

Institute for
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Virtual Water Trade

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I. Introduction

Freshwater represents a unique natural resource on which the survival of humans and the environment depends. The utilisation of water is required for the production of almost every commodity: grain, fruits and other food as well as clothing, cars and technical devices. In agriculture water is used either as rainwater or in irrigation and in industry it is used for instance as coolant. Final products do not contain that water anymore (or only a minor share of it). Therefore it is called the *Virtual Water*. The trade of commodities also means the exchange of water embedded in products. For water-poor countries it appears to be reasonable not to produce water-intensive goods but to import these from water-abundant regions, thus saving the natural resource and enabling its efficient use. In the light of a growing world population and increasing water scarcity *Virtual Water Trade* (VWT) seems to represent a plausible perspective, since the global distribution of water-intensive agriculture and industrial production sites become a crucial issue in the future. The concept of VWT can thus be utilised both descriptively/analytically as well as targeted/strategically.

In recent years, VWT has gained more weight in the scientific as well as in the political debate. To mention only some milestones: in 1993 the concept of Virtual Water Trade was established by Tony Allan (SOAS, London), in 2002 the water footprint concept was introduced by Arjen Hoekstra (IHE, Delft) and for the first time VW-flows were quantified around the world, thus feeding the debate with quantitative statements. The World Water Council organised an electronic conference on “Virtual Water Trade and Geo-Politics” in 2003, and in 2005 the German Development Institute (DIE, Bonn) arranged a workshop on VWT in the context of a research project on behalf of the Federal Ministry for Economic Cooperation and Development.

VWT can be regarded as a genuine transdisciplinary subject. It is the topic of scholars from natural as well as social sciences such as hydrology, geography, economics, agricultural science, political science and international relations. Furthermore, VWT is relevant for different actors – not only scientists, but also political decision-makers and civil society, trade actors, water managers, farmers etc. Moreover it encompasses numerous elements and processes on a local, regional and global scale, i.e. environmental, social, economic, cultural, political and institutional. From a social-ecological perspective VWT might be regarded against the background of a double-sided critique questioning both naturalism and culturalism, i.e. a naturalising of society as well as a culturalisation of nature. Such an approach opens new perspectives for scientific reflection and problem-oriented research.

On the 3rd and 4th of July 2006 the Institute for social-ecological Research (ISOE) organised an international workshop on Virtual Water Trade in Frankfurt¹ in which

¹ The workshop was a joint project of the research area “Water & social-ecological planning” and the interdisciplinary research project “Demographic trends, needs and supply systems for water and food”.

experts with different disciplinary backgrounds and expertise in water research from Great Britain, The Netherlands, South Africa, Jordan, Israel and Germany participated. The workshop aimed at examining the relevance of VWT from the perspective of social ecology. One main objective was a better understanding and evaluation of the concept's potentials. In order to gain an insight into the theory and state of art of the concept the latest development in research and politics was discussed. Moreover it should be analysed what are the prerequisites for an implementation of VWT and how can it be applied in a sustainable manner. Therefore, issues of regulations, indicators for the adaptive capacity of societies for VWT as well as an integration of natural and social factors have been discussed. In addition the workshop addressed specific conditions and empirical findings in selected Middle Eastern and Southern African countries.

The documentation of the workshop provides a detailed summary of the contributions based on the participant's presentations as well as the notes of the organisers. Specifications after further inquiries during the workshop discussion are integrated into this documentation and the quintessential discussion points are highlighted in addition. The documentation closes with some remarks of the workshop organisers. The complete PowerPoint presentations of the speakers are available at <http://www.isoe.de/ftp/vwttalk.zip>.

II. List of Participants

Name	Institution	Country	City
Prof. Dr. Allan, Tony	SOAS	Great Britain	London
Dr. Becker, Nir	University of Haifa	Israel	Haifa
Dr. Brüntrup, Michael	GDI (DIE)	Germany	Bonn
Prof. Dr. Döll, Petra	University of Frankfurt	Germany	Frankfurt
Earle, Anton	ACWR	South Africa	Cape Town
Hachelaf, Miriam	ISOE	Germany	Frankfurt
Dr. Hummel, Diana	ISOE	Germany	Frankfurt
Prof. Dr. Hoekstra, Arjen	University of Twente	Netherlands	Enschede
PD Dr. Kluge, Thomas	ISOE	Germany	Frankfurt
Dr. Liehr, Stefan	ISOE	Germany	Frankfurt
Lux, Alexandra	ISOE	Germany	Frankfurt
Dr. Magiera, Philipp	GTZ	Germany	Eschborn
Malzbender, Daniel	ACWR	South Africa	Cape Town
Meissner, Richard	Private	South Africa	Pretoria
Dr. Niemann, Steffen	University of Frankfurt	Germany	Frankfurt
Portmann, Felix	University of Frankfurt	Germany	Frankfurt
Prof. Dr. Salameh, Elias	University of Jordan	Jordan	Amman
van der Schaaf, Charlotte	GTZ	Germany	Eschborn
Warner, Jeroen	University of Wageningen	Netherlands	Wageningen

III. Programme

Monday, July 3rd 2006

Opening	Diana Hummel, ISOE
Objective and Programme of the Workshop	
Introduction	Chair: Diana Hummel, ISOE
The Concept of Virtual Water Trade – State of the Art of the Current Discussion/Research	Tony Allan, SOAS, London
Virtual Water Trade: A Review of Research on Saving Water Through International Trade, National Water Dependencies and Sustainability of Water Footprints	Arjen Hoekstra, University of Twente
Virtual Water Analysis – A (Constructive) Critical Perspective	Jeroen Warner, University Wageningen
Discussion	
Regulation	Chair: Thomas Kluge, ISOE
Legal and Regulative Aspects of Implementing Virtual Water Trading	Daniel Malzbender, ACWR, Cape Town
Agricultural Trade, Food Security and Poverty Issues in VWT	Michael Brüntrup, DIE, Bonn
Discussion	
Indicators	Chair: Alexandra Lux, ISOE
Indicators to Estimate a Country's Adaptive Capabilities for VWT	Stefan Liehr, ISOE
Redefining the Water Poverty Index	Elias Salameh, University of Jordan
Discussion	

Tuesday, July 4th 2006

Case Study Region SADC	Chair: Thomas Kluge, ISOE
Regional VWT Regimes – Potentials from a Political Science Perspective	Richard Meissner, Private Researcher, Pretoria
Various Spatial and Economic Starting Conditions for SADC Countries	Anton Earle, ACWR, Cape Town
Discussion	
Case Study Region Middle East	Chair: Diana Hummel, ISOE
Potentials and Risks for VWT in Israel	Nir Becker, University of Haifa
Potentials and Risks for VWT in Jordan	Philipp Magiera, GTZ, Eschborn
Discussion	
Integration and Modelling	Chair: Stefan Liehr, ISOE
Green and Blue Water Modelling on a Global Scale	Petra Döll, University of Frankfurt/Main
Discussion	
Working Groups	
Working Groups	1. Indicators 2. Regionalisation
Presentation of the Working Groups	
Closing Discussion	

IV. Summary of Presentations and Discussions

1. Introduction into the Concept of Virtual Water Trade – State of the Art in Research and Critical Perspectives

The notion of the VWT concept is ambiguous: it varies between an analytical and descriptive concept on the one hand and a political strategy on the other hand. As *analytical concept* VWT represents an instrument which permits the identification and the assessment of policy options not only in the scientific but also in the political discourse. As *policy* it has to be questioned whether VWT can be implemented in a sustainable way, whether the implementation can be managed in a social, economical and ecological manner, and for which countries the concept offers a meaningful option. This touches economic, political and social power structures, geo-political conditions, obstacles and competitions. The first part of the workshop provides the background latest development in the debate on VWT, in particular its evolution in science and politics, theoretical and methodological approaches as well as critical argumentations. The presentations address the following issues:

- Theoretical assumptions of the VWT-concept and state of the art of debate in science and politics
- Methodological approaches
- Critical aspects, e.g. risks for stabilising (new) inequalities and dependencies

Tony Allan: The Concept of Virtual Water Trade -- State of the Art of the Current Discussion & Research

At the beginning of his presentation Prof. Dr. Tony Allan (King's College London/ School of Oriental and African Studies SOAS – Water Research Unit) gives an historical overview of the development of the VWT concept which is marked by contention but also growing recognition: Already in the early 1980s economists and agricultural economists in Israel noted that the country was irrational by exporting water intensive irrigated crops. Ten years later (1990) the London Group (SOAS – Water Research Unit) introduced the idea that it was sensible to 'import' embedded water in crop commodities into water lacking political economies and in 1992 the term **Virtual Water** was introduced at an evening seminar of the London Group. In 1993 ALLAN offered a paper about Virtual Water to the journal *Water International* but withdrew it because of controversies with the deputy editor. Nevertheless the concept spread through other papers in the following years and in 1999 the UNESCO-IHE (Institute for Water Education) started to model and to quantify the VW flows all over the world (HOEKSTRA/SAVINJE/HUNG/CHAPAGAIN)².

² In: HOEKSTRA, A.Y. (2003): Water Trade Virtual Water Trade – Proceedings of the International Expert Meeting on Water Trade Virtual Water Trade. Value of Water Research Reports Series No. 12. IHE Delft.

In 2003 MERRETT³ of the London Group published a critique of the concept with the following arguments: “[1] ‘Virtual Water’ refers to real water – there is nothing virtual about it. It denotes the crop water requirements of food exports. [2] ‘The import of Virtual Water’ is a metaphorical term, not a scientific one, and its use leads to statements that are plainly false. It denotes the import of food. [3] In its policy applications, ‘the import of virtual water’ leads to a neglect of the current and future status of the agricultural sectors of the countries importing and exporting food.”⁴

The critique identified weak points of the concept which lead to further specifications of the VW concept. The consensus between advocates and opponents was that the concept is as useful as many other ideas in economics such as comparative advantage and transaction costs. In 2004 WICHELNS⁵ emphasised that the VW concept was only safe if users of the approach were aware of opportunity cost.

The awareness of the concept increased constantly which is shown in the amount of workshops and expert-meetings taking place as well as the attention of the 4th World Water Forum in Mexico City 2006. There, a milestone was marked when Egyptian water professionals including the Minister of Water convened a session on VW.

It appears to be normal that 25 years of continuous discursive politics precede the operationalisation of a good idea in policy-making. The process from the inception of the concept to international recognition took more than 10 years of contentious science discourse and it can be expected that another 10 to 20 years will be needed for the adoption with in politics.

ALLAN reveals the discursive politics via the perceptions of sustainability by different parties such as the water users and policy makers and by those quantifying and modelling underlying fundamentals.

However, the crucial questions are how to achieve a convergence of the trajectories as presented in Figure 1 and if integrated water resource management (IWRM) reforms can contribute to a better conversion.

Virtual Water is contextualised in the framework of (1) sustainability, (2) water security, (3) different types of water and (4) politics.

With regard to *sustainability*, the VW concept is about science fundamentals: it can be used to identify economic solutions and to protect the environment. The VW concept reduces the demand on local freshwater and soil water resources. Hence, it can alleviate impacts on the local water resource which is used to provide ecological services and secures the local economy.

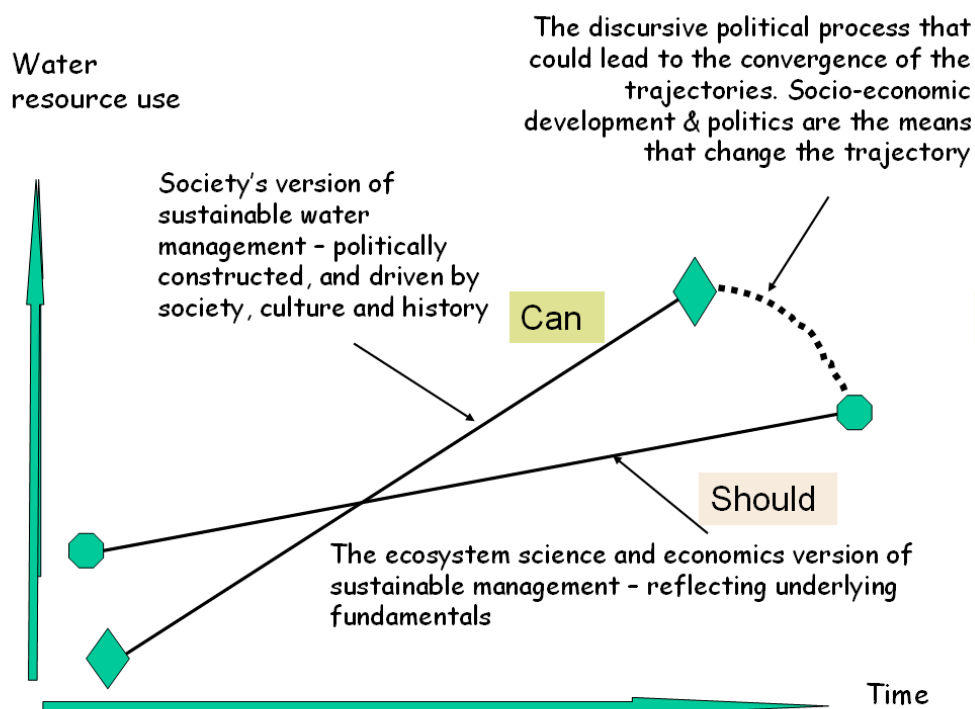
³ MERRETT, S. (2003): ‘Virtual Water’ and Occam’s Razor. Occasional Paper No 62. SOAS – Water Issues Study Group. King’s College, London.

⁴ MERRETT(2003): p. 4

⁵ Wichelns, D. (2004). The Policy of Virtual Water Can Be Enhanced by Considering Comparative Advantages. In: Agricultural Water Management, No 66, p. 49-63.

Figure 1: Conceptualising the trajectory of water management

Presentation – ALLAN, p.21



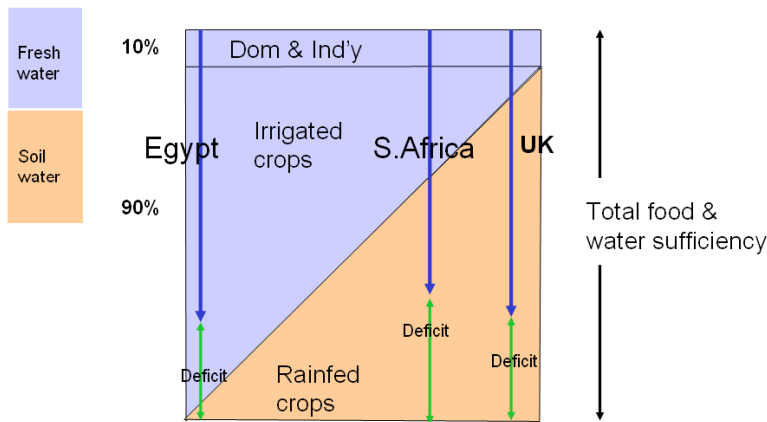
The essential idea is that VW is economically “invisible” and politically “silent”. It solves problems without being recognised by economists or politicians, which means that it is happening without being verbalised. Years ago it was predicted that the next wars will be fought about water; this did not become true, because the trade of VW solved the conflicts silently without legal framework.

Synergies exist with respect to *water security*: Security is achieved in problemsheds as well as in watersheds. In water short economies such as those of the MENA (Middle East and North Africa) and southern African regions there are three invisible hydro-economic processes that enable the economies where inexpensive water is increasingly scarce to be secure: i) soil water in other catchments (soil water is not counted because it is bound in the soil without someone’s help); ii) international trade in staple food commodities (Virtual Water) and iii) socio-economic development which enables politically feasible water re-allocation (it mobilises the trade process).

According to ALLAN there are several *Types of water* (Figure 2): i) freshwater & soil water; ii) big water & small water; iii) Virtual Water and iv) manufactured water i.e. desalinated water. ALLAN explicates the term Virtual Water as a term which is both intensive insofar as it links water and food production and extensive in that it links water, food and trade. To produce a tonne of grain about 1000 tonnes (cubic metres) of water are required. If the tonne of grain is conveyed to a freshwater and/or soil water short political economy or river basin, then that economy is spared the economic and in particular the political stress of mobilising about 1000 cubic metres of water.

Figure 2: Link of water and food production through VW
Presentation – ALLAN, p.41

Types of water



Fresh water is used for domestic and industrial purposes as high cost water as well as for irrigation as low cost water.

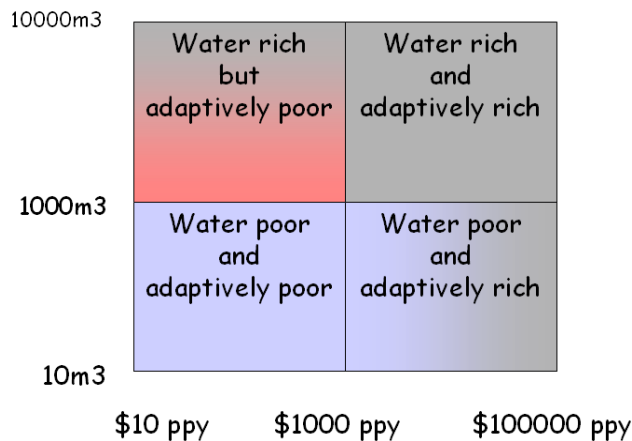
Soil water, is water from soil profiles without irrigation and is used in rainfed agriculture.

The deficit (green arrows in Figure 2) is met by Virtual Water which means food imports.

Virtual Water is a non hydro-centric approach because it does not take the river-basin or the groundwater basin as the starting point instead it is integral to the global system. "Communities and political economies achieve security including water security by effectively combining their environmental, human, social, manufactured and financial capitals via political processes". According to TURTON AND OHLSSON (1999)⁶, two orders of scarcity should be distinguished: The water scarcity (first order resource scarcity) and the scarcity of adaptive capacity (second order resource scarcity). The latter is much more important than the natural resource scarcity. VW can be seen as a second order remedy in that it alleviates water scarcity.

⁶ TURTON, A.R., OHLSSON, L. (1999): "Water Scarcity and Social Stability: Towards A Deeper Understanding of the Key Concepts Needed To Manage Water Scarcity in Developing Countries. Paper for the 9th Stockholm Water Symposium, Sweden 9-12 August 1999.

Figure 3: Two dimensions of water poverty
Presentation – ALLAN, p. 57



Two dimensions of water poverty are shown in Figure 3. As indicators are used the water resource (y-axis), and the GDP (x-axis), both values are indicated per capita and year. Both the water status and the social adaptive capacity are dynamic, therefore the status of a state can change at any time.

Communities and political economies have trajectories reflecting worsening local water resource availability because of increasing populations and/or improving economies.

Virtual Water in international trade is unmatched in the volumes of water mobilised by long distance movement. More important it is unmatched in its variability of sources and its flexibility of the delivery of remedies to distant regions which endure water deficits. Engineered local water storage and distribution cannot match these qualities.

Political processes do constantly difficult things such as constructing knowledge which overwhelms science based knowledge and economics. They accompany water re-allocation, water pricing, Virtual Water Trade – in other words demand management instruments. The capacity of invisible processes such as Virtual Water Trade, to hide the real economy is taken up without a thought. In contrast, an unacknowledged appreciation is that they are politically without costs.

Relevant for regulation and reforms are different positions: For example, solution perspectives on water security in the MENA region differ between “outsiders” and “insiders”: Outsiders refer to fundamentals via politically detached science and see ranked solutions in (1) Virtual Water, (2) allocative efficiency and (3) productive efficiency. Insiders on the other hand refer to a politically determined, sanctioned discourse and see solutions in (1) productive efficiency (without any political price), (2) allocative efficiency (3) Virtual Water. VW is only named third because it is an identity challenge to admit “We are short of food or water” which is seen as a sign of political and economic weakness and vulnerability. Good ideas are subordinate to the more powerful old knowledge which drives political processes. Like most *underlying fundamentals* identified by scientists and engineers awareness of Virtual Water is overwhelmed by the *constructed knowledge* of the actors in the political

realm. Virtual Water is an outsiders' idea. It is about economic fundamentals. For insiders Virtual Water is apparently socially and politically seriously destabilising in regions such as the Middle East. The deeply established MENA 'sanctioned discourse' has tended to reject the idea of Virtual Water.

Finally ALLAN concluded: "Political feasibility is the important concept in achieving water security via the achievements of economic diversity and strength together with ecological consideration and sensitivity".

Arjen Hoekstra: VWT – A Review of Research on Saving Water through International Trade, National Water Dependencies and Sustainability of Water Footprints

The presentation of HOEKSTRA deals with three main topics: (1) saving water through international trade, which is already happening and will increase, (2) national water dependencies because some nations have enough water others do not and so dependencies occur and (3) the sustainability debate of water footprints even for individuals.

Water needs of goods and services

To estimate how much water circulates in virtual flows the water content of goods has to be identified. It can be assessed by crop water requirement (m^3/ha) and crop yield (tonne/ha) and the Virtual Water content of a crop or livestock product by distributing the Virtual Water content of the root product over its derived products. Some exemplary figures are given:

*Table 1: Virtual Water Content of Products
Presentation – HOEKSTRA, p.4ff*

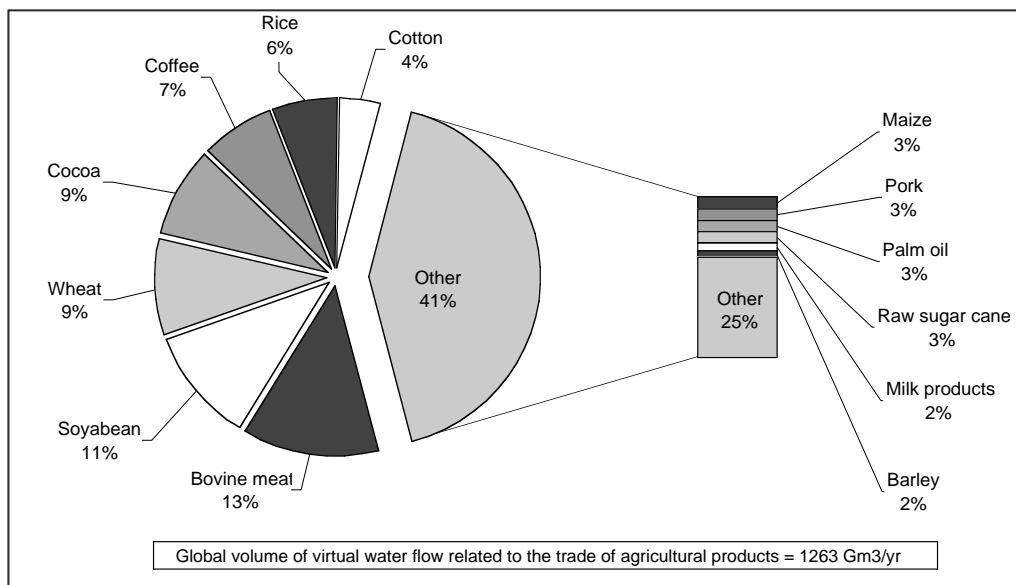
1 kg wheat	1 m ³
1 kg rice	3 m ³
1 kg milk	1 m ³
1 kg cheese	5 m ³
1 kg pork	5 m ³
1 kg beef	15 m ³
1 cotton T-shirt	4000 l
1 hamburger	2500 l
1 cup of coffee	140 l
1 glass of beer	75 l
1 slice of bread	40 l
1 sheet of A4 paper	10 l

International Virtual Water flows

If the water content of a good and the amount of the trade volume per year are known, the *Virtual Water flow (m³/yr)* can be generated through the multiplication of trade volume (tonne/yr) with the Virtual Water content (m³/tonne). In the years 1997-2001 the Virtual Water flow of crops, crop products, livestock and livestock products and industrial products amounted to 1,625 billion m³/yr; which responds to 16% of the global water use. The main agricultural products which are traded as Virtual Water are listed in Figure 4 below.

Figure 4: Contribution of various agricultural products to the total sum of international Virtual Water flows

Presentation - HOEKSTRA, p.8



National Virtual Water balances can be calculated from the amount of Virtual Water going into the country through imports and the amount of water leaving through exports (Table 2).

Table 2: National Virtual Water balances (1997-2001)

Presentation - HOEKSTRA, p.10

Top 5 Exporter	Gm ³ /yr	Top 5 Importers	Gm ³ /yr
Australia	64	Japan	92
Canada	60	Italy	51
USA	53	UK	47
Argentina	45	Germany	35
Brazil	45	South Korea	32

Saving water through trade

National water saving: A water scarce nation can save water by importing a water-intensive commodity instead of producing it domestically. The amount of water that would be used by domestic production is the national water being saved, in other words the amount of Virtual Water imports.

Global water saving: International trade can save water globally if a water-intensive commodity is traded from an area with high to an area with low water availability. The difference between the amount of water used in the exporting countries and the water that would be used for the same production in the importing countries is the global water saving.

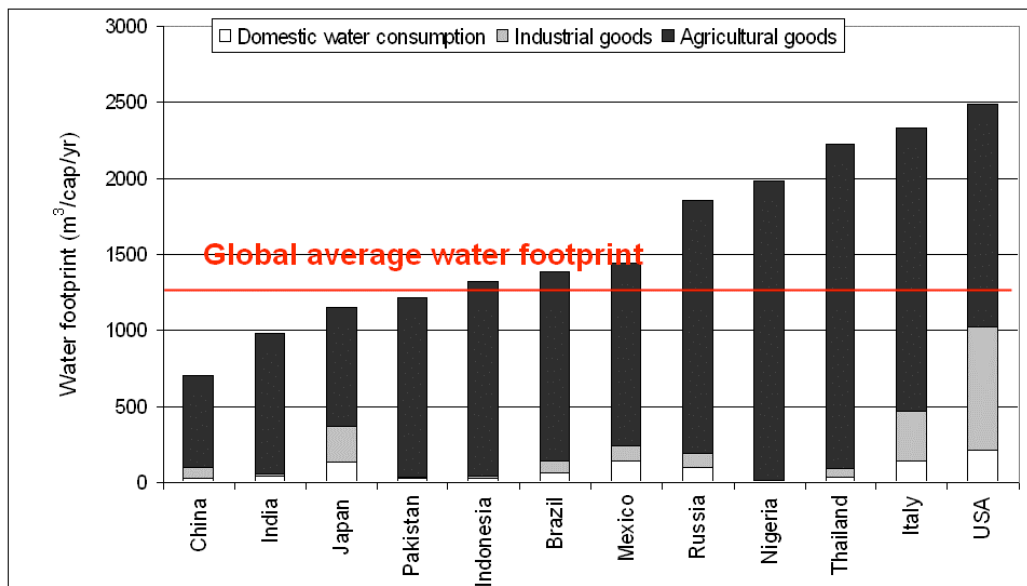
From 1997 to 2001, 352 Gm³/yr have been saved globally as a result of the international trade of agricultural products which refers to 6% of water used in agriculture.

Water footprint of nations

The presented calculations led to the idea of the water footprint of a nation (Figure 5), which is the total amount of water used for the production of goods and services consumed by the inhabitants of the nation. Water consumption is partly related to domestic use of resources, and partly to resource use outside of the country borders, resulting in the internal and external water footprint.

Figure 5: Water footprint per capita

Presentation – HOEKSTRA, p. 21



National water footprint = national water use + Virtual Water import - Virtual Water export

The major determinants of the water footprint are:

- The volume of consumption related to GNI (Gross National Income)
- The consumption pattern (e.g. high meat consumption vs. low meat consumption)

- The climate (evaporative demand at place of production)
- And the agricultural practice (water use efficiency)

Water dependency of nations

Most of the European countries, North Africa, Middle East, Japan and Mexico have net import of water in virtual form and a significant external water footprint. In the MENA region, only Syria is a Virtual Water exporter. Other countries of the region are Virtual Water importers and depend on Virtual Water to different degrees: Morocco (15%), Tunisia (17%), Egypt (19%) and Algeria (33%). A high dependency on Virtual Water import can be revealed for Israel (74%), Jordan (73%) and Lebanon (67%).

On the basis of different country and product case studies HOEKSTRA demonstrates the water footprint and Virtual Water transfers within and between countries. Innovations have been made in a product study about cotton. In this study a distinction between blue, green and dilution water is made. The localisation of cotton producing regions is more precise and so the climate parameter can be better estimated. Furthermore, the Virtual Water content estimation is based on ‘actual water use’ instead of ‘crop water requirement’, which allows a better accounting for possible water shortages.

For the discussion and evaluation of the Virtual Water concept HOEKSTRA lists some relevant questions with respect to different scale players:

Global perspective:

- + Is Virtual Water Trade a mechanism to increase global water efficiency?
- What is the risk of shifting the environmental impacts?

National perspective:

- + Is import of water in virtual form a solution for a water-scarce country?
- What is the risk of becoming water dependent?

Consumer perspective:

- + How does a consumer influence his/her own water footprint?
- What incentives are needed to stimulate consumers to change their consumption pattern?

Jeroen Warner: Virtual Water Analysis – A (constructive) Critical Perspective

WARNER emphasises that the International Political Economy (IPE) debate has to be linked to the debate on Virtual Water so that the approach does not remain too hydro-centric. If the debate evolves just around ecological sustainability and the future of water resource, it will be neglected that it is a matter of *people* who deal with water.

The presentation can be seen as a kind of research agenda because “Virtual Water” is getting closer to becoming a policy prescription rather than remaining only a descriptive tool and the occurring consequences shall be taken into account better sooner than later. However, the questions arise if it is realistic to expect that such a policy prescription can be enforced (realism of prescription) and which macro-

economic shifts such a policy prescription will promote at a global and national level.

As a *descriptive* concept, VW is a useful medicine against undue 'hydrochondria' – the idea that water is constantly in crisis. VW usefully uncovers an international redistribution mechanism that has the potential to remedy local imbalances. Climate change and water pessimists still dominate the discourse and the Malthusian horror story still affects strongly the resource conflict debate. According to this view, population growth results in competition for resources and the tragedy of the commons. At the end, acute resource conflicts or even water wars will occur.

As a *prescriptive* concept, WARNER appoints some serious problems to VW. A key weakness of prescriptive VWT is the failure to consider the allocative effects within countries. Reliance on VW delays important allocative choices and in doing so may delay political, economic, ecological- and land-reforms, and may distract attention from pressing property rights issues. A Virtual Water strategy has important redistributive effects between sectors and regions, especially between city and countryside.

Traditionally, in the International Political Economy of Food a distinction is made between the invisible hand, i.e. the market, and the visible hand, i.e. the state. The underlying assumption is that of the global food market as a level playing field, consisting of free trade and competitive advantage etc. Unaccounted-for distortions and externalities are the exploitation of labour and ecological degradation.

VW as a policy prescription relies on the international political economy, which makes it vulnerable to shocks and pressures. In spite of liberal belief, the global food market is not a level playing field. Subsidies distort prices and they are normally paid by the countries in the temperate zones to promote agriculture which leads to a negative feedback on the agriculture in the poor countries.

With respect to the question of the effects of a Virtual Water push, increased dependency relations between poor and rich countries are to be expected on the global level. Given the size of the economies in India and China, a VW import strategy would wreak havoc on world prices and resource distribution. Therefore, distortions remain. The price of food produced in the temperate zones does not reflect true costs of labour, inputs and (renewable and non-renewable) water since such inputs are almost everywhere subsidised. WTO (World Trade Organisation) rules will address international trade distortions in the future, in particular price dumping, with the effect that world grain prices may go up. Producer distortions and externalities are likely to remain unaddressed. With respect to weak states, the question arises who will enforce a VW push and how will governments enforce the right to use or forego the use of water and land. Moreover, what happens to the land and water taken out of agricultural production?

Based on different country examples, negative effects in the recipient countries are named: unemployment and a switch from food to non-food production which does not lead to real water savings but rather to migration into the cities since the urban poor have better political access to subsidised food than the rural poor. As can be shown for Yemen, which is generally seen as a success story of VW strategy, a no-

ticeable switch from food to non-food production can be detected, which did not necessarily lead to greater water saving. Another negative effect is a possible erosion of rural governance since weak tax base results in weak administration, Furthermore, energies concentrate on urban growth.

WARNER regards Virtual Water as “a choice for the city”. By focusing on the urban electorate the infrastructural links and investments in the countryside may be neglected and farmers may not be equipped to switch to higher value production, i.e. precision irrigation. Furthermore, farmers’ bargaining power is eroded, which may lead to further marginalisation. These factors intensify the rich-poor disparity within the countries and promote centralisation. For example, in Egypt, centralised importation of cheap grain is like creating a food ‘reservoir’ which gives the state a monopoly on the food market with the result that food is redistributed according to political arbitrariness

With respect to the national level, a possible delay of adaptive management can be the effect: Pushing Virtual Water is likely to perpetuate economic inefficiencies, preventing necessary adaptation of technologies to scarcity and remedying negative externalities from exploiting natural resources (pollution) and labour. Viewed from a theory of democratic perspective, Virtual Water can be seen as a way of avoiding tough decisions on rights and allocation, political contest (multi-party democracy) and participation of different stakeholders about the road ahead. This results in the risk of a perpetuation of an unequal process of reallocation between social groups as well as between countries.

WARNER points out that even if the concept is political invisible it has great social effects on the society. Approaches are needed for a better safeguarding of the internal and external balance: Food security at national level requires a proper balance between world market and domestic livelihoods, with due regard for ‘food sovereignty’. Measures are required to prevent erosion in rural areas e.g. creation of non-agricultural livelihoods.

Discussion

One discussion topic was an *integrated perspective* of VWT, beginning with the relations between Water Footprint and Ecological Footprint and the connection between Virtual Water and Virtual Land. Moreover, aliment production does not only require water and land, but energy should be taken into consideration as well. Food is the sum of energy + land + water. All three factors have to be considered in a more integrated framework. The economy has to be appropriately taken into account. For example, there is a significant relation between economy and energy resources; oil prices are of great importance. Hitherto, land and energy have not been taken into consideration in the models. The participants concluded that much more analysis is required, but it should be done step by step. Furthermore, a possible confusion of the term Virtual Water Trade was addressed. HOEKSTRA points out that this is particularly the case for economists who only see trade in real things. Therefore he prefers the term VW-transfer or VW-flows.

There was an agreement that social impacts of VWT must be (better) taken into account in the analysis. As BECKER stresses, *rationality* cannot be limited to economy, instead it is to set up societal goals and try to act to fulfil these goals. In the course of the discussion it became clear that it does not make sense to judge Virtual Water as being “good” or “bad”. In this context the participants dealt with the implications of VWT as an analytical concept on the one hand and a policy tool on the other hand. The studies of HOEKSTRA prove VWT as a given fact. However, as he insists, VWT is senseless as a prescriptive tool. What would prescription be like? WARNER argues that it could mean that trade does not stay silent anymore and VWT would be officially implemented. Then, politics must be influenced not to implement VWT without considering the consequences.

This leads to the point of the role of science in the VWT discourse. One main subject of the controversial debate was the *responsibility of science* with respect to politics. Some participants argued for a strict division of powers between the domains while others emphasised their interdependency. WARNER emphasised the relevance of agency, which is what people are doing and what the consequences of people’s actions are in order to avoid a hydro-centric perspective. Further he promotes to stay in contact with those in power in order to engage a co-produced science with policy makers. ALLAN sees the increasing interest in the concept with pleasure but adverts to survey the ongoing path that people use the concept in their own interest. Scientists should be prepared to get politically involved in a constructive manner. For HOEKSTRA the responsibility of research consists in scientific analysis and knowledge generation which must be robust, because politicians use the generated values to promote their concerns, whether as threat or as solution, without asking about the background of the information. He also underlines that politics and science have to be seen as two different, separated spheres with specific approaches to the VW concept. Therefore, science has to be kept independent and not be exploited as an instrument for politics. The scientific approach is analytical and policy has a specific agenda and wants to get to a certain result. BECKER underlines the importance of scientific freedom, not to work too close with politics, since science underlies no political taboos. KLUGE emphasises the task of science and research to create analysis and data in order to identify limits and options for the capacity of society. But there is the fact that once data is published it cannot be corrected anymore, therefore the use or misuse can not be influenced. Science must be aware of that responsibility. LIEHR specifies that the autonomy of both spheres must be maintained. However, dealing with political issues science is responsible for a proper and differentiated interpretation of the generated scientific knowledge. Limits of scientific statements must be made explicit.

2. Regulation

Virtual Water Trade plays an increasing role concerning sustainable water resource management. It appears to offer new perspectives for social-ecological forms of regulating societies' practice with water and the production and distribution of food or other products. Trade relations can be evaluated and justified from a new point of view. The adaptation pressure resulting from new production conditions causes a need of specific national or regional regulations for each country/region and society, considering specific political, institutional and legal frameworks. Furthermore, potentials and risks of VWT depend to a considerable degree on the conditions of the world trade. Trade happens within the framework of power constellations, governmental interests and entrepreneurial strategies, which are operating on different scales (global, national, regional, local). Within these scales the specific objectives of different actors can cause conflicts of interest. The presentations and the discussion of the session focus on the following issues:

- Which preconditions are necessary to use VWT as solving strategy?
- Where do the dangers arise of stabilising new inequalities, imbalances and dependencies?
- What are possible consequences for the different sectors by implementing VWT and how is the complexity caused by multi-requirements (environment, agriculture, industry, trade etc.) to be dealt with?
- What legal and regulatory support (as well as investments etc.) is needed for a regionalisation of VWT?
- Which transient models regarding the cultural, economic, ecological and social context are feasible?

Daniel Malzbender: Legal and Regulative Aspects of Implementing Virtual Water Trading

Legal and regulatory measures can play an important role in shaping a suitable environment for Virtual Water Trade. The most effective role of legal and regulatory measures is arguably in the fields of water law and international trade law.

Case study South Africa

South Africa has incorporated elements of a Virtual Water strategy into its water policy and law. South Africa's National Water Resources Strategy, which has been developed as a requirement of the National Water Act (36 of 1998), is the overarching departmental strategy document for water resource management in the country. The National Water Resources Strategy as well as its specific sector policy paper, the Water Conservation and Water Demand Management Strategy for the Agriculture Sector are geared towards a policy of increasing water efficiency. At the same time, the South African Department of Water Affairs and Forestry has embarked on a Water Allocation Reform. Unlike under the previous Water Act, large-scale water use now requires a water use licence and users need to pay for their water use. The increased drive towards economic pricing of water is likely to lead to

improved water-use efficiency in the long-term. It can already be seen that the policy will lead to a shift towards more high value crops.

Motivation for South African legislation

The above policies are, however, not based on a deliberate application of the Virtual Water Trade concept. The process is a response to the increasing level of water scarcity in the country but not integrated into a cross-sectoral framework of water and trade policies. As a consequence there are sector strategies, which are at times opposing each other. South Africa's Agricultural Trade Strategy talks about "trans-boundary cooperation in SADC (South African Development Community) to promote agricultural export processing and efficient distribution networks, possibly through the development of an industrialisation strategy in terms of the SADC Trade Protocol". The Water Conservation and Water Demand Management Strategy for the Agriculture Sector on the other hand emphasises the need to increase water use efficiency in order to enable the South African agricultural sector to compete with imports from other SADC countries. A lack of cross-sectoral coordination makes the development and implementation of a cohesive Virtual Water Trade strategy difficult.

Legally, national water sector reforms, like the one in South Africa, are independent from the SADC Treaty or its Protocols. The SADC Regional Water Policy and Regional Water Strategy have an important function for water policy harmonization and are guidelines for project implementation in member states but are not legally binding documents.

Relevance of international trade agreements

International trade agreements determine the conditions at which goods can be traded between countries. They can support Virtual Water Trade by allowing free trade (Custom Unions, Food Trade Agreements (FTAs)), but they can also distort trade. The relevant linkages for the implementation of (regional) Virtual Water Trade are those between the WTO agreements, the SADC Trade Protocol and national policies (for water and trade). The SADC Trade Protocol is a FTA in terms of Art. 24 GATT. Through gradual tariff reductions and the eventual creation of free trade between member states the SADC Trade Protocol (as do other regional FTAs or Customs Union Agreements) provides the basis for tariff free trade flows. Regional and international trade agreements, particularly those allowing free trade, are thus an important factor for national (water and trade) strategies promoting a Virtual Water Trade strategy.

WTO law and trade distortions

At the same time, the WTO Agreement on Agriculture (AoA) provides the legal basis and locks at the current levels of trade distorting subsidies provided by many developed countries (mainly the EU, US, Japan, Korea, Switzerland and Norway). The availability of cheap, subsidised grain makes it relatively easy for individual countries to apply a Virtual Water Trade strategy (but makes them vulnerable to price

changes should the level of subsidisation be reduced over time). On the other hand it makes a regional Virtual Water Trade strategy more difficult to implement as grain traders have no incentive to use regional supplies as long as subsidized imports from developed countries are cheaper. The forthcoming developments in the WTO Doha Round negotiations (and probably subsequent rounds) will therefore have important implications for the implementation of Virtual Water Trade strategies in different world regions.

How can international trade law aid the regionalisation of VWT?

In this context regionalisation is understood as the implementation of Virtual Water Trade in a defined region, with some countries of the region being exporters, others importers of Virtual Water.

In this scenario legal and regulatory intervention is most needed and can be most effective with respect to trade laws. Regional Virtual Water Trade is easier to implement where regional trade blocks (FTAs, Customs Unions) exist, as this ensures tariff free trade flows between member countries. Regional Virtual Water Trade could (theoretically) be promoted by the setting of common external tariffs (as mandatory for Customs Unions but also possible for FTAs) that make imports from outside the region less attractive than those from inside the region. An example would be the setting of high import tariffs for grain imports from outside the region, forcing regional buyers to shift to regional supplies. However, it has to be remembered that such a scenario is not consumer friendly (at least in the short term) and hence difficult to implement, particularly for developing countries with high poverty levels. It is also difficult to implement as many developing countries are dependent from external trade partners (e.g. EU) or have opposing interests compared to other members of the same trade block (e.g. Namibia, Botswana vs. rest of SADC). What is more likely leading to a supply shift (away from external to regional suppliers) are legal measures that support better facilitation of cross-border trade. In addition to intra-regional tariff reduction (where there is no FTA or customs union), these measures include:

- the regional harmonisation of customs procedures, transport documents, import licences, etc.
- the regional harmonisation of quality standards, SPS (Sanitary and Phytosanitary) measures
- adoption and/ or enforcement of anti-corruption measures

How to deal with multi-sectoral requirements

It is clear the effective implementation of the strategy depends to a large extent on factors outside the field of water management, primarily in the field of trade policy. Yet, experience from South Africa shows, that knowledge of the Virtual Water Trade concept is largely confined to the water sector and that government departments (ministries) operate mostly in isolation. It is therefore necessary to create the awareness and understanding of the concept in the other sectors and to bring departments together at high decision-making level in order to align departmental strategies or

develop cross-sectoral strategies. Relevant sector-policies need to be coordinated and harmonised. Furthermore, acts need to be harmonised. Legally, many country's constitutions contain provisions that require intergovernmental cooperation, often supported by additional legislation (in South Africa the Intergovernmental Relations Framework Bill is currently going through the parliamentary process). Dealing effectively with the complexities of the Virtual Water Trade concept on the policy level is often less a legal problem than one of institutional cooperation in practice.

Where the adoption of a region-wide Virtual Water Trade strategy is envisaged, improved linkages between the responsible national departments (ministries) within a country, at regional level (e.g. SADC) and between member states and the regional organisation (e.g. SADC Secretariat) are required. A strengthened regional institution with substantial competencies can be useful for regional policy coordination and implementation (e.g. EU Commission). Legally, such transfer of competencies from national governments to a regional organisation requires the conclusion of international agreements. To date the EU is the only regional organisation, which has done this on a large scale. Other regional groupings have not (and are perhaps unlikely) to achieve a similar level of regional integration. Nevertheless, policy coordination by a regional organisation is increasingly being practiced in regions with less regional (legal) integration than the EU (e.g. SADC).

Michael Brüntrup: Agricultural Trade, Food Security and Poverty Issues in VWT

The examination of BRÜNTRUP focuses on the Virtual Water Trade concept under its prescriptive aspect. This means the usefulness of the concept, with regard to applicability and relevance, to modify the existing agricultural trade and thereby contributing to solving the initial problem of water scarcity. He underlines that the Virtual Water Trade concept is meaningful for an economically and ecologically efficient utilisation of the scarce resource water. However there are limitations:

- Water is not a function of market, because it has many externalities. It is not like other factors of production with the rule: *use as much as you can*.
- The concept deals only with one resource, but the production process involves more than water which distorts the cost calculation.
- Poverty and vulnerability are not adequately taken into account, especially in poor countries.

The determinant of agricultural trade in general is the demand which is product specific and depends on consumption habits (exceptions are feed stuff and commodities). Further determinants are storage and transport technologies as well as transaction costs and comparative advantages. Water is usually saved because of comparative advantages and that has a linkage with VWT.

Factors of comparative advantage in agriculture

VWT is a partial principle of comparative advantages applied to water. Partial because in rainfed agriculture there are no direct costs for water, but is logged into in the production function and costs. In irrigation agriculture water is a cost factor but

only if it is priced. The other production factors and their costs determine agricultural production and trade as well, often more than the used water. These factors are mainly labour costs which are much cheaper in developing countries than in industrial countries; capital which is more expensive in developing than in industrial countries; and land for which the costs depend on the region.

Interactions of water use, factor use and developed technologies are limitations, but do not present a neutralisation of the principle of comparative advantages. Further limitations of the rapid growth of VWT are (1) the slow structural changes in many countries from agriculture to industrialisation. It has to be calculated in generations and not in years or decades. (2) The path dependency of production, as small farmer can not change easily to other production paths. (3) The endeavour of food self reliance to avoid dependency. Especially the poor countries aim at independency because they already often depend on two or three export commodities. (4) Poverty and vulnerability of poor countries with mainly rural population (70-80%) with the main income source in agriculture (direct and indirect).

Trends in international and agricultural trade

The trends in international trade are mainly that:

- a growing trade is accompanied by increasing production;
- a decline of prices leads to strong fluctuations of the import prices and strong regional differences, i.e. in Sub-Saharan Africa.

Future trends with respect to natural resources are difficult to predict, depending for instance on the Asian growth, climate change, technological development as well as WTO and agricultural policies.

Subsidies are mainly for stabilising the incomes of farmers, and they are also usually very inefficient. If the policy might change and subsidies are stopped, prices will probably increase in the first step but with growing efficiency the prices will decrease. This reveals that subsidies do not play a decisive role for the price level. Much more relevant for the level of prices is technological progress.

Conclusion

One important factor is the application of the concept of comparative advantages to natural resources, partial since water costing is imperfect with respect to the micro and macro (shadow price) level. The concept of comparative advantages does not replace the need for (blue) water pricing, but mainly works in conjunction with it. With respect to green water, mainly regulatory policy based on costs of water use for public goods is required. There is no simple recipe, because the regulations have to be set into relation with other production and consumption factors. In particular in very poor countries agriculture is important and needed for poverty reduction and VWT only represents a solution in the long run.

Recommendations:

- Pricing of water (also green water), e.g. by a land tax

- Long term alignment of production along comparative advantages, e.g. in research and development and investments for infrastructure
- Diversification of micro incomes and trade revenues within and outside agriculture
- Structural change needs very long transition time
- International agricultural liberalisation: contains both supportive and limiting aspects for VWT, with overall limited impact.

Discussion

The discussion in this session centred on the role of international trade agreements, cross-sectoral co-ordination and the preconditions for an implementation and regionalisation of VWT. International trade agreements determine the conditions at which goods can be traded between the countries and can support VWT by allowing free trade. On the other hand, they can also distort trade. The workshop participants agreed that a regionalisation of VWT is meaningful and required, but trade realities make an implementation difficult. Already on a national level water and trade policies can contradict each other. Strategies must be developed from a programmatic sense to a political discourse. As BRÜNTRUP exemplifies with the case of Benin, in developing countries VWT must not necessarily come into conflict with regional requirements under conditions of a global market. The north of Benin relies highly on VWT by exporting cotton to the world market and maize, beans and yams to regional markets. Cross-sectoral co-ordination is essential and its absence is one main problem for a successful implementation of VWT. The possibility of a regional master plan for SADC has been considered in the discussion, but according to MALZBENDER it seems to be too early for such a project and would fail. Policies must be started on a lower level. Outside the water sector, the VWT concept is barely known and thus an awareness-raising is necessary in other relevant sectors. KLUGE underlines the necessity of other strategies such as land reforms, credits etc. DÖLL concludes that VWT will only be a long-term solution for many poor countries and considers possible alternative strategies for poverty reduction and development such as investment in education. In many poor African countries one can find increasing investments in irrigation, while investments in education are missing. The premise however is an economy and a functioning labour market absorbing better educated people – otherwise there is no motivation for families to send their children to school.

3. Indicators

It is crucial under which basic conditions Virtual Water Trade is favourable and profitable for water poor countries. The meaning of VWT has to be analysed and evaluated in different dimensions (societal, cultural, economic, political, ecological etc.) depending on the specific context for different countries and regions. To estimate the potentials and risks of VWT for and the adaptivity of a society implementing a VWT-strategy, appropriate indicator systems which allow to determine the multi-sectoral potentials of the concept from the perspective of a specific country or region have to be developed. This session deals with the following themes:

- Which indicators are needed to estimate the potentials of Virtual Water Trade?
- Which indicators are needed to determine the adaptive capacity of societies?
- How can already existing indicators such as the water poverty index (WPI) be adopted to Virtual Water?
- Which indicators allow an integrated perspective, combining social and natural, as well as quantitative and qualitative aspects?

Stefan Liehr: Indicators to Estimate a Country's Adaptive Capabilities for VWT

The presented approach is based on a social-ecological perspective and some initial considerations and ideas within “work in progress” to evaluate the socio-economic preconditions for VWT.

The focus lies on the impacts of VWT, on the demand for changes in societies implementing VWT and finally on possibilities about how to find an access to these questions in order to support a policy-oriented assessment of the concept which takes specific regional conditions into account.

Analytical perspective

The analytical perspective has water scarcity as starting point because of an unequal distribution of water in the world. This water is involved in production. The use efficiency depends on the specific conditions in the countries and that there is a global trade of goods. The idea of this perspective is the estimation of Virtual Water flows and thereby classifying countries and regions as net importers and exporters. This leads to the assessment of the efficiency in water use and to the analysis and evaluation of VWT potentials in specific countries. The main goal is to reveal inadequacy in the distribution of water-intensive production sites from the specific perspective of water scarcity conditions through the analytical perspective.

Strategic perspective

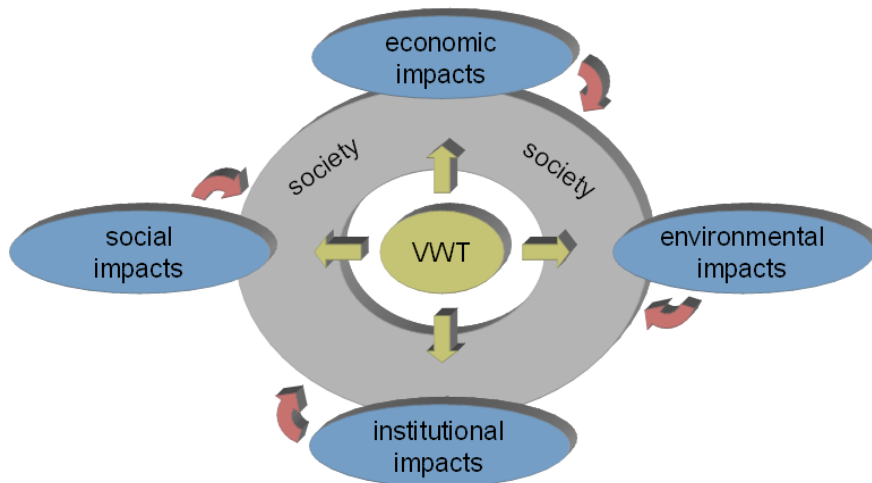
The strategic perspective (also known as the prescriptive perspective) takes the results of the analytical perspective as starting point. The idea is to provide information for policy advises and strategic decisions to increase the efficiencies in water use and the security of supply as well as the utilisation of comparative advantages and the reduction of water poverty and poverty in general. An extension of the perspective and a basic requirement for the implementation of VWT is the inte-

grated analysis of social-ecological consequences of VWT as well as an integrated assessment of chances and problems.

The trade of VW has social-ecological impacts in different areas: economy, society, institutions and environment. The influences in one area interact with the others which mean the occurrence of direct and indirect influences.

Figure 6: Social – Ecological Impacts

Presentation – LIEHR, p.5



Impact examples can be (see Figure 6):

- Pressure on the economic structure including infrastructure due to changed needs for products (employment and structural shift between agriculture, industry and service);
- Pressure on the environment due to changes in agriculture and industry (e.g. pollution and resource use);
- Pressure on the institutional structure due to changes in regulatory needs, property rights, land- and water-reforms as well as the access to loan markets and
- Pressure on the social structure due to changing requirements for social flexibility concerning working conditions, knowledge, gender aspects etc.

Societies have to adapt to the possible changes in the different areas and methods are required to evaluate how a society will react, i.e. measures have to be developed to indicate the adaptive capability of a country with respect to VWT.

Adaptive capability

LIEHR presents the following definition of adaptive capability: “The potential of a society (or a social-ecological system) to adjust its self-forming structures and dynamics in order to cope with pressures, which means to maintain its sustainable integrity.” In our context, it refers to pressures caused by VWT used as a strategic concept.

From the social-ecological perspective, key aspects in this context are flexibility, the need of learning and feedback mechanisms within the society, participation and

diversification of the people and sectors, reduction of path dependency and the sovereignty of decisions for future options to react on changes.

Assessing the adaptive capability for a VWT strategy requires a bi-directional view, i.e. a historical as well as a prognostic view. To find out what the indicators or pre-conditions of positive adaptive capability for the VWT concept of a region are, reversal questions could be posed:

To which extend have societies already reached an adaptation to VWT in the past?

How does VWT work in certain cases without considerable negative consequences or on the other side which present problems could be attributed to VWT in certain cases?

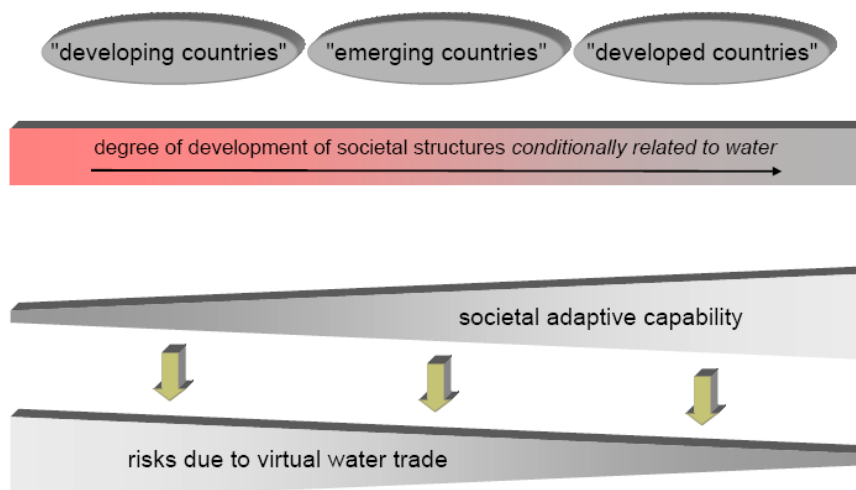
How is the future ability of a society to cope with changes due to an increase of VWT?

The societies must be analysed to validate indicators out of the different areas mentioned before in order to characterise the development status with respect to VWT in the fields of economy (agriculture, infrastructure, high-tech), society (distribution equity, gender, education, urbanisation), environment (pressure on resources, land degradation) and institutionalisation (legislation, urban / water / environmental government).

Figure 7 'Typology of Countries and Regions' illustrates a possibility of measuring social adaptive capability with respect to VWT. The purpose is to look at the degree of development of social structures conditionally related to water. Conditionally related to water means structures which are directly or indirectly linked to water (see Figure 6) and cause changes in the society. For example the loan market: it has no direct influence on water but it has an effect on people's options for reacting on VWT. The differentiation of country types ("developing countries", "emerging countries", "developed countries") is not meant in the common sense like it is applied in political sciences or by the World Bank. It is meant as a classification of countries possessing a low, medium or high degree of development of social structures related to water.

Figure 7: Typology of countries and regions

Presentation - LIEHR, p.8



“Developing countries” are characterised by dominance of agricultural production, rural growth as economic basis, strong traditional structures, importance of local and regional markets, urbanisation problems, low educational standards, small diversification of income sources, small flexibility and strong path dependence. These characteristics lead to the assumption that VWT will be in conflict concerning regional requirements and global conditions.

“Emerging countries” are characterised by an agricultural sector in transition, upcoming non-agricultural sectors, high inter-sectoral exchange, emerging and existing structures for gathering new knowledge and abilities and capital resources. In this country category, VWT in addition to adequate measures (e.g. capacity building, institutional strengthening) may represent an important impulse for sustainable development and growth.

Features of “developed countries” are in particular high flexibility, non-agricultural options for production with high water-related value added and smaller risks of economic crisis caused by path dependency. In this country category, VWT may have high potentials for the reduction of water scarcity and the support of a stable, sustainable dynamic of growth.

A future task for this typology is to consider the different conditions of countries in their role as exporters and importers of VWT.

Indicators for the assessment of the adaptive capability

In order to assess the degree of development of societal structures conditionally related to water, the before mentioned societal areas have to be considered. For the economic development status, indicators for economic structure, agriculture, infrastructure and technology are required. The social development status can be evaluated by indicators for distribution equity, education, gender, urbanisation and the environmental development status indicators for pressure on resources. Evaluating the institutional development status requires indicators for functionality and governance etc.

Development indicators already exist but they are not meaningful enough to make assertions concerning the adaptive capability for VWT. Two of them are the Human Development Index (HDI), which indicates the overall social development status and the Water Poverty Index (WPI) which indicates the water stress at the household and community level.

The HDI is composed of three dimensions: health (life expectancy at birth), knowledge (2/3 adult literacy rate, 1/3 combined primary/secondary/tertiary gross enrolment ratio), living standard (GDP per capita at PPP in USD). Missing are institutional, environmental, more economic and social aspects.

The WPI is composed of five dimensions: resources (physical availability), access (access to clean water; sanitation, coverage of irrigation needs), capacity (socio-economic condition reflecting or impacting water access or quality), use (water allocation) and environment (water provision, management and importance to governance). The missing points of the HDI are partly encountered but after all aspects like

infrastructure and transportation, activities by economic sector, potentials for high-tech exports, rural-urban comparison and regulation are still missing.

LIEHR presents a matrix of indicators which could be suitable for a further selection in order to define an appropriate indicator system for the adaptive capability of a country implementing VWT. At the end he asks whether there is a consensus about the need for the development of such an indicator system and which kind of relation could be established between indicators and modelling.

Figure 8: Proposed Indicators

Presentation – LIEHR, p. 12

Economic development status	Social development status	Environmental development status	Institutional development status
<u>Economic structure</u> <ul style="list-style-type: none"> • Employment by economic activity (agriculture, industry, services) • Growth and structure of output by economic activity 	<u>Distribution equity</u> <ul style="list-style-type: none"> • Gini coefficient 	<u>Pressure on resources</u> <ul style="list-style-type: none"> • Population density and growth • Use rate of potential arable land / land use patterns • Pollution • Water import dependency • Water self-sufficiency • Human vulnerability concerning environmental deterioration or disasters 	<u>Functionality</u> <ul style="list-style-type: none"> • Corruption measure • Democracy measure • Participation
<u>Agriculture</u> <ul style="list-style-type: none"> • Agricultural output (crop, food, livestock) 	<u>Education</u> <ul style="list-style-type: none"> • Literacy • Enrolment ratio • Knowledge index 		<u>Urban governance</u> <ul style="list-style-type: none"> • Urban governance index (UN-HABITAT)
<u>Infrastructure</u> <ul style="list-style-type: none"> • Infrastructure index (roads, access to sanitation facilities and drinking water) 	<u>Gender</u> <ul style="list-style-type: none"> • GDI (gender related development index) • GEM (gender empowerment index) 		<u>Water & Environmental governance</u> <ul style="list-style-type: none"> • Environmental governance index (sub-index of EPI = environmental performance index)
<u>High-Tech</u> <ul style="list-style-type: none"> • High-technology exports 	<u>Urbanisation</u> <ul style="list-style-type: none"> • Rural-to-urban migration • Urban poverty rate • Rural poverty rate 		

Elias Salameh: Redefining the Water Poverty Index

The Water Poverty Index (WPI) of arid and semiarid climatic zones is redefined by introducing the contribution of rain fed agriculture into WPI calculations and by making the WPI equation account for diversities in climatic conditions within arid and semiarid zones, and for recycled household water used in irrigation. The research is driven by the fact, that the literature quotes the amount of 1000-1500 m³/cap/yr to cover the water needs for domestic use, irrigation and industry.

The WPI is a measure which indicates the wealth or poverty of an area's available water resources for domestic needs and for the demand of food production commensurate with the size of its population. Typically for the calculation of the water poverty line only the demand for domestic uses and for irrigation requirements sufficient to cover food needs have been taken into consideration. But such limited definitions are at best inadequate or even misleading because other factors such as rainfed potentials, which strongly affect food production are totally ignored.

Here WPI is redefined so as to account for the major factors affecting the water situation in arid and semiarid regions. It pays particular heed to diversities in such

climatic zones, to rainfed agricultural productivity, and to the state of wastewater treatment and reuse.

The factor of industrial uses, although very easily introduced into the equation, has not been included. The reason for this omission that industrial water uses which constitute an artificial imposition on a natural system, can be effectively managed by means of economic forces within each part of the industrial sector.

The known WPI is calculated by the division of the available surface- and groundwater resource through the population.

SALAMEH proposes to introduce more factors for a more detailed insight in water and food scarcity of a country. The used factors are:

- Productivity of rainfed land depending on the amount of precipitation
- Evapotranspiration depending on the average temperature used as a calculated factor.
- Percentage of treated waste water.
- Available irrigation water (the water which is available minus the water needed for domestic purpose; in developed societies the value is about 100 m³ annually)

The WPI results show that under natural conditions and by using all available water in irrigation Syria, Palestine (West Bank), Saudi-Arabia and Israel are not water poor. Their natural resources can satisfy their household uses and a 100 percentage of food coverage. Under these same conditions Jordan can only cover 15.5%, Egypt 37.5% and United Arab Emirates 9.6% of their food needs (the actual higher coverage percentage in Jordan is a result of fossil water use).

If it is considered that only half the surface area receives more than 300 mm/yr of precipitation only Syria and very closely also Palestine (West Bank) can be seen as “not water poor” although the available water surface and groundwater for Palestine is considered to be only 120 million m³/yr. The situation for all other countries with rainfed irrigation worsens in this case. Jordan for example can only be able to cover 12.3% of its food needs and Saudi-Arabia only 7.9% instead of 15.5%.

The conclusion is that the WPI as indicated above not only takes available surface and groundwater resources as a measure of water poverty or richness into consideration but also accounts for rainfed agriculture and the effects of climate on it. This seems to be a fairer way of judging the water resources of a region, especially because water is not only used for household, but also in irrigation areas and in areas which are poor in rainfed agriculture.

As an extreme example it can be considered on the one hand an area which is totally satisfied by rain and does not require any irrigation water. Its population needs for household use will never exceed 100m³/cap/yr and it can be self-sufficient in food production. Whereas on the other hand another region with zero rainfed area requires to satisfy the household and food production requirements at least (100+1200=) 1300 m³/cap/yr, if it lies in the moderate climate zone with 12° C of average cropping season temperature.

According to the water poverty line defined by other authors to be 1000 m³/cap/yr, can be considered water sufficient, whereas Palestine (West Bank) can only be considered as 11% water sufficient. However, the new WPI concept shows that Egypt is

only 37.5% water sufficient and the Palestine is more than water sufficient which reflects more the reality.

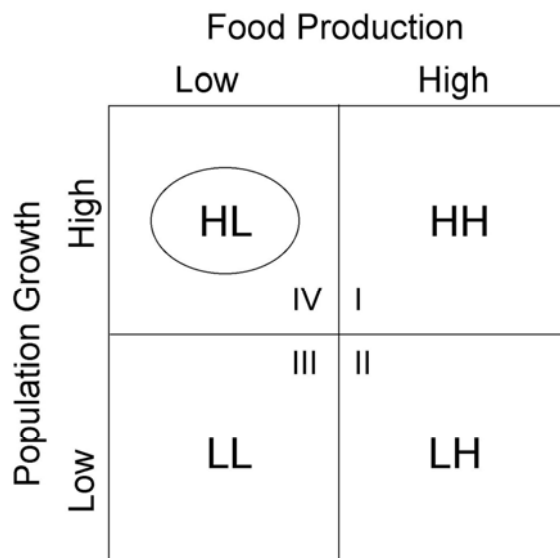
Not taken into account thus far is the temporal variability of rainfall and rates of soil infiltration but that might be the next step in the future to reach an even better picture of the situation.

Discussion

The comments and discussion centred mostly on socio-economic impacts of VWT on societies, the meaning of adaptivity and the role and purpose of indicators.

SALAMEH illustrates the socio-economic impacts with regard to population growth versus food production. The Middle Eastern states were chosen as examples: VWT takes place and the process cannot be reversed, yet the consequences can be analysed in order to deal with the impacts on society. SALAMEH constitutes that the import and export of VW encourages population growth, mainly in the receiving countries because the food security status improves which enhances livelihood and standard of living. His question is: How to develop mechanisms to stop population growth? The second point is the shift of cultivation. The import of food (mainly wheat and other grain) causes a change to higher value agricultural products such as tobacco or even illegal crops like marihuana which provokes a higher amount of consumers. The third point is the interference from outside, as illustrated in Figure 9:

Figure 9: Flip chart illustration of Elias Salameh



The first quadrant shows high food production and high population growth that is more or less balanced because the society is able to feed the population. In the second quadrant low population growth and high food production is shown, and a stable society can be assumed. The third quadrant with low food production and

low population growth implicates a stable or semi-stable scenario. The critical case is shown in the fourth quadrant: High population growth and low food production indicates a non-stable society. The latter case leads to impulses for stabilisation from outside. It often provokes a stabilisation of undemocratic conditions or even dictatorships. Careful analyses of social and economic structures of society are necessary to counter these risks.

With respect to indicators and the presentation of LIEHR the problem of scaling (in particular time) was mentioned and how predictions can be done in the future. MAGIERA states that an indicator system does only make sense when it allows projection into the future. A tool is needed to describe the adaptation to VWT of a specific country. For policy action it is necessary to see what will happen in 10 or 20 years. Thus, indicators need to be sound for policy advices to determine the areas with fast changes and their causes.

Another issue of discussion was the problem of complexity: On the one hand, there is the risk of oversimplification, and on the other hand too many indicators will make the analyses too complex to handle. With respect to indicators for the different social, institutional, environmental, economic and institutional areas it was questioned whether there is sufficient data and if all mentioned factors can be addressed equally or whether a prioritisation is required. An appropriate selection and weighting of the variables would be meaningful.

Another question raised was the implication of *adaptive capability* respectively adaptivity. The implications for countries, being highly adaptive or low adaptive, have to be specified. As LIEHR explains, poor countries which for example derive their main income in the agricultural sector have problems to compensate the import of Virtual Water through high value crops, because they possess few production sites outside the agricultural sector. They are often characterised by traditional structures, particularly in rural areas. Importing Virtual Water has specific effects on these structures and the task is to analyse how these countries and especially certain societal areas deal with the changes. As KLUGE specifies, 'adaptivity' refers to the capability of societies for social development which means to enable development perspectives in countries. Conditions are very different for industrialised and developing countries.

4. Case Study Regions: SADC and Jordan River Basin

Two case study regions are particularly suited for VWT due to their water scarcity conditions and geo-political situation: the Middle East with the focus on the Jordan River Basin and the Southern African Development Community.

The Jordan River Basin (Israel, Palestine, Jordan) is characterised by an extreme water scarcity and a high population growth. Until 2050 a doubling of the population from 15.8 Million to 31.2 Million people is estimated for the region. In consideration of the arid conditions VWT seems to be an inescapable strategy, but the cultural, political, social and economic differences in the region present a complicated situation.

The SADC region seems to be a positive example, where the exports of fruits, vegetables, flowers and tobacco exceeds the import of cereals. In South Africa the water sector reform already contains legally fixed elements of the concept of VWT as an answer of increasing water scarcity. The session dealt with the topics:

- What are the potentials and risks in the case study regions?
- What are the institutional and political conditions for implementing VWT in the respective region?
- How is the respective society prepared for a VWT strategy? Which adaptive capacities do they have at their disposal?
- Can VWT as a new form of trade relationships be considered as an adequate substitute for technological solutions such as large scale dams, pipelines etc.?
- Which regional trade structures are possible?

SADC

Richard Meissner: Regional VWT Regimes – Potentials from a Political Science Perspective: South Africa and Zambia as Case Studies

The main emphasize of the presentation is to determine different views of stakeholders in South Africa's and Zambia's agricultural sectors on Virtual Water and Virtual Water Trade because the debate has been conducted at a highly theoretical and abstract level.

Due to time constraints, only a small number of stakeholders could be contacted to ascertain their views. Even so, to supplement the opinions, a desktop study was conducted. Press clippings were the main source of information for this part of the research. In particular, information was gathered on the prevailing drought in both of the countries and its impact on their agricultural sectors, trade in commodities (literally Virtual Water Trade), ethanol or bio-diesel production, and the transportation of agricultural commodities. Although the time was limited for the study, the results and conclusions do have meaning in the debate on Virtual Water Trade. They give a bird's eye view of the opinions of very important role players in both country's agricultural sectors as well as a preliminary stakeholder analysis should a so-called Virtual Water Trade strategy be ever implemented on the Southern African sub-continent.

The presentation summarises the findings contained in the study. The issues raised below will indicate some of the opinions as well as the institutions and political conditions that exist for the implementation or complete ignorance of such a strategy.

South Africa

In South Africa (SA) land reform and agricultural policy dominates the agricultural policy agenda. Within the land reform strategy the government counts on the spirit of cooperation with the commercial farmers. The National African Farmers Union (NAFU) also promotes the land reform to accelerate food production. In this regard the Department of Agriculture (DoA) is committed to poverty reduction in SA and Africa, to broaden access to agriculture and to increase productivity and profitability in the sector. Another important agricultural interest is the Trade, Development and Co-operation Agreement (TDCA) between the European Commission (EC) and SA (maize and wheat are not covered).

The contribution of agriculture to the country economy and poverty relief is also an important factor to take into consideration. In 2000 the total farming assets were R425 billion (~Euro 45 billion). Agriculture contributes 3% to the country's GDP (Gross Domestic Product) and 7-8% to exports as well as 10% to employment. It is thus an important source of income for many people (in 2003: 1.182 million people). In the last 50 years the agricultural contribution to the GDP decreased from 16.6 to 3.8% while finance increased from 9.3 to 20.7%. Nevertheless the DoA is adamant that agriculture is a vitally important sector to the economy of SA and the stability of SADC.

Because agriculture is such an important sector in South African society the pressure on the sensitive environment is very high. Reliable water resources, especially ground water are needed but the water resource lies under threat from over-exploitation, pollution and exotic plant species. Agriculture uses the most water (about 49%) and is together with mines and industries the main polluter. Also climate change is an issue; SADC can expect less rain in the future which might have a negative impact on food production with droughts being dangerous threats for commercial and subsistence farmers.

Thus, a Virtual Water Trade strategy seems viable but stakeholders have a different view. Their views orbit around the following issues:

The GM (gene manipulation) debate (AfricaBio and GrainSA support it to increase crop production; the Anglican Church hold the view to use it only if it is safe, affordable and sustainable; does not reduce jobs or destroy biodiversity; and does not increase the dependence on rich nations

The US market; it has an influential impact on the maize price.

Food aid is a double-edged sword – helping the poor to survive while killing commercial farming activities

Subsidies of commercial farmers in the developed world are a sensitive issue in the developing world. If the developed world is serious about aid to Africa it should not subsidise food or export it to Africa in the name of food aid and so force the farm-

ers there out of production (AgriSA and NAFU). Farmers believe that it is a way for the US to get rid of over-production, with a negative impact on local markets

Ethanol (bio-diesel); The low price of maize stimulated farmer to come up with new ways to create a new market for the maize production. Ethanol (out of maize) could be a solution to create a market for maize in SA by 3.5 million ha and thereby an increase of the price. Eight ethanol plants are being invested and one is already operational with the Minister of Public Works strongly supporting this technology.

Transport: The transport infrastructure must be maintained and enlarged otherwise SA will be unable to supply SADC with food, due to a shortage of handlers in harbours and rail stock (Grain Handling Organisation of South Africa).

Production methods: Efficient utilisation of soil moisture, new cultivars of maize, fertilisation according to soil moisture content, narrower spacing between rows, and minimum disturbance of soil can lead to a doubling of production (Pioneer Seed).

Water allocations – VW and VWT is important to enhance land and water allocation reform and water conservation (Orange-Riet Water User Association).

Competitive advantage (discussed in the presentation of Michael Brüntrup)

The agriculture agenda: VW is not at the forefront of decisions regarding water allocation and management in SA, but can become an issue in future decisions in the political arena as a part of water allocation reform as it is also linked to land reform. This implies that water will be taken away from previously advantaged farmers to previously disadvantaged farmers with negative socio-political spin-offs. VW will not become very important since SA produces agricultural products in order to be self-sufficient and to export those products in which the country has a comparative advantage (University of the Free State).

Zambia

The second country to be examined is Zambia; it indicates a similar political noisy, or rather 'silent', profile.

Firstly, Zimbabwe's political and economic instability has a positive impact on Zambia's farming and agricultural sector; especially in the tobacco export industry jobs were created. Therefore, Zambia's agricultural sector is expanding with high potentials due to problems in Zimbabwe and opportunities from South Africa. However Zambia is a high-risk economy because agriculture accounts for 22% of the GDP. In 2004, the economy grew by 5%, economic growth was higher than population growth for the fifth year and inflation is under control at 19.5%.

In 2005 the government announced a US\$150 million plan to boost agriculture, diversify Zambia's economy and reduce its dependence on copper. Farmers were encouraged by cash loans to produce maize, wheat, cotton, tobacco, sunflower and vegetables for local consumption and the export market. Also irrigation systems are of the plan, with the aim to increase arable land under irrigation from 50,000 to 90,000 ha this decade.

The societal problem is mainly poverty (86% of 11 million people live below the poverty line) and the environmental problems are droughts and land degradation (although land is abundant). Because of these factors (except drought), a VWT strat-

egy does not seem very viable and the stakeholders' views are confirming this. There is no relevant awareness of the concepts VW and VWT mainly because many stakeholders do not understand the concepts. Women are major producers of agricultural commodities in Zambia and so the awareness lies mostly in their involvement and in the African Growth and Opportunities Act (AGOA), a domestic US Act which gives developing countries access to the US market for several goods. Therefore, the focus is on other issues rather than on VW and VWT.

Food insecurity and trade in agriculture is a sensitive issue. Zambia is water abundant and can therefore produce enough so that it can export commodities, however, because of drought, it has to import more.

Because of the abundance of water, Zambia has a comparative advantage to produce certain export agricultural commodities which will improve the socio-economic outlook of the country and stimulate job creation and poverty reduction, but cheap imports reduce the chances of producers to grow more. In addition, there should be more investments in water infrastructure and services in all sectors of the economy because the limited access to markets, trade barriers and a lack of attractive financing for potential entrepreneurs inhibit the development of industries (University of Botswana).

VW and VWT are used to divert attention, especially in Zambia's case, and take the focus away from the main problems like poverty.

To sum up: Stakeholders are not very enthusiastic about VW and VWT in SA and Zambia, in Zambia some are not even aware of the concept. Current political, economic, social and environmental conditions indicate that VW and VWT will remain low on the agricultural and political agenda in both countries because other pressing issues have priority – job creation, economic growth, HIV/AIDS and poverty reduction.

Relevant factors for a cross-regional master-plan

MEISSNER proposes the following questions in order to formulate a cross-regional master plan, although a cross-regional master plan throughout the entire SADC region seems not to be an easy task:

- Are stakeholders in the agricultural and water sectors aware of VW and VWT?
- Do they agree that these are options to solve water scarcities and increase agricultural production in the region?
- Is VW and VWT on the individual SADC members' policy agendas?
- What are the alternatives to the plan?
- If none, how do we implement it, considering the following policy processes (important & sobering): problem identification – agenda setting – policy formulation – alternatives to the policy – policy adoption – policy implementation – policy evaluation.

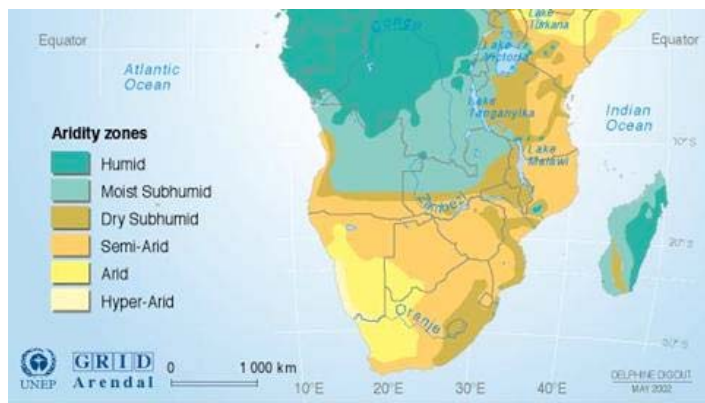
Anton Earle: Various Spatial and Economic Starting Conditions for SADC Countries

In this presentation EARLE reflects about the trends in terms of VWT within the SADC-Region.

The SADC region is a very large net importer of VW but besides that it is more interesting to look at what is happening between the SADC countries. The main focus will be on the water situation in the SADC, the current trade in VW, which is represented through cereal trade (cereals comprise close to 60% of the region's direct food intake and would be more when meat products are factored in), the future VWT among SADC countries – enablers, hindrances and unintended consequences and the intra-regional VWT which is happening despite the political silence.

The water stress in the region comes not from water shortage but is related to the distribution of water which underlies large spatial and temporal variability. Problems are also shared river systems and that water is not where it is needed and transportation is very expensive.

*Figure 10: Aridity Zones of the southern part of Africa
Presentation – EARLE, p. 7*

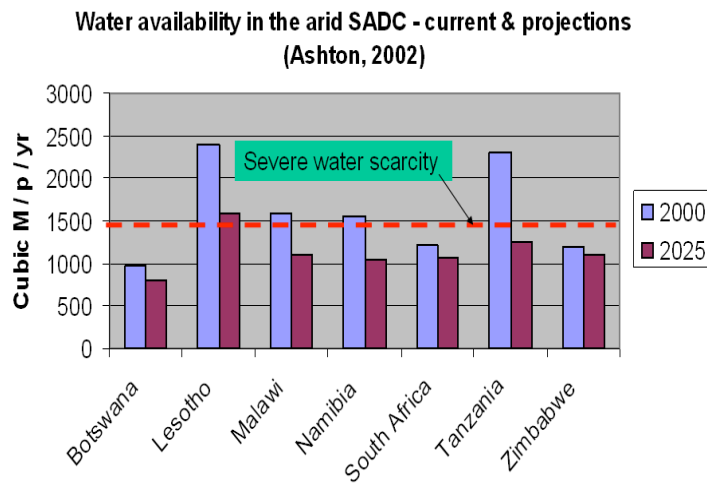


Source: World Meteorological Organization (WMO), United Nations Environment Programme (UNEP), *Climate Change 2001: Impacts, Adaptation, and Vulnerability*, Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC).

The spatial distribution of water availability is shown in Figure 10. Evapotranspiration is 2 to 100 times higher than the mean annual precipitation, runoff is poor and only 10% of the rainfall is available for the river basins. Additionally the anthropogenic pressure places stress on the natural system.

Figure 11: Water availability

Presentation – EARLE, p. 10



Compared to the year 2000, a water scarcity is predicted for every country except Lesotho by 2025 (Figure 11). Population growth rates are adjusted for the countries' HIV/ AIDS prevalence in 2000.

If water availability is taken as an indicator it is important to see the dependency ration which means the amount of water that comes from outside of a country's border.

There are four countries in the region that are gifted with water specifically with soil water: Angola, DR Congo, Mozambique and Zambia, The three extremely water scared countries Namibia, Botswana and South Africa are served by international water transfer schemes and the transfer takes place as „real” or “virtual” water. There are already existing and planned schemes for these three countries which have all access to international credits and financial resources to do it.

The reliance on Virtual Water imports from cereals increases in the region by a decrease of the export. In this context it is important to know that the trend strongly depends on the South African market because it is the biggest and strongest in the region. The South African people represent only 20% of the SADC population but SA accounts for roughly 50% of the production.

The traditionally large cereal producers are Malawi, Tanzania and Zimbabwe; but their production oscillates because of water stress and political instability. The medium level producers are Angola the DR Congo, Mozambique and Zambia; their production rises fast because peace takes hold. The low producers are Botswana, Lesotho, Namibia and Swaziland; their economies have diversified from the production of cereals to i.e. tourism.

Currently up to 8 km³ of Virtual Water is imported per year as cereal imports by the SADC states of which only about 1 km³ is sourced from other SADC states. About 5 km³ of water is transferred within and between SADC states and is proposed to increase up to 7 – 8 km³ by 2025.

In the breadbasket countries Mozambique, DR Congo, Angola, Zambia the total cultivable area is 162 million ha as considered by the FAO. Together, they produce 6

million tonnes of maize and cereal products. The irrigation potential is roughly 14 million ha, but at the moment only 2% is developed which underlines the huge potential of the region.

Mozambique – Grain imports drop and increase as development continues, it could be a grain exporter.

DR Congo – Grain imports are dropping as fighting gets less. Huge areas are suitable for rainfed agriculture which can be considered a long term prospect.

Angola – Oil and diamond revenues have allowed increased imports and therefore a drop in international aid. Many areas are suitable for grain production, but there is very little infrastructure.

Zambia – Many areas where rainfed agriculture is possible. Horticulture earns foreign exchange with vegetables, flowers etc. Zambia would need an incentive to shift to cereal production.

This shows that the potential of the region to become food self sufficient is given but there are hindrances to overcome:

- Political instability that keeps people off the land and farm investments low;
- Low world market prices for cereals make it difficult to convince farmers to invest in increased production;
- Transport and storage infrastructure is in a bad condition. Transport costs within the region can be more expensive than import costs from overseas;
- Political resistance in the region towards reliance on neighbour states because of staple food.

South African has signed a Free Trade Agreement with the SADC states that opens the country's market for agricultural products. However, the South African market is also very open to cereals from international markets because of the lower prices. Thus as SA has encouraged its farmers to focus more on higher value products (by taking away agricultural support) the resultant slack in the supply of cereals has been filled mainly by imports from the EU and US.

The future scenarios to reduce foreign imports could be that the region invests in the agriculture and infrastructure of the humid states in the north while the arid states in the south just need water for their non-agricultural sectors. This leads to proposals to transfer water from rivers such as the Zambezi and Okavango – but with large social, financial and environmental costs. Infrastructure such as railways and roads can be used for a range of other purposes – generally contributing to regional development. But to implement these proposals a high degree of political support would be needed.

The largest international physical transfer of water is the Lesotho Highlands Water project; 750 million m³ are transferred through tunnels annually with capital cost of US\$ 2 billion and royalty payments of US\$ 31 million per year. The costs over a 20 year period are 18 US cents per year, which is cheap enough for domestic and industrial use but not for agriculture.

Observing the current situation it becomes clear that the intra-regional VWT is already happening and is going to increase in the future. Trade is being eased through harmonisation of standards, dropping of tariffs (there are none for SADC most ce-

real products entering SA), improving border crossings and upgrading of transport links. It is to be expected that this will be happening in spite of official SADC resistance to VWT. VWT links the soil water abundance in wet countries to the ability-to-pay of the dry countries.

Jordan River Basin

Nir Becker: Potentials and Risks for VWT in Israel

The presentation focuses against the background description of the water sector in Israel on the economic and political conditions for domestic implementation of VWT in the country as well as on the regional structure for trade and other market mechanisms.

VWT is a logical way to show the paradox in using water in a less efficient way than it should be used. In the economic theory this issue relies on the subject of relative advantages and factors proportion models (HECKSCHER – OHLIN Theory). Under this theory a country should specialise in producing goods in which it has relative intensity in factors which are used heavily in producing the goods. Hence, countries that have relative abundance in water resources should specialise in water intense goods and other countries should trade those goods for other goods.

In Israel in particular and in the Middle East in general water is a scarce resource. However, even scarcity is a relative term. Some countries have a real scarcity problem while others have a quasi-scarcity problem. Quasi-scarcity is based on the fact that sometimes the problem is a simple economic problem of using too much water at a given price. This is for example the case in Israel.

Israel has a population of about 7 million people concentrating along the coast and Palestine has about 3 million inhabitants in the West Bank and Gaza, with a total area of 27,000 km². The climate is Mediterranean which means hot and dry summers with a yearly catchable water potential of 1,5000 million m³. The total needs of the population (food, household, industry) amount to 7,300 million m³ (calculated with a per capita use of 1,000 m³) but the total availability (soil, production including recycled minus export) is 3,100 million m³. This results in a gap of 4,200 million m³. In 2003, the water supply was 1,920 million m³ and will increase until 2009 to 2,520 million m³ because of newly built desalination plants.

Table 3: Water balance in Israel: Supply and demand in million m³
Presentation – BECKER, p. 10ff

SUPPLY	1997	2003	2009	DEMAND	1997	2003	2009
Natural recharge (expectancy)	1,480	1,480	1,480	Domestic	550	680	720
Saline Water	160	160	140	Industry	150	170	190
Effluent	250	280	500	Agriculture	1,150	800	700
Desalination	-	-	400	Nature and Environment	10	50	50
				Political agreements	110	110	210
Total	1,890	1,920	2,520	Total	1,970	1,910	1,870

In Israel, a developed country, the agricultural sector is shrinking continually, the domestic consumptive water use increases constantly and the industrial water use stays nearly the same in absolute terms due to new technological solutions. The origin of the existing water crisis is the slow development of new water resources and a continuous over-extraction. The source of hope is waste water treatment and desalination. But the key question should be: Why wasn't there any attempt to adjust consumption to supply?

The presentation claims that VWT has an obvious potential to solve some basic water problems in Israel and in the region as a whole, but there are obstacles in the realisation of this. Therefore two facts are crucial: The first one is the outcome of the attempt to implement the theory of VWT on a domestic base and the second one is the issue of demand vs. supply management. In Israel it has been dealt with these facts in the last decade and both have won bringing about the worst solution: 500 million m³/yr of desalinated water are planned to be added to the system. In return the water price has been raised to a level which decreases the demand. Desalination plants started to operate about 20 years earlier than what economic theory predicts they should. Another result is the environmental service of water. Taking the Dead Sea problem as a test case we see that there is no willingness to solve even those issues relative to conventional agriculture production. It seems that dealing with water "import" wins even less support.

Hydro-Politics

Although the government should be involved it is nearly impossible to do so in a neutral manner because once the government gets involved, interest groups arise and put pressure on the government which hinders an efficient way of actions. In Israel two main groups are relevant: The farmers and the Mekorot (the water supply company) workers. The agriculture lobby is very well organised but not tax payers. The farmers want to get large amounts of water at the lowest possible price which leads to two results: Depleted aquifers and inefficient water use. The Mekorot, with

high salary workers and the “hand on the tap”, suggests new projects under the supposition that the government will pay. The result is that both sides achieve their goals and desalination plants are constructed to assure the supply and the water price is increased to assure the continuity of Mekorot.

The main critiques BECKER makes are that it always seems easier to solve a problem after a catastrophic event rather than to prevent it; and that politicians prefer supply rather than demand management. Which means it is easier for politicians to create new possibilities to generate more water for the demand satisfaction than to regulate the consumption through price increase.

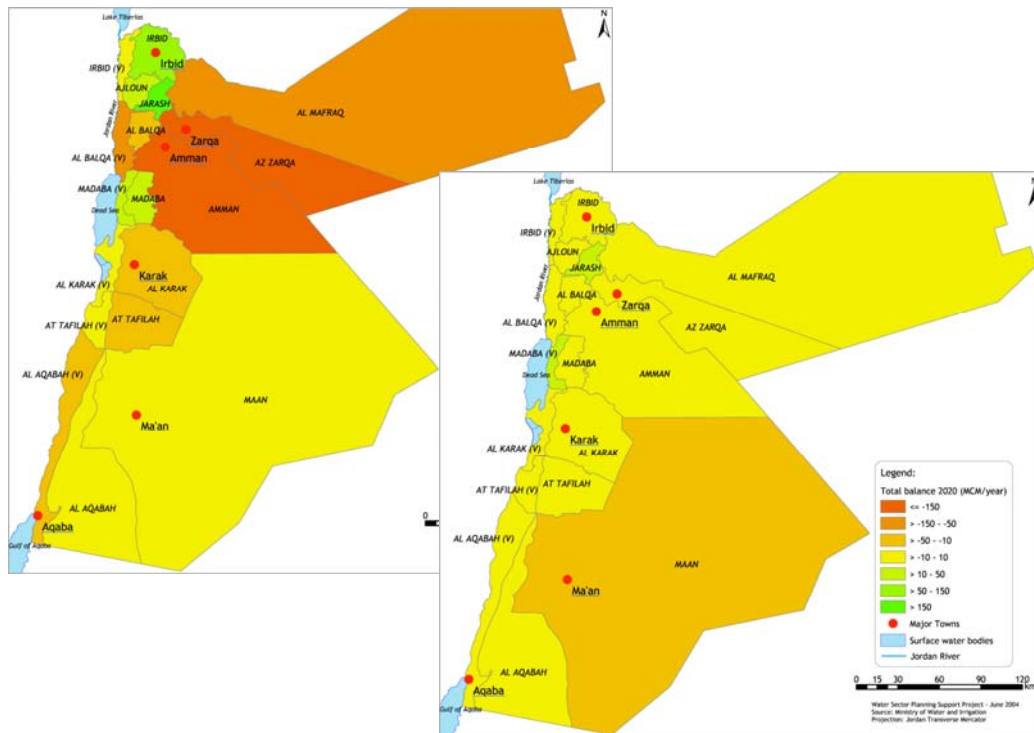
On a regional basis VWT is an obvious way to show how small the issue of water is in the Middle East conflict is. It is presented by the Israeli – Palestinian water conflict and by the Israeli – Syrian water conflict. In both cases the consequences of giving up 200 – 300 million m³/yr would have a negligible effect on the Israeli economy but could ease tension. Finding a common understanding of water issues in the Middle East could go far to enhance the possibilities of achieving stability in the region.

BECKER concludes that even if the concept of VWT is accepted the approach will not win, still the losses are not so heavy for the same reason the water conflict has not escalated until now. The approach on the water problem in Israel by hydro-politics is inefficient because they try to solve it from the wrong side where large supply projects will prevail. For Israel VWT is also not the best possible solution because everything is a question of pricing. When water is cheap enough Israel, as a water scared country, exports VW to Europe for example as citrus fruits. As long as this happens the water crisis can not be that crucial for Isarel.

Philipp Magiera: Potentials and Risks for VWT in Jordan

Jordan has a National Water Master Plan (NWMP) that runs until 2020, aiming at a balance of water resources and water demand. The projected results for 2020 with and without the NWMP balancing and allocation are mapped in Figure 12. On the left side is the situation without the NWMP which shows a high water scarcity and on the right side the result with the demand management and other institutional measures like reallocation and waste water treatment are presented.

Figure 12: Water situation in Jordan with (right) and without (left) NWMP, projections for 2020
 Presentation – MAGIERA, p. 3



The aim of the plan is to show that it is possible even with the scarce resources to satisfy the needs of the population and to safeguard the renewable ground water. Not taken into consideration is the planned Red-Dead-Sea-Chanal.

The presentation discusses the potentials and risks of VWT in different contexts like the environmental, political, economic, social, institutional and agricultural context and afterward gives an outlook on future policy measures.

One potential for further VWT in the physical context is the low domestic water resource of 1,250 million m³/yr with a high share of irrigation use. VW is already imported mainly in the form of wheat, barley, maize and meat and the NWMP supposes that any additional million in the number of population will result approximately in an additional need for Virtual Water import in the range of 700 million m³/yr. Risks for a further use of VWT as a policy tool are the reliance on decision makers of mega-project on the demand side. To realistically deal with VWT is not part of the solution bundle of the Ministry of Water and Irrigation (MWI). On a small scale the import of VW decreases the traditional irrigation in local agriculture which might be important for the water cycle.

From the political point of view the potentials are that the government of Jordan has already been criticised for lifting various subsidies and a leveraging of VWT options prevents opening another front of criticism. Also, VWT is a possible argument in a legal battle against big agricultural investors who refuse to pay groundwater fees and it would decrease the dependency on politically sensitive negotiations regarding transboundary water with Jordan's neighbours. A risk is of course

the aim of food self-sufficiency, should VWT dependency develop into a political issue, popular countermeasures will be asked from the government.

Existing policies of the Ministry of Agriculture are another risk for further VWT: Conserve basic agricultural resources to produce food and protect the environment; increase the return of agricultural investments to improve the farmers' situation to discourage migration from the rural to the urban areas; increase the net income and growth rate of agriculture and increase the export.

The potentials in the economic context are the flexibility of trade relations in reacting to climatic variability; the low return of agricultural water use can be replaced by higher returns when allocating water to domestic uses and investments needed in the water sector could be reduced. The risks are dependency on staple food, as well as the fluctuations of world market prices as well as the GMO debate as it is mentioned in the SADC.

The potentials on the social side are in first order the potential to re-allocate the water from agricultural to domestic uses, it could be also promoted by an increase in irrigation efficiency and water reuse, but not forever. Then there are health risks that could be avoided by an adequate water supply and lastly, imported goods have a high prestige factor. On the risk side the employment of unskilled workers in agriculture are threatened and would lead to an even higher unemployment rate.

From the institutional point of view a decreasing level in state control and subsidies would open new VWT possibilities and the closer trade within the Arabic Free Trade Zone might strengthen the region. But on the risk side it is to remark that no institutional approach exists until now and the responsibility lies between the MWI, the Ministry of Agriculture and the Ministry of Industry and Trade. There is no clear leadership due to the current political system.

The last point is the agricultural context: Jordan exports VW in the form of tomatoes and eggplants mostly to the Gulf States. The import of VW has, not only therefore, been on a constant rise. The risks are that the agricultural lobby avoids paying water fees and that if the current fees remain very low, there is no incentive for further VWT. The rare wet years also alleviate the pressure on agricultural reforms.

As conclusion and outlook Magiera summarises the main points: The most likely scenario is a further silent increase of VW imports without further policy measures in the mid term as an open political debate on the issue is seen as unlikely. In the long term, development depends on the measurements taken by the MWI to promote supply or demand management. If supply management prevails, the "abundance of water" is likely to slow down VWT and if demand management prevails, chances for an institutionalised use of VWT as a management tool for the GOJ are higher to assure the supply of drinking water.

Discussion

The examples fit perfectly ALLAN's observation that VW is an explanation for the fact that conflicts between countries about water are not as prominent as expected. Instead, VWT is a *means to avoid conflicts* and thus represents a tool to bring peace, as he states. In comparison, the process of putting knowledge into policy executed very rapidly in Southern Africa, while the policy making in the Middle East is more hauling.

The different conditions of the countries presented underline the necessity to *distinguish exporting and importing countries*, because they do not coincide with the category 'industrialised' and developing countries. Again, the lack of *cross-sectoral co-ordination* was emphasised as a main problem. With respect to political processes and policy alternatives EARLE remarked that every decision that a government or the primary sector takes to intervene actively may have unintended consequences, which determines the political *acceptability*, e.g. whether big interest groups are 'winners' or 'losers'. As MAGIERA explains for Jordan, lobby groups become a problem when it comes to reallocation of the water resource from agriculture to the municipal or industrial sector, because they have to find new ways of production or move their production to areas where treated waste water is available.

Furthermore, the issue of regionalization was stressed. As HUMMEL states, the VWT concept must be seen in the context of regional development and should be framed within the context of IWRM. KLUGE observes that issues of sanitation and irrigation receive the most attention in the water discussion. A regional plan should be developed to use the potentials of Virtual Water, but must also consider transportation investments in large scale agriculture and impacts on the social sector. Furthermore, the role of donors and funding from outside has to be taken into account, i.e. VWT should be framed within the MDG debate, World Summits etc. On that base scenarios can be built and can be introduced into the political arena of the discourse. EARLE explains that the right factors and right actors are needed: For the scenario development it is important that you can slow down technical processes if required and let the political process catch up. Pushing VWT in the SADC region is quite sensitive as it is perceived as a donor driven activity. An afternoon working group discussed the issue of regionalisation in more detail (see below).

5. Integrated Modelling

The amount of Virtual Water used for the production process of traded goods can be quantified, and different methodologies for the quantification have been developed. For primary crops it is based on the crop water requirement calculations of the FAO as well as climate and yield data of the producing country. Even for livestock and industrial products the Virtual Water content is quantifiable. It is thus possible to create global maps based on physical indicators to identify global water use and efficiency and analogue the potential quantity of water that can be saved by a water scarce country by importing Virtual Water in form of various products. To create adequate modelling approaches a combination of physical and social dimensions should be forced in order to analyse and shape their interactions and future dynamics. The session concentrated on the questions:

- Which methods and approaches are needed?
- How is an integration of natural science data and social indicators possible?
- How to deal with different scales (global, regional, national)?

Petra Döll, Stefan Siebert and Felix Portmann:

Green and Blue Water Modelling on a Global Scale

The aim of the research on which the presentation is based is to quantify the Virtual Water content on a global scale of crops and then modify it with the trade volumes to get to VWT. The presentation discusses the necessity of the distinction of blue, green and Virtual Water as well as the need of high spatial resolution and some ideas for a more integrated modelling approach.

DÖLL and colleagues defined green water as the fraction of the precipitation that returns to the atmosphere (as gas) by the process of (evapo)transpiration, while blue water is the fraction of the precipitation that reaches groundwater or surface waters. When blue water is technically transferred to plants via irrigation, the part of the irrigated water that is (evapo)transpires is also considered to be blue water. Thus water used for crop growth can be both green or blue, while only blue water is used for domestic and industrial purposes.

Green water has no supply costs, while blue water can have very high supply costs. Also the opportunity costs of green water in crop production are low compared to blue (irrigation) water, as the only other opportunity is natural vegetation. That shows that the value of VW in crops is strongly related to the proportions of green and blue water content in the accounted crop. With respect to blue water, withdrawal and consumptive water use is distinguished while the green water use is by definition consumptive. Consumptive water is the part of the withdrawn water that evapotranspires during use and does not flow back to the river.

DÖLL proposes to modify the equation of CHAPAGAIN and HOEKSTRA⁷:

$$\text{WaterScarcity} = \frac{\text{(green and blue) water used to produce the goods consumed in the country}}{\text{water availability in country}} \\ \text{(= blue water resources + rainfall on cropland during growing season)}$$

To see for which country VWT is a risk or a potential a more differentiated equation is necessary to use it as indicator, therefore importing and exporting countries have to be distinguished and what has to be taken into consideration is the consumptive irrigation water use.

That means for the importing countries:

$$WS = \frac{\text{consumptive irrigation water use}}{\text{blue water resources}}$$

And for exporting countries:

$$WS = \frac{\text{net exported consumptive irrigation water use}}{\text{blue water resources}}$$

VWT models of high spatial resolution which distinguish blue and green water are necessarily complex and include all the uncertainties of hydrological models, water use models and Virtual Water content models. The main uncertainties include variables (with a high spatial resolution) like precipitation, radiation, crop land extent etc. Nevertheless, a high spatial resolution is necessary to deliver significant results, For example, the average rainfall in mainland USA is 745 mm/yr, while it is only 593 mm/yr over wheat areas but 1182 mm/yr over rice areas, which significantly affects the Virtual Water content of these crops. Besides, a high spatial resolution will make it possible to analyse Virtual Water at the scale of river basins instead of only countries.

Currently, research is in progress to answer the following questions for the global scale: Which crop is grown where and when? -and- Is it grown under rainfed or irrigated conditions?

Up to now, all VWT models include only data on current trade volumes. The step towards a VWT model that simulates trade, too, appears to be very difficult.

The last issue is how to integrate socio-economic factors in quantitative water modelling. To model societal processes is very difficult. A possibility might be to combine the modeling of the perspectives of societal actors with qualitative and quantitative scenarios. DÖLL and colleagues suggest a number of interesting quantitative analyses related to VWT: transport-related energy consumption due to VWT, the cost of food transport as compared to cost of (new) irrigation and changes in Virtual Water flows due to increased biofuel production.

⁷ HOEKSTRA, A.Y., CHAPAGAIN, A.K. (2004): Water footprints of Nations – Volume 1: Main Report. Value of Water Research Reports Series No. 16. IHE Delft.

Discussion

For an appropriate assessment of the feasibility of VWT models are required which quantify Virtual Water. The studies both of HOEKSTRA and DÖLL reverse the blind spots outwards by highlighting the increasing globalisation of trade and the Virtual Water balance of countries and regions, the net importers and exporters. Another issue in the discussion was the distinction between blue and green water resources and the exchangeability of these two types of water. BECKER adds that an integrated modelling should not separate society and economics, because economy is part of society. Green water is incorporated in recent studies and emphasised that not only blue water, but also green water does have opportunity costs. Again, the question is posed what the consequences of these explanations are and for what purpose data is compiled. They can be used to identify the vulnerability of different countries and regions and thus can be applied for preventive strategies and for crisis management. LUX demonstrates the relation between indicators and models and asks whether indicators can be extracted from models. According to DÖLL ideally it might be possible to model the quantifiable indicators, but it might be difficult to compare real ones with the computed.

The role of indicators, models and scenarios was further discussed in a working group (see below).

6. Working Groups

Regionalisation

The working groups concentrated on the question of how Virtual Water can be put on the political and societal agenda and thus bringing the issue of Virtual Water into communication. Initial question was, how to identify the proper spatial scale ('problem-shed') for this communication processes. There are strong reasons why river basins are not the eligible scale: problems that should be tackled by Virtual Water Trade – or which emerge due to the implementation VWT – seem to be different on varying spatial scales. Furthermore, the wider context of water (re-)allocation must be considered. From this it follows that problem-oriented approaches seem to be appropriate to define scales. There was also an emphasis on cross-sectional perspectives on Virtual Water Trade respectively food trade. The process of communication must be linked to the existing political/societal agenda and in many cases policy strategies focus on food security and provision. There is a need to re-frame the VWT-issue in order to enable (non-hydro) politicians to comprehend opportunities and obstacles.

For bringing the complexity of VWT-issues into discussion without improper simplifications, a participatory stakeholder approach was broadly sketched as one conclusion of working group discussion: Starting point is a problem-oriented proceeding in defining the level of action respective the relevant stakeholder groups. A multi-step process will follow and starts by specifying and contextualising the problem definition. Thus, stakeholder and experts from various fields state their views and interests and contribute their specific knowledge. Goal is on the one hand to identify "islands of consensus" as well as "conflicts of interests"; on the other hand the knowledge base for further processes can be established. As integrative tool 'participatory scenarios' might be profitably as method within this step, because visualisation of interdependencies within and among spatial scales, stakeholder groups, policy fields etc. could be enabled. Here it becomes obvious that it is crucial that firstly all relevant stakeholders (including delegates from government and other state/administrative bodies for integrating the process into the existing power structure) are included and secondly that the approach is appropriately designed for generating trust in the process as well as confidence among the participants and initiators.

The next step is a vision shaping process that specifies strategic goals and opens various alternative options or channelling corridors for problem solving. Against the background of consensus and conflicts, as well as goals and options it becomes necessary to find ways for (participatory, cross-sectoral and multi-criterial) valuation of options. The working group suggested to use a matrix-approach for this kind of qualitative assessment that considers impact on one axis and (un-)certainty of various aspects or variables on the other axis.

Figure 13: Flip chart of the Working Group Regionalisation

		Uncertainty		
		Low	Mid	High
Impact	Low			
	Mid			
	High			

It is the task of the stakeholder forum to negotiate where on the impact-uncertainty-scale single issues must be located. It may be expected that this process is conflictive and therefore must be moderated. However, there is no blueprint – depending on the specific situation of the countries (e.g. as Virtual Water importing or exporting countries) the outcome of such a stakeholder approach will differ. For example, one result can be a regional development plan that balances advantages and disadvantages of an intended shift in (agricultural) production patterns, import-export-relations and water allocation between sectors and so on.

Indicators

The working group dealt with the role of transdisciplinary research on VWT, scenarios and indicators for the assessment of societies' capacity to adapt to VWT. In this context, the notion of 'adaptive capability' was specified: In our context it refers to a distinct form of re-allocation of water resources.

Again, the role of science and research was subject to controversy. According to HUMMEL VWT should be viewed in the context of sustainability research. She plead for a problem-oriented, transdisciplinary approach in order to provide an integrated perspective on the consequences of policy options. Thus, analysis should exceed data and figures (which are nonetheless necessary), but include standpoints, perceptions and interests of different actors and stakeholders. HOEKSTRA underlines the importance of qualitative analysis for an integrated assessment.

One issue of broad consensus among the workshop participants is the use of models and scenarios in this context to keep the balance between society and science to identify problems and consequences in different societal areas. LIEHR points out that scenarios are important for taking different interests of different actors into account. By providing quantitative analysis and qualitative descriptions, scenarios enable the development of consistent pictures. They allow the identification of opportunities and corridors of potential developments. Scenarios show limits respective feasible development paths and can thus be utilised as an instrument of communication (and also of critique) under the question of "what is acutely the best for society".

For models and scenarios, assumptions must be specified: What are the objectives (for example, whether it is a single objective and/or based on different policies).

What are the opportunities and constraints? Exogenous and endogenous variables must be taken into account.

BECKER and SALAMEH remark that it has to be kept in mind that water issues are not only economic and political issues – they are also environmental, national and emotional ones. This circumstance is taken into account in LIEHR's considerations about indicators. On the other hand the argument was put forward that VWT is already a form of adaptation of a certain situation of a country. Countries have different starting points to import or export Virtual Water. For some it is water scarcity, in other countries it is simply an issue of prosperity. In most cases it is driven by economic factors. Therefore a blue print which can be used for all countries and regions is impossible.

V. Concluding remarks

The workshop provided a comprehensive picture of the concept of virtual water trade and a better understanding of its implications and potentials. Some significant points of discussion shall be highlighted:

The virtual water trade concept emphasises existing mismatches between water availability and water demand and seeks to satisfy demand by the use of new forms of resource allocation. Thus, the virtual water trade concept can complement existing approaches of demand side management.

It became apparent at the workshop that the application of the distinction between “blue” and “green” water on virtual water balances is a relatively new development in research. For the examination of virtual water the distinction provides more information about the modes of water use and an additional dimension for the evaluation of the water contents of the specific products, i.e. the weighting of both water forms.

Another important topic is the twofold notion of virtual water trade as a descriptive-analytical concept on the one hand, and a prescriptive/ strategic concept on the other hand. As descriptive-analytical concept VWT can be regarded as an instrument which allows an integrated problem analysis as well as the identification and the assessment of policy options. As a strategic concept, VWT offers new integrated measures to deal not only with water scarcity but also food security and trade relations. Thereby it has to be considered that bringing the concept into the focus of scientists and politicians means that formerly invisible and silent processes become transparent in an official dispute and discussion. Therewith the processes become more negotiable and potentially permit the participation of different social actors.

In the discussion it became clear that the analysis of the concept’s potentials and limits cannot remain on the global perspective of water balances, but must be specified in a regional perspective. A regionalisation of VWT would mean that virtual water trade is implemented in a defined region, with some regions being exporters, and others being importers of virtual water. Regionalisation implies integration, i.e. an integrated perspective on different sectors. A narrow view on the potentials of VWT for water efficiency is inadequately. Water must be seen in its relation to other sectors, and the impacts of actions referring to water must be considered in their impacts on all other domains of society. Therefore, the specific socio-economic pre-conditions of the respective societies must be carefully analysed, as they dispose of different levels of adaptive capacities to cope with the fundamental changes combined with the implementation of VWT.

For further research this implies a double-sided research desiderate: On the one hand, more quantitative analysis is required in order to describe and analyse the virtual water flows on international, regional and national levels. On the other hand, more qualitative research is needed in order to get deeper insights into the basic conditions of the countries and to assess whether virtual water trade can be an instrument which stimulates – or restricts – development perspectives for the countries. Therefore, decision criteria for courses of action must be developed.