ADVANCING THE WATER-FOOD NEXUS: APPROACHES AND METHODS

TIAS-USF WEBINAR SUMMARY

TUE, NOV. 25, 2014

Organized and hosted by The Integrated Assessment Society (TIAS)
https://www.tias-web.info

and
the Institute of Environmental System Research (USF), Univ. of Osnabrück

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Contents

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1. Introduction to the Water-Food Nexus Theme

The Water-Energy-Food Nexus is a relatively new approach for promoting security in all three sectors, by reducing trade-offs, building synergies and improving governance across these sectors, and thus stimulate the transition to a green economy. The "nexus" is an important theme for The Integrated Assessment Society and the Institute of Environmental Systems Research since sectoral and disciplinary integration lie at the core of their mission. In order to launch the Nexus as a theme for TIAS, the webinar held on November 25th, 2014 narrowed the focus to water and food security, since the intersection of these two sectors alone is sufficiently broad and complex. TIAS' goal is to support those practitioners, decision-makers and academics whose work focuses on water security or food systems, and thus inevitably requires deeper consideration and understanding of both sectors. Events such as this webinar support our members and other interested professionals, by providing a forum for knowledge exchange, identifying areas requiring more attention, and expanding networks.

The following questions were addressed in the webinar:

- Where is the Nexus approach now and what are some of the key challenges being faced? What areas require strengthening and improved guidance?
- What are some of the more promising Nexus assessment methods and tools used?
- What kind of networking and research opportunities can we identify that will help knowledge exchange and development?

The agenda for the webinar is provided in Box 1 below.

Box 1: Agenda

Welcome and Introduction to the Webinar Theme
Caroline van Bers, Programme Manager, TIAS

The importance and value of the Nexus Approach
HenkWesthoek, Progamme Manager, Water, Food and Agriculture, Netherlands Environmental Assessment Agency

Improving food and water security through Water Footprint Assessment
Ashok Chapagain, Science Director, Water Footprint Network (replacing Ruth Mathews, Executive Director, Water Footprint Network)

Assessing prospects for food and water security using scenario analysis
Claudia Ringler, Deputy Director, Environment and Production Technology Division, International Food Policy Research Institute

Discussion Chaired by Joanne Vinke-de Kruijf, Univ. of Osnabrück and TIAS
- WF Nexus challenges to be addressed
- Promising methods and tools for nexus analysis
- Networking and research opportunities

Summary and Follow-up
Caroline van Bers, Programme Manager, TIAS

2. Feature Presentations

The Nexus experts, Henk Westhoek, Ashok Chapagain, and Claudia Ringler presented their knowledge and experience with an initial overview of the Nexus approach, followed by the Water Footprint approach to nexus analysis, and finally the prospects for water and food security with the use of scenario analysis.
Link to all presentations
Link to recording

2.1 The value of the water-food nexus approach

Henk Westhoek, Programme Manager, Water, Food and Agriculture, Netherlands Environmental Assessment Agency, Netherlands

Link to Henk Westhoek's presentation

Summary of the presentation

Henk Westhoek presented some basic background on the water-food nexus, including the fact that 70% of 'blue' water is used for agriculture and demand is increasing. In many regions water is not managed in a sustainable and efficient manner, which leads to lower crop yields. Water is *one* of the essential natural resources for food production, and limited water availability is one of the causes of low crop production and rural poverty. It is expected that issues associated with water quantity and quality will increase and that means that solutions will be needed in the near future. Food production is expected to increase because of increased demand resulting from shift in diets due to urbanization, increased welfare worldwide and supermarketization. Dietary shifts mean more meat and dairy, and the consumption of more non-traditional food products and that results in more trade. Furthermore, water demand from non-agricultural sectors and the effects of climate change put pressure on water availability. There are two ways to look at water issues: separately or in a larger context.

Between 2005 to 2045 vast changes are expected in the distribution of land use systems (e.g. agriculture and water use). Integration is needed to solve a range of problems. A key approach is integrated water resource management (IWRM). Related approaches are Integrated Soil Fertility Management (ISFM), Integrated Land Management (ILM) and Integrated Pest Management (IPM). All integrated approaches look at the resource and demand side of the food system. Options on the consumption side are the reduction of food wastes and losses as well as dietary changes. In order to achieve dietary changes food companies and retailers need to be involved. The conceptual approach of 'food systems' looks *institutionally* at natural resources and environmental effects. It is helpful in identifying new challenges & opportunities, both for governments as for private actors.

Henk described the conceptual framework for food systems and natural resources, including the food system activities and actors, natural resources and environmental impacts, the socio-economic drivers and the food system outcomes. Opportunities for changes lie in the socio-economic drivers and the interaction between activities and actors.

Henk concluded that the water-food nexus is highly relevant. It opens up opportunities on the consumption side and also addresses impacts on food security and rural livelihoods. It could be extended to the food system approach which examines actors and there are a large number of examples.

Discussion and questions

Question (Jan Bakkes): Henk, what would be the big determining areas of investments?

Answer (Henk Westhoek): There are two major areas of investment. One is agriculture and food production, and the other is the investment in more sustainable food systems.

Question (Mike Nagy): The information provided was very detailed but has not yet been enough time to absorb it. Question: we are concerned with water waste, poor irrigation methods and mineral accumulation in soils. How do we get new technologies to reduce poor irrigation practices?

Answer (Henk Westhoek): Much has been done to improve irrigation practices. However, apart from the central role played by governments in introducing these practices, there is a major role for private sector actors, e.g., large food companies and retailers. They can do much to support regional products.

2.2 Improving food and water security through Water Footprint Assessment

Ashok Chapagain, Science Director, Water Footprint Network (replacing Ruth Mathews, Executive Director, Water Footprint Network)

Link to Ashok Chapagain´s presentation

Summary of the presentation

Production, consumption and unsustainable natural resource use, lifestyle and resource efficiency are linked. The water footprint assessment manual is the international standard for footprint assessment. The footprint is an indicator that measures the pressure that human activities put on natural resources. It is an indicator that can link natural resource use of production to the consumption of that product. It is an indicator that can aggregate natural resource use across a value chain and for a process, product, product group, company, individual or group of individuals. It is an indicator that can measure the amount of a natural resource consumed or the amount of assimilation capacity used, and it is an indicator that can lead to the assessment of the sustainability, efficiency and equity of natural resource use, production and consumption.

A differentiation is made between **green** water (volume of rainwater evaporated or incorporated into product), **blue** water (volume of surface or groundwater evaporated or incorporated into product, lost return flow) and **grey** water (volume of water needed to assimilate pollutants). The concept of water footprint assessment starts with setting of goals and scope. For water footprint accounting you need to understand the geographic and temporal allocation of water resources for industry, agriculture and domestic water supply. For water footprint sustainability assessment you need to assess the sustainability, efficiency and equity of water use/consumption and pollution. For water footprint response formulation you need to identify the most strategic actions to be taken at the local, regional, national and global scale, individually and collectively.

For sustainability assessment it is important to verify if the water footprint violates sustainability criteria and if the water footprint can be reduced with a reasonable effort and if the water is used for the highest and best purpose to meet broad social, environmental and economic goals. The water footprint along a supply chain grows with every step in the supply chain because of the water use in each step. The virtual-water content of a product is the freshwater 'embodied' in the product. It refers to the volume of water consumed or polluted for producing the product, measured over its full

production chain. If a nation exports/imports such a product, it exports/imports water in a virtual form. Over 40% of the water footprint of European consumers is outside of Europe. Water footprint allocation for sustainable development comprises environmental sustainability (which means water footprint allocation at the local (catchment or river basin, aquifer) level), economic efficiency (which means water footprint allocation at the process (farm field, factory, household) level) and equitable sharing (which means water footprint allocation at the global level).
Response formulation: Environmental sustainability includes water governance, water footprint caps and regulations based on Water Footprint Assessment. Economic efficiency includes technology and improved practices, and for social equity consumers share responsibility for water footprint of production.

Discussion and questions

Question (Jan Bakkes): Ashok, who are the champions, considering the three dimensions of response together?

Answer (Ashok Chapagain): tough question. We do not have one organisation or group working as a champion to bring these together. UN Water and other global organisations should have this role and we are trying to get them to work with WFN and others. The traditional way of thinking in large institutions is holding us back to some extent.

Question (Sylvia Kay): How can consumers share in the responsibility of the water footprint for production? And in your last slide you mentioned water caps - could you elaborate on this?

Answer (Ashok Chapagain): 1) Consumers, when organised, can act as the pressure groups for increased sustainability and they influence through their purchasing habits (e.g., organic cotton).
2) Water caps – government or river basin water authorities should design and implement these caps.

Question (Claudia Ringler): What share is water use in food processing compared to production, and what is the grey water footprint of processing versus production?

Answer (Ashok Chapagain): I do not have the numbers in front of me but the water footprint is much higher for production than processing. The grey water footprint of processing is very high, and industries struggle with this, but they have the biggest opportunity to improve with current technologies.

For more information including data please visit the Water Footprint Network site:
www.waterfootprint.org

2.3 Assessing prospects for food and water security using scenario analysis

Claudia Ringler, Deputy Director, Environment and Production Technology Division, International Food Policy Research Institute

Link to Claudia Ringlers´ presentation

Summary of the presentation

Claudia Ringer's presentation is divided into 6 key messages.

1. Global hunger and malnutrition persist

Today, about 870 million, or 1 in 8 people worldwide, still suffer from hunger, including 150 million

children.

2. A scenario approach can be used to assess linkages of food with other sectors

Major drivers affecting water, food, climate and energy are increasing population and urbanization; rising incomes and demand as well as dietary changes; rising energy prices and biofuel expansion; increasing volatility of food prices; growing land and water constraints; and climate change and higher frequency/intensity of extreme weather events. Scenarios are an internally consistent verbal picture of a phenomenon, sequence of events, or situation, based on certain assumptions and factors (variables) chosen by its creator. Scenarios are used in estimating the probable effects of one or more variables, and are an integral part of situation analysis and long-range planning (businessdictionary.com). There are qualitative and quantitative scenarios and quantitative scenarios should combine socioeconomic with biophysical approaches. A modeling tool Claudia Ringler uses for scenario assessment is called the IMPACT Model.

3. Water (and energy) scarcity threaten food security

Irrigation is the largest water user and usually seen as the major driver of water scarcity, but at the same time it is the key for securing future food supply. Improvement in agricultural water use efficiency is usually a slow and difficult process and diets are shifting towards increasing water use intensity (livestock products, vegetables, sugars, aquaculture). That means that agriculture is both vulnerable to and a contributor to water scarcity. And water stress is rising.

Energy demand is increasing just like water and food demand. Rising energy prices affect agriculture (biofuels are more profitable and that promotes the food-fuel competition) and water use (e.g. irrigation becomes more costly). With two different scenarios (Yield Increase and Energy Shock) the model can simulate projected changes in world prices of crops in 2050. Yield Increase leads to a price reduction and Energy Shocks in the form of higher prices lead to price increases.

4. Water quality is a key component of the nexus

Water quality is also important and water use and food production are both adversely affected by water quality. Nitrogen and phosphorus emissions from agriculture are likely to increase and therefore affect water quality, agriculture and public health.

5. Sustainable intensification is essential to meet agriculture and food requirements

Sustainable intensification is important to reduce water use in food production, to reduce energy use and to help countries to adapt to climate change. A study by IFPRI that involved Claudia Ringler examined eleven technologies for sustainable intensification.

6. A nexus approach should be adopted to achieve sustainable food security

The nexus approach can be supported by increasing investment in agricultural R&D, increasing resource use efficiency and improving water-use efficiency. It is also supported by developing strong institutions which support resource rights, employ fiscal policy that promotes sustainable and healthy diets, address food losses and waste as well as promote biofuels that compete less with food. Technological innovations at the nexus include improved land management, nitrogen use efficiency in new crop varieties and heat tolerant varieties; The yield benefits of all technologies are larger if the crop is irrigated.

Claudia concludes that a nexus approach is critical to ending hunger and malnutrition; second, sustainable intensification with a nexus approach can create more with less inputs, and third, policy coherence is needed to account for interdependencies across sectors.

Discussion and questions

Question (Mike Nagy): What studies do you have that illustrate the co-relation of degraded soil nutrient quality and increased water use? We have depleted organic content in soils here in Canada and

beyond due to intensive monoculturing resulting in the reduction in their ability to retain and deliver moisture.

Answer (Claudia Ringler): We looked in Kenya if irrigation can improve yields and we found that in some cases more nutrients are washed out with irrigation. So you should not always go for irrigation. Irrigation only makes sense if you have a certain level of soil fertility and can maintain or improve soil fertility.

Question (Shokhrukh Jalilov): Thank you for the excellent presentation! Regarding those 11 technologies - in your report have you estimated the cost of implementation of each technology as farmers could be interested in the particular technology based on its benefits and costs?

Answer (Claudia Ringler): No, some of the technologies do not yet exist in the field. We have, however, made an assessment of the relative differences in cost across the technologies and the likelihood of adaptation of these technologies (http://www.ifpri.org/publication/food-security-world-natural-resource-scarcity).

Question (Henk Westhoek): Thanks for your interesting presentation! Would yield increases and lower food prices not lead to higher consumption of meat and dairy and thus to higher water use?

Answer (Claudia Ringler): Yes, but higher meat consumption in the developing world is good, because there is under-consumption of proteins. And because of higher water use it is so important to use technologies for more efficient water use. There are trade-offs between undernutrition and water use.

3. Discussion

(Chaired by Joanne Vinke-de Kruijf, Univ. of Osnabrück and TIAS)

Joanne Vinke-de Kruijf: For the discussion we have prepared some questions: *Where is the Nexus approach now and what are some of the key challenges being faced?* In the presentations we heard that we need to increase food production. One of the big challenges will be sustainable and efficient use of water and other resources that support food production. From the presentations we also learned more about two different approaches to solutions, one is underpinned by technology and the other by strong governance.

Another prepared question is: *What areas require strengthening and improved guidance? And what are some of the more promising Nexus assessment methods and tools used?*

Dale Rothman: I want to make sure that we don´t ignore the potential of behavioural change. I would like to hear more about that because we hear that we need to produce more food and improve technologies but what about the potential of change on the consumer side.

Henk Westhoek: Good point, but not all consumers have a choice. It is important to change the consumer´s environment in order to make good food choices possible.

Claudia Ringler: Good food choices are more a conscious decision, that is, they can be better controlled by people than the choice to reduce undernutrition, which is generally due to a lack of access to food, which mostly affects poor people.

Jan Bakkes: I wanted to respond to Dale's question on the consumption side. In China there is an

economic transition starting where they want to rely more on domestic consumption, which is closer to a US model of the economy. So the domestic consumption in China becomes much more important. And China is a country where people know that water is an issue. That is an interesting opportunity but it also brings many challenges on both the supply and consumption sides, and it is an interesting case from the macro policy side of domestic consumption.

Bill Cosgrove: My question is how do we introduce a nexus approach on a regional and global level?

Claudia Ringler: One approach is the UN Sustainable Development Goals. They include many of the nexus elements. To implement them, frameworks have to be developed and trade-offs have to be discussed. To apply the nexus approach on a global level there is still a lot of work to be done.

Caroline van Bers: Are there specific themes from this webinar which need more attention?

Mike Nagy: I think that bio-fuel production in relation to overall food waste is an important study as it relates to poor use of water.

Henk Westhoek: I would also suggest a focus on the food system approach which is very effective for both consumption and production. I know that many food companies for example are very interested in reducing their water footprints. I would suggest we seek some kind of collaboration.

Ashok Chapagain: We need to have a holistic approach rather than looking specifically at efficient energy use for example.

Jan Bakkes: From what I have heard today the nexus approach sounds more like a problem analysis.

As a result of the presentations and discussions, the organisers have identified some important areas for potential follow up, in particular:

- The introduction of new technologies to reduce poor irrigation practices including cost of implementation.
- Using the nexus approach to promote food crops over biofuel crops (unless derived from waste or crops on marginal or peripheral land).
- Addressing the WF Nexus in countries and regions with abundant water like Canada and Germany that are focused more on energy savings in agriculture.
- Economic, governance, institutional versus technological solutions for long term WEF security (i.e. relative emphasis)
- The need for training and educational materials on the Nexus approach.

These topics will be explored in the months ahead with our presenters, interested participants and TIAS and USF members to identify ways in which we can contribute to advancing these areas through applied research, networking and capacity development. Follow up activities will be presented on the TIAS website: http://www.usf.uos.de

Annex 1: About our Presenters

Henk Westhoek, Netherlands Environmental Assessment Agency

Henk Westhoek is the programme manager for the Department of Water, Agriculture and Food in the Netherlands Environmental Assessment Agency (PBL) since 2001. Before joining PBL he worked for 10 years for the Dutch Ministry of Agriculture on issues related to livestock and the environment. He has also worked in Indonesia and Rwanda.
Mr. Westhoek has been involved in numerous national and international assessments and scenario-studies. He was Lead Author for the *International Assessment of Agricultural Science and Technology for Development* (2008) initiated by FAO and the World Bank. He was co-author of the study *Scenar 2020 - Scenario study on agriculture and the rural world* and *Cross-roads of Life on Earth: Exploring means to meet the 2010 Biodiversity Target*. Mr. Westhoek holds a Masters degree in Soil Science and Plant Nutrition.

Ashok Kumar Chapagain, Science Director, Water Footprint Network (WFN)

Ashok Kumar holds a PhD in the field of Water Systems and Policy Analysis. He has helped develop the concept of Water Footprint since its inception and has a strong publication record in the field of Water Footprint and co-authored the 'Water Footprint Assessment Manual' used globally as the standard in this field. He has led the development of various tools related to water accounting.

As WFN Science Director, Ashok provides advice to WFN partners and maintains scientific rigour in applying the Water Footprint Assessment (WFA). He is responsible for developing and implementing WFN's research and training programme. He leads face-to-face training courses in different parts of the world, e-learning courses and various other knowledge sharing activities. He helps multinationals to understand global water risks, and supports them in addressing the environmental impact of their water footprint by developing the case for them to support a stronger public policy for water management. Prior to joining WFN, he worked for WWF-UK for six years to help develop policy and practice in water stewardship and water security. Prior to his doctoral studies, Ashok worked as an irrigation engineer in Nepal for 12 years.

Ruth Mathews, Water Footprint Network

Ruth Mathews is the Executive Director of the Water Footprint Network, the leading international organization advancing the research, data, methods, tools, dissemination and applications of the water footprint assessment. The Water Footprint Network brings together partners from a wide array of sectors in a dynamic, continuous learning community with the goal of promoting sustainable, equitable and efficient water use through development of shared standards, sustainability criteria, practical guidelines and through implementation of response strategies to reduce water footprints and their impacts.
Prior to joining the Water Footprint Network, Ms. Mathews was the Programme Manager for WWF in Vietnam where she was responsible for WWF's conservation activities in-cluding ecologically sustainable water management, sustainable production, species conservation, protected area management, and climate change. She also provided strategic leadership mentoring to the WWF's Climate and Energy Team in Beijing, China.
In the US, Ms. Mathews founded River Matters, an organization to provide services that support ecologically sustainable water management (ESWM). She also spent seven years with The Nature Conservancy where she led the application of ESWM by working collaboratively with water managers, scientists, water users, and other conservationists to protect and restore river flows in a variety of settings. Ms. Mathews holds a Master of Science in Water Resource Management, has

published articles in leading scientific journals and has presented extensively worldwide.

Claudia Ringler, International Food Policy Research Institute

Claudia Ringler is Deputy Division Director of IFPRI's Environment and Production Technology Division since 2011. From 1996 until her current appointment in 2011, she served in various other research positions in that division. She currently co-leads the Institute's water research programme and is also a theme leader in the CGIAR Research Program on Water, Land and Ecosystems.
Dr. Ringler's research interests are water resources management - in particular, river basin modeling for policy analysis and agricultural; and natural resource policy focused at sustainable agricultural productivity growth. Over the last several years she has also undertaken research on the impacts of global warming for developing country agriculture and on appropriate adaptation and mitigation options. Dr. Ringler has field experience across Asia, Sub-Saharan Africa and Latin America. She has participated in various International Assessments, such as the Millennium Ecosystem Assessment, the International Assessment of Agricultural Science and Technology for Development, and the UNEP-led GEO-V Assessment. She is currently a member of the Scientific Steering Committee of the Global Water Systems Project (GWSP). Dr. Ringler has more than 80 publications in the areas of water management, global food and water security, natural resource constraints to global food production, and on synergies of climate change adaptation and mitigation. She holds a PhD in Agricultural Economics and a Masters degree in International and Development Economics.