studies carried out by several components of the International Geosphere- Biosphere Program, the World Climate Research Program, International Human Dimensions Project, DIVERSITAS, and nearly a decade of synthesis activities under the Global Water System Project (GWSP).
While past research has mostly focused on the identification of water related problems, the authors emphasize that in coming years the focus needs to shift to solution oriented approaches. These should be based on "co-production of knowledge involving scientists and stakeholders". "To view sustainability through a water lens means, virtually automatically, adopting an integrated and systemic perspective." This reflects the aim of Future Earth to foster interdisciplinary collaboration across the sciences and involve policy-makers, funders, academics, business and industry, and other sectors of civil society in the process.

The SWFP should be based on four guiding principles:

- **Generate robust knowledge**

  "The science agenda should generate new knowledge through co-production of knowledge of researchers and stakeholders, at and for different scales, from regional to global. The co-production of knowledge will help to ensure clear policy relevance."

- **Enhance water security**

  "A particular challenge is to explore the synergies between sustainability and security concepts, to develop operational targets and monitoring processes that recognize that security has different meanings at different levels/scales and for different groups"

- **Support good governance**

  "It is essential to go beyond simplistic panaceas for governance reform and to pay due attention to complexity and context dependence and conditions for success and failure of governance arrangements"

- **Monitor progress**

  "An ability to recognize sustainable practices and the attainment of sustainability goals will require a well-designed measuring system."

The authors recommend organizing the SWFP under three major thematic areas:

- **The State of Global Water**

  to produce factual knowledge on the global state of water, develop conceptual and methodological innovations to improve analysis and diagnostic capabilities.

- **Water as Global Change Agent**

  to focus on the role of water as an agent of change that either enhances or detracts from the goal of sustainability

- **Governance of Transformation**

  to explore the dynamic society-nature interface and interaction at and across different levels and to govern the transformation towards a sustainable water future.

These three thematic areas should be complemented by one cross-cutting area:

- **Communication, Capacity Development and Counsel**

  to develop an interface to and with the many communities and to serve water-related endeavors of the Future Earth community and focus on formulating and transmitting the message about the role of water, its governance and management.

Summary by Anna Schürkmann, full reference of article:

Pahl-Wostl,C., Vörösmarty,C., Bhaduri,A., Bogardi,J., Rockström, J., Alcamo, J., 2013, Towards a sustainable water future: shaping the next decade of global water research, Current Opinion in Environmental Sustainability (5): 708-714

Connecting Past, Present, and Future: From "Water in the Anthropocene" to "Sustainability in the Water-Energy-Food Nexus"

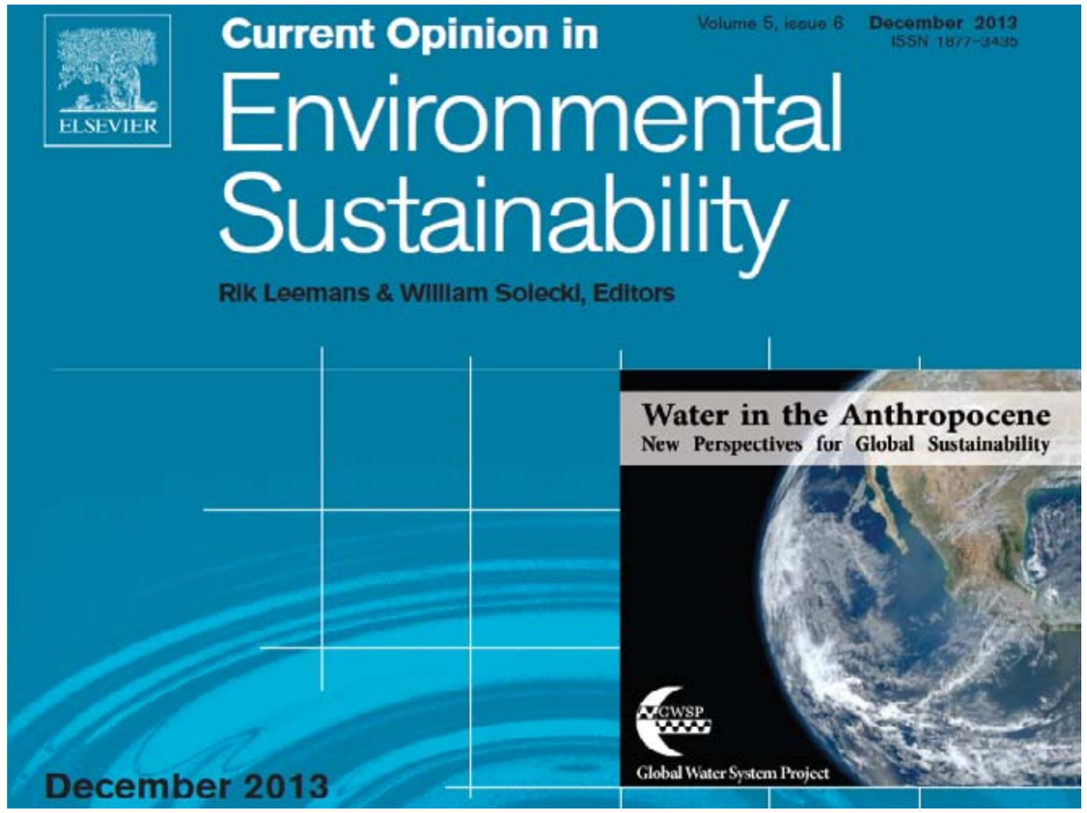
by Anna Schürkmann

In May 2013 the International Project Office of the Global Water System Project (GWSP) organized the international conference "Water in the Anthropocene – Challenges for Science and Governance". The conference brought together over 350 participants from all over the world and with various professional backgrounds. Out of the great variety of presentations 19 were selected to be published as an article in a special issue of the journal "Current Opinion in Environmental Sustainability". The special issue with the title "Water in the Anthropocene – New Perspectives for Global Sustainability" was published in December 2013 and is, next to the "Bonn Declaration of Global Water Security", a key product of last year's GWSP conference.
The 19 articles in the special issue cover three major themes: (1) Global Water System - Current State and Future Challenges, (2) Global Dimensions of Change in River Basins and (3) Balancing Water Needs for Humans and Nature.

The special issue gives a good overview over current and future challenges regarding water related science and policy, identifies fields of action, and provides recommendations for future research.

The Water-Energy-Food nexus is the focus of three articles of this special issue. One article by Lawford et al. is based on a study investigating the Water-Energy-Food security nexus from a basin perspective. Another contribution by Ringler et al. explores the potential for improved resource use efficiency in the Water-Energy-Land-Food nexus; and a third one by Pahl-Wostl et al. proposes an outlook on the next decade of global water research within the framework of the "Sustainable Water Future Program".

In this Newsletter you find brief summaries of the three articles highlighting key findings and recommendations of the authors.



Rivers of the Anthropocene Conference January 23-24 2014 in Indianapolis, USA

Summary by Sina Marx

Rivers of the Anthropocene is a transdisciplinary research project examining global river systems during the age of the Anthropocene. Approaching rivers and their landscapes not simply as natural phenomena or as human artifacts but as human-nature entanglements, a group of international researchers seeks to provide a transdisciplinary analysis of the interactions between humans and their river environments. By mapping the ecological, geographical, cultural, social, political, and scientific histories of river systems, this project will provide insight on issues of relevance to public policy, environmental conservation, and heritage management.

As the kick-off event for the Rivers of the Anthropocene project a two-day international conference was held at Indiana University-Purdue University on January 23-24, 2014. Organized by the IUPUI Arts and Humanities Institute, the conference was followed by a one day workshop to create a flexible, interdisciplinary methodological and conceptual framework for examining the human-environment interface, one in which specialists in the earth sciences can learn from the approaches of the humanities and human sciences and vice versa.
Bringing together 25 experts from 5 countries – natural scientists, social scientists and humanists, practitioners, journalists and artists —, the aim of the conference was to create new transdisciplinary approaches for addressing freshwater systems around the globe in an attempt to create meaningful dialogue and measurable results. Both GWSP Co-Chairs Claudia Pahl-Wostl and Charles Vörösmarty were present as speakers.

"Rivers of the Anthropocene" addresses a fundamental problem facing scholars and policy makers alike: despite important advances in our understanding of the earth as a system — one in which humans and human systems have become recognized as prime agents in effecting changes to the earth — we have yet to create an approach that brings together scholars of earth systems with scholars of human systems. This is to the detriment of our overall understanding of global ecological change and limits our ability to respond to escalating crises. Without integrating methods from the earth sciences, social sciences, and humanities, scholars of the environment lose important tools in tackling some of the biggest issues facing humanity in the 21st century. As humans continue to play an increasingly significant role in altering their planet, it is incumbent upon environmental scholars to understand the human-environment interface in all its complexities. It is not enough that scientists measure what humans have done or what they can do to shift environmental systems; it is necessary that they work hand-in-hand with specialists in human systems to understand the limits and feedback mechanisms that beliefs, practices, ideologies, social structures, and cultural norms impose on human action. A comparative study of international river systems is a good place to begin building more meaningful bridges across the science-humanities divide, and it addresses the pressing issue of global water insecurity, which 80% of the earth's population faces.

Sam Turner, Professor of Archaeology at Newcastle University, during his lecture at the Rivers of the Anthropocene Confernce

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The Water Visions Lab Network – Building Bridges over Troubled Water?

by Anna Schürkmann

The collection of articles and interviews in this Special Issue of the GWSP-Newsletter gives an overview of some current and future challenges humans are facing regarding water, energy and food security. Although topics and perspectives differ substantially among contributions, there is one thing that almost all of them have in common: the call for new, innovative, and interdisciplinary approaches to address these challenges. Sometimes without explicitly using the word "innovation", it is clear that the solution lies within social, institutional, technical, and business innovations. When feasible (and often innovative) solutions are found and suggested, a barrier for implementation remains and can often not be addressed by a single person or organization.

Overcoming these barriers is another major challenge that humanity faces these days. A variety of partners, coordinated through the GWSP-IPO, recently initiated the Water Visions Lab Network (WVLN). The Water Visions Lab Network (WVLN) aims at integrating research with practical solutions. This will be achieved by identifying a feasible set of technical, social, and institutional innovations to attain sustainable water solutions (sustaining environmental services, reducing threats to ecosystems while ensuring human water security) at the local level.

The WVLN is designed to address three major innovation barriers: (1) long diffusion time of innovations, (2) lack of knowledge exchange between theory and practice and (3) lack of understanding of the implementation and adoption process. Within the WVLN framework, representatives from different parts of society (public and private sector, scientific community, civil society, NGOs, and other) will come together and work towards developing water related innovations. Thus, the developed product will be based on a broad range of subjective preferences and concerns from different sectors and people from global, regional and local level. It will open up opportunities for a wide range of technical, business, institutional and social innovations.

The WVLN will organize sets of different 'Innovation Labs' each with a focus on a particular region. The labs will comprise three phases: the pre-lab phase, the lab phase, and the post-lab phase. The pre-lab phase is designed to establish a knowledge base on water related challenges and issues of a particular region form local and global perspectives. The lab phase brings together representatives from different stakeholder groups (science, industry, NGOs, government, civil society) to work on particular water related issue in the region and develop solutions. The post-lab phase is dedicated to the implementation of the innovative solutions. This also includes a scientific component to monitor the implementation process itself and the longer term impact of the innovation. Labs can therefore benefit from the experiences made in previous labs.

Additionally to the direct implementation of innovative solutions in the post-lab phase, results will be presented and delivered to a wider audience through four different platforms: (1) Conferences and workshops, (2) an active online platform, (3) a water Exploratorium/Museum, and (4) handbooks and reports.

The first Innovation Lab of the WVLN is planned to take place in India. India's water resources are under growing pressure due to population growth and rising incomes. It is widely recognized that past approaches of supporting development do not suffice in the face of present and future challenges. Solutions to water related problems, such as too much or too little water at a given time and in a given place, challenge the well-being of many people in the country. Efforts to solve these problems are ongoing and it is widely accepted that interdisciplinary approaches and solutions are needed when confronting these challenges.

The Water Innovation Lab India as part of the WVLN will herein serve as a platform bringing together actors from different sectors to develop solutions and deliver them to stakeholders for implementation. According to the process design illustrated in Figure 1 the Water Innovation Lab India will integrate and build on existing innovations to create and identify gaps in knowledge and implementation of water related solutions. Participants of the lab will come from a variety of professional backgrounds and sectors and the setting will enable an integrative, nexus oriented perspective on water related problems and solutions.

Partners of the Water Visions Lab Network:
Center for Development Research (ZEF), City University of New York (CUNY), DB Sediments, Federation of Indian Chamber of Commerce and Industry (FICCI), German Water Partnership (GWP), Global Water Partnership (GWP), Global Water System Project (GWSP), International Food Policy Research Institute (IFPRI), Innovative Living Institute (ILI), Institute of Hydraulic Engineering and Water Resources Management-RWTH Aachen University (IWW-RWTH-Aachen), School of Oriental and African Studies – University of London (SOAS), UNESCO Institute for Hydrological Education (UNESCO-IHE), University of Amsterdam (UvA), University of Osnabruck, United Nations University – Institute for Environment and Human Security (UNU-EHS), United Nations University - Institute for Integrated Management of Material Fluxes and of Resources (UNU-FLORES), World Business Council for Sustainable Development (WBSCD).

Addressing the Water Quality Challenge: GWSP Cooperates with UNEP and UNU in the International Water Quality Guidelines for Ecosystems (IWQGES) Project

by Janos Bogardi and Zita Sebesvári

Meeting growing human needs for water, food and energy without irreversibly degrading the important goods and services provided by healthy ecosystems is one of the most pressing challenges for society in the 21st century and is central to current notions of water security (Bogardi et al. 2012; Cook and Bakker, 2012; UNU-INWEH and UN-Water 2013). Freshwater systems are impacted by multiple stressors to the extent that these seriously threaten water security, for humans and nature at a global scale (Dudgeon et al. 2006; Vörösmarty et al. 2010). As a consequence, freshwater biodiversity is in serious decline (Strayer and Dudgeon 2010; Dudgeon et al. 2006). There is growing awareness that the water requirements to sustain ecosystem health and biodiversity in rivers and wetlands can be well aligned with human needs and deliver a range of ecosystem goods and services to society (Postel and Richter 2003; Bernhardt et al. 2006).

While the quantity dimension of water security – also within the Water-Energy-Food nexus – had been acknowledged and prominently addressed in conferences and in policy, the consideration of the looming water quality crisis as a global challenge has only recently become an emerging priority area of concern.

Development of IWQGES

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 the United Nations Environment Programme (UNEP) to coordinate it. In its work, the UN-Water TPA on Water Quality recognized the need to develop international water quality guidelines for the protection and rehabilitation of aquatic ecosystems.
In February 2013, the UNEP Governing Council adopted the decision to develop International Water Quality Guidelines for Ecosystems. These "(..) may be voluntarily used to support the development of national standards, policies and frameworks taking into account existing information while integrating, as appropriate, all relevant aspects of water management". (The Operative Paragraph 1 of decision 27/3)
By acknowledging ecosystems as legitimate "water users" with respective quality requirements for their own sake, but also as providers of essential ecosystem services whose sustainability depends on securing the ecosystem health and functionality of freshwater bodies, the urgency to act in the spirit of the mandate given to UNEP becomes apparent.

Focusing on ecosystems services

Deteriorating water quality has a significant effect on water availability as part of the resource cannot be considered for higher value uses. Deteriorating water quality status and hydromorphic changes of water courses are among the leading causes of degradation of aquatic ecosystems and their related services, threatening livelihoods and development. While aquatic ecosystems are the richest habitats by number and diversity of species, the Millennium Ecosystem Assessment (2005) noted that aquatic ecosystems are deteriorating faster than many other natural systems. Consequently their ability to provide ecosystem services declines.
Water quality and biological conditions of freshwater bodies do not only characterize the status of freshwater ecosystems, but reflect also the prevailing situation in neighbouring terrestrial ecosystems as well. As ultimate sinks in the landscape (through surface runoff and seepage from groundwater bodies) the freshwater ecosystems are excellent proxies to characterize the ecological health of an upstream catchment or even an entire river basin. Environmental stresses and their evolutionary trends, even far away from lakes, wetlands, water courses or ground water, can ultimately be detected in the state of the recipient water bodies.
While international water quality guidelines (with a utilitarian focus) already exist among others for drinking water, recreational use, irrigation, livestock, and water reuse, comparable international water quality guidelines for ecosystems with a focus on freshwater ecosystem health are absent or have only recently started being developed in few countries. Next to the "utilitarian" water quality standards, similar regulatory mechanisms are needed for the freshwater ecosystems. These would provide a good framework and basis for freshwater ecosystem remediation and monitoring schemes, ultimately ensuring freshwater ecosystem health and function, including provision of ecosystem services. Water quality standards for ecosystems would facilitate the integration of an ecosystem-based management approach (considering ecosystems as legitimate water users) in water resources management and water allocations
Ecosystem services have been considered for too long as "services for free". Overstressing the resilience of freshwater ecosystems by neglecting the precautionary principle has led to massive deteriorations with consequences for human health and livelihoods. The situation has become alarming in many parts of the world and has led to an increased demand of immediate action and solutions to tackle the problems.

Organization and project implementation

In the implementation of the IWQGES, UNEP is working closely with the United Nations University – Institute for Environment and Human Security (UNU-EHS). The mission of the United Nations University is to contribute, through collaborative research and education, to efforts to resolve the pressing global problems of human survival, development and welfare that are the concern of the United Nations, its Peoples and Member States.

Within the particular partnership for the development of the IWQGES, UNU-EHS is providing scientific input of its own and is drawing scientific input from the Global Water Systems Project (GWSP), UNESCO- IHE and other relevant international and national institutions and individuals. UNU-EHS has established, with support and endorsement of UNEP, the Drafting Group (DG) which is composed of international scientists, preparing the draft IWQGES. For this, UNU-EHS was able to draw on a broad network of scientists globally directly but also through its close links to GWSP, and to engage them to work on a project of direct relevance to the UN system.
Since May 2013 the implementation of this project is ongoing and approaches the stage of the Preliminary Draft Version. This would serve as the basis for interaction between the drafting and advisory groups of the project.
It is foreseen that the consolidated draft version, expected to be available by the end of 2014 would serve as the basis for regional consultations in 2015.

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GWSP Summer Water Academy – Investing in the Future

by Anna Schürkmann

How to get the knowledge across? This seems to be one of the major challenges in current debates about sustainable development. Practitioners, policy makers and scientist alike face the problem of bridging the gap between them to efficiently exchange and share experiences and knowledge. Great effort is taken by scientists in many different fields to understand current and future challenges humanity is facing and their underlying causes. Practitioners and policy makers are constantly trying to improve their practices and frameworks to work towards sustainable development. Nevertheless, communication between the "worlds" remains difficult.

The Global Water System Project (GWSP) has recognized these challenges a long time ago and has supported various steps to enhance the dialog and exchange between science, policy and practitioners. This year's conference "Sustainability in the Water-Energy-Food Nexus" is only one such example. To take advantage of the diversity of participants of the conference, GWSP is organizing a Summer Academy for students to train communication skills, connect to senior scientists and benefit from the experience of peeking "behind the scenes" of such an event.

The participants will be trained in three major fields of communication: How to write an easily understandable scientific paper, how to present their research personally to different non-scientific audiences and how to report on and synthesize someone else's research. Experts in communicating science will give background information and individual feedback on the topic of communicating science. Senior scientists will support and work intensely with the students in editing their papers and presentations and they will work closely together with the students and session chairs on the session reports.

This threefold approach was chosen to touch different aspects of science communication. A well written scientific paper reaches a broad scientific audience and increases the impact of the research in the scientific community. The ability to orally present scientific findings in an understandable, accessible and concise way to non-scientific audiences (policy makers, media representatives and students) is crucial when trying to achieve maximum attention and implementation of the own findings. Being able to distill and summarize key messages and findings from different studies forms a solid basis for writing, presenting and debating about causes of, targets for and progress on sustainable development.

Together with supervisors and tutors the participants will produce three major outputs: An improved version of their article that is ready for submission to one of the special issues in "Water International" and "Sustainability Science", an oral presentation that is tailored to a specific audience and a report article on a conference session that will be published in a special issue of the journal "Change and Adaptation in Socio-Economical Systems".

GWSP book to be launched in August 2014: "The Global Water System in the Anthropocene"

For one decade, the Global Water System Project (GWSP) has coordinated and supported a broad research agenda to study the complex global water system with its interactions between natural and human components and their feedback processes. This peer-reviewed book addresses the worldwide experiences on the responses of water management to global change within this last decade.

With selected contributions from the GWSP Conference "Water in the Anthropocene" held in May 2013 in Bonn, the book reflects the shift in mind-set that is required to address the water challenges of tomorrow, discussing issues like water governance and related institutional and technological innovations as well as variability in supply, increasing demands for water, environmental flows, and land use change.

With 28 chapters this edited volume embraces a wide variety of disciplinary and interdisciplinary perspectives that correspond to the four sections of the book:

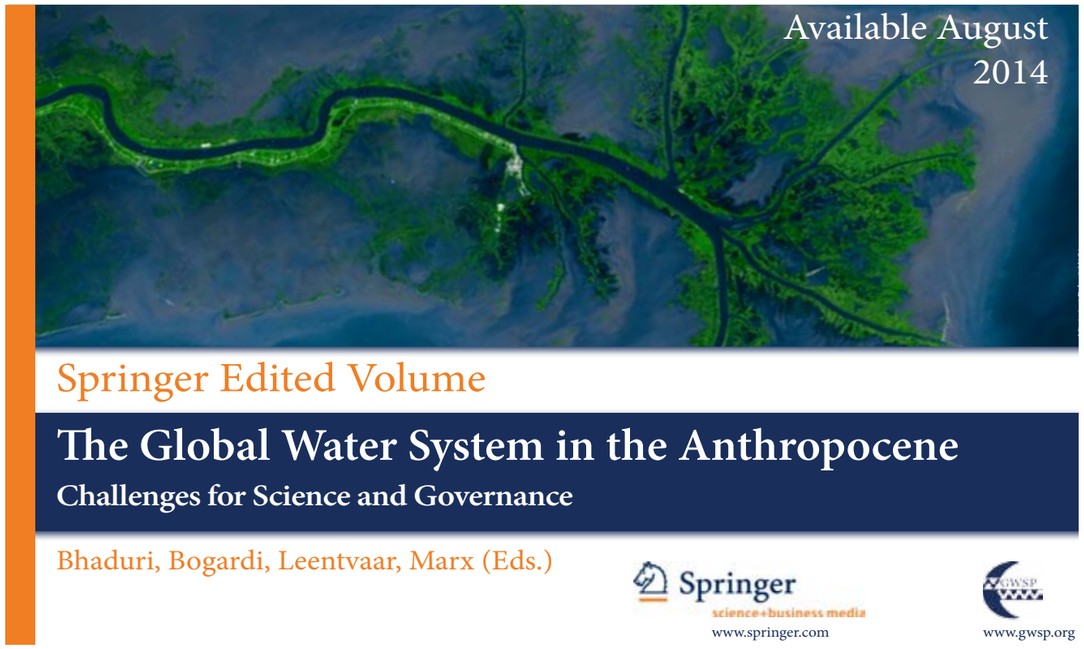
Global Water System: Current State and Future Perspectives
The papers under this theme present assessments of global water resource availability, deal with earth observations and the role of indicators, data and models of the global water system. They discuss aspects of how to account for water and uncertainties globally, covering both physical processes and socially mediated water fluxes, water withdrawals and uses as well as virtual water trade.

Dimensions of Change in River Basins and Regions
The theme focuses on adapting to global changes at the river basin and regional scale. It includes contributions about adaptive resource management towards water security in river basins, papers addressing institutions and governance challenges in water scarce regions as well as papers bringing in historical perspectives to understand river systems in the Anthropocene.

Ecosystem Perspectives in Water Resources Management
The third theme presents different approaches to ecologically sustainable water management drawing on various case studies. The section focuses on how to mitigate the negative impacts of anthropogenic activities on the resilience of social-ecological systems.

Governing Water in the Anthropocene
The fourth section concentrates on the crosscutting issue of global water governance, acknowledging the fact that the global "water crisis" is in fact a governance crisis. Case studies in water governance and management under global change from different parts of the world are complemented by contributions dealing with issues like water law, ethics and institutions in water governance.

To order the book, please go to: www.springer.com/water



Upcoming Special Issues

CASES – Spread the Word Even Further

To facilitate an ongoing discussion after the two days of the conference "Sustainability in the Water-Energy-Food Nexus" short summaries of each session will be published in a special issue of the open access journal "Change and Adaptation in Socio-Ecological Systems" (CASES). Participants of the GWSP Summer Water Academy and other early career scientists will write short reports on individual sessions, highlighting the key findings and messages of the presentations. They will be supported by senior scientists and the session chairs.

The special issue is seen as a major tool to include a broad public in the debate and make the contents of the conference accessible for anyone interested in the topic. With the support and feedback from the communication experts, who are teaching at the GWSP Summer Water Academy, the authors will produce easily understandable and concise summaries of the sessions. Published in an open access online journal, this will enable a broad audience to access the latest proceedings and findings on the Nexus topic and engage in the debate. A high quality and scientific correctness is assured by a two stage review process that is required by the journal and will be facilitated by the guest editors of the special issue.

Water International - Call for Papers!

A special issue of the journal "Water International" under the theme "Sustainability in the Water-Energy-Food Nexus" will be published soon after the conference. Guest editors for the special issue will be: Anik Bhaduri, Claudia Ringler, Rabi Mohtar, and Waltina Scheumann. The special issue aims to address the following key questions:

1. How can governance and management practices reduce tradeoffs and exploit synergies across the Water-Energy-Food Security Nexus?
2. How to establish a comprehensive theoretical framework that assesses the costs of tradeoffs and the synergies across different resource uses?
3. What are the direct and indirect drivers of change supporting or constraining a nexus approach, including analyses of social, economic, political and cultural aspects that are influenced by the management of resources at different scales?
4. How are river basins being managed to deal with challenges arising from the Water-Energy Food Security nexus?

All participants are invited to submit their full article by August 31st 2014 to gwsp.ipo@uni-bonn.de!

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Organizational Framework

GWSP Mission

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.

DIVERSITAS an international programme of biodiversity science

GLOBAL CHANGE IGBP

IHDP International Human Dimensions Programme on Global Environmental Change

WCRP World Climate Research Programme