Tele-connections of global catchments through virtual water trade

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1. Advances in research

1.1 Accounting for virtual water flows across sectors and geographical regions

	WR/cap	WR	NVWE	NVWE / WR	NVWE/ WU
	m3/person	106m3	106m3	%	%
Nation	**1737.4**	**2210885.7**	**46627.8**	**2.1%**	**8.4**
The Huang-Huai-Hai region	**331.4**	**103251.4**	**8137.8**	**7.9%**	**11.2**
Beijing, Tianjin, Shanxi, Shandong, Henan					
Northeast	**1195.7**	**128114.4**	**1319.3**	**1.0%**	**2.6**
Liaoning, Jilin, Heilongjiang					
The Yangzi river basin	**961.8**	**624501.0**	**17007.9**	**2.7%**	**9.3**
Shanghai, Jiangsu, Zhejiang, Anhui, Jiangxi, Hubei, Hunan					
South	**2294.0**	**316722.5**	**17735.5**	**5.6%**	**25.7**
Fujian, Guangdong, Hainan					
Southwest	**3157.6**	**782195.3**	**1230.5**	**0.2%**	**1.5**
Guangxi, Chongqing, Sichuan, Guizhou, Yunnan					
Northwest	**2197.9**	**256101.2**	**1196.8**	**0.5%**	**1.2**
Inner Mongolia, Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang					

1.2 Analysis of intra-country virtual water trade strategy to alleviate water scarcity

The virtual water strategy

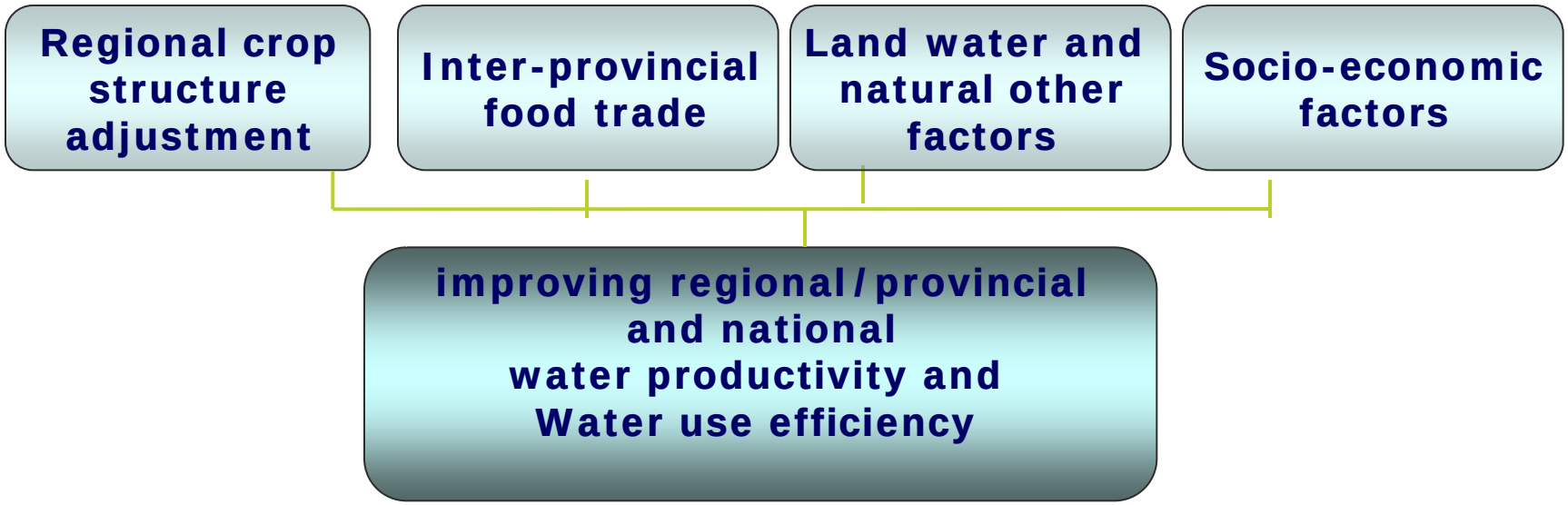
Dimension 1: import water intensive products AND export products with high value of water use (water scarce importer).

Dimension 2: produce water intensive crops in water abundant and high water productivity areas and export to water scarce areas (water rich exporter).

Strategy at the country level: promote regional structural adjustment and inter-regional trade based on comparative advantages (considering water endowments and other factors).

Multi-Criteria Analysis

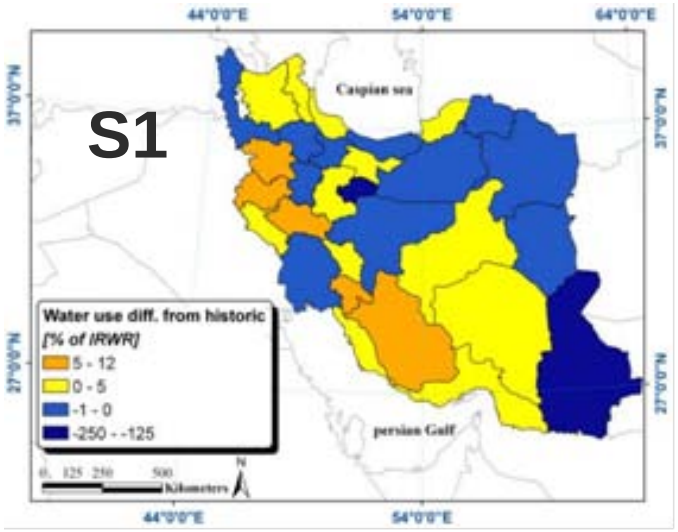
- Assessment of the '***virtual water trade strategy***' to alleviate water stress- case of Iran.

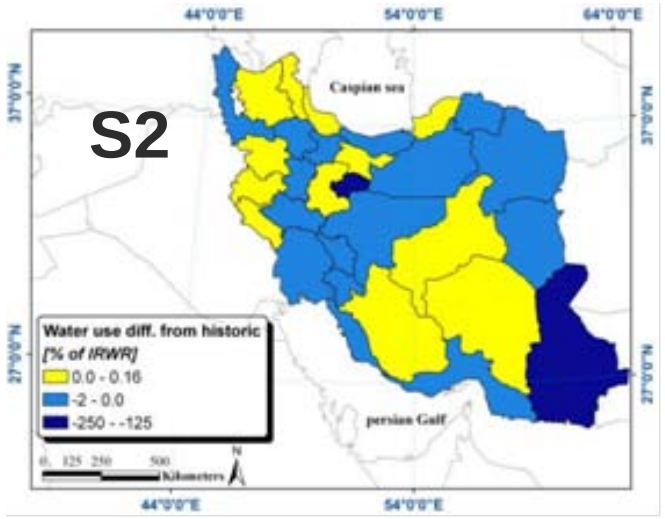


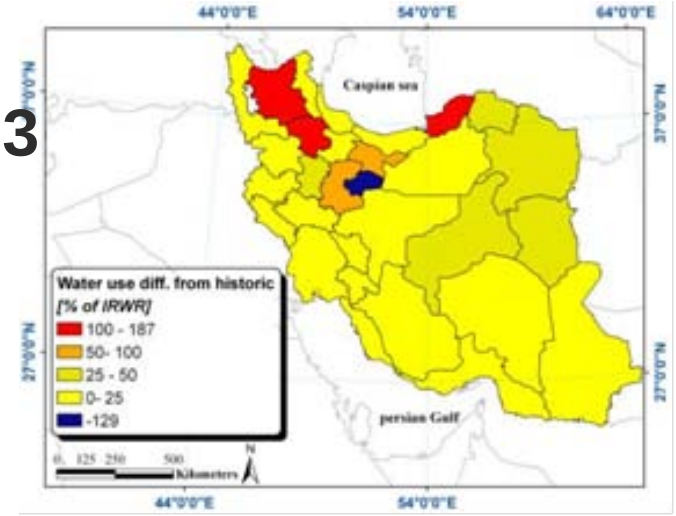
Scenarios and Results

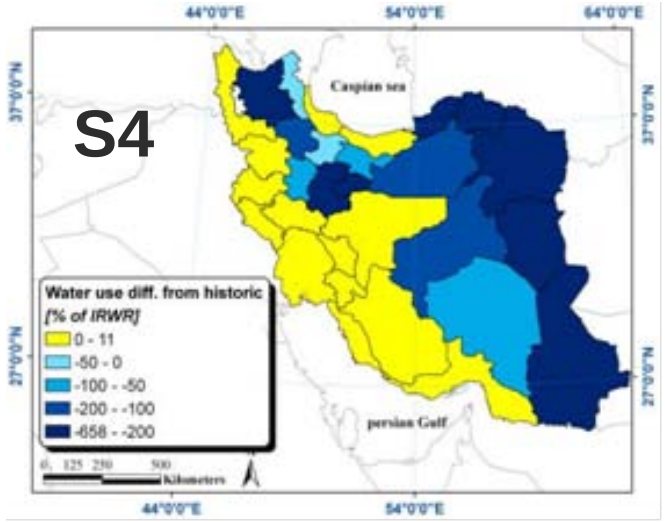
Scenarios	Conditions	Description
S1	Constraints as described in the LP of Table 1	Continuing the historic trend with constraints limited by historical values
S2	*WSR* in 10 water abundant provinces allowed to be higher than historic values, up to a maximum of 0.7 (leaving 30% for environmental flow [*Yuan et al.*, 2009])	Continuing the historic trend while giving flexibility to water use in water abundant provinces for food production
S3	Restrictions on *WSR* were relaxed in all provinces to produce maximum cereal and wheat at self sufficiency level	This scenario is in favour of food security. The practice will of course not be sustainable
S4	Cereal crops were not grown in seven water-scarce provinces where *WSR*>1, and maximized in others, while limiting *WSR* to 1	This scenario is in favour of water security.

Differences in water use as percentage of internal renewable water resources resulting from adjustment in the structure of cropping pattern



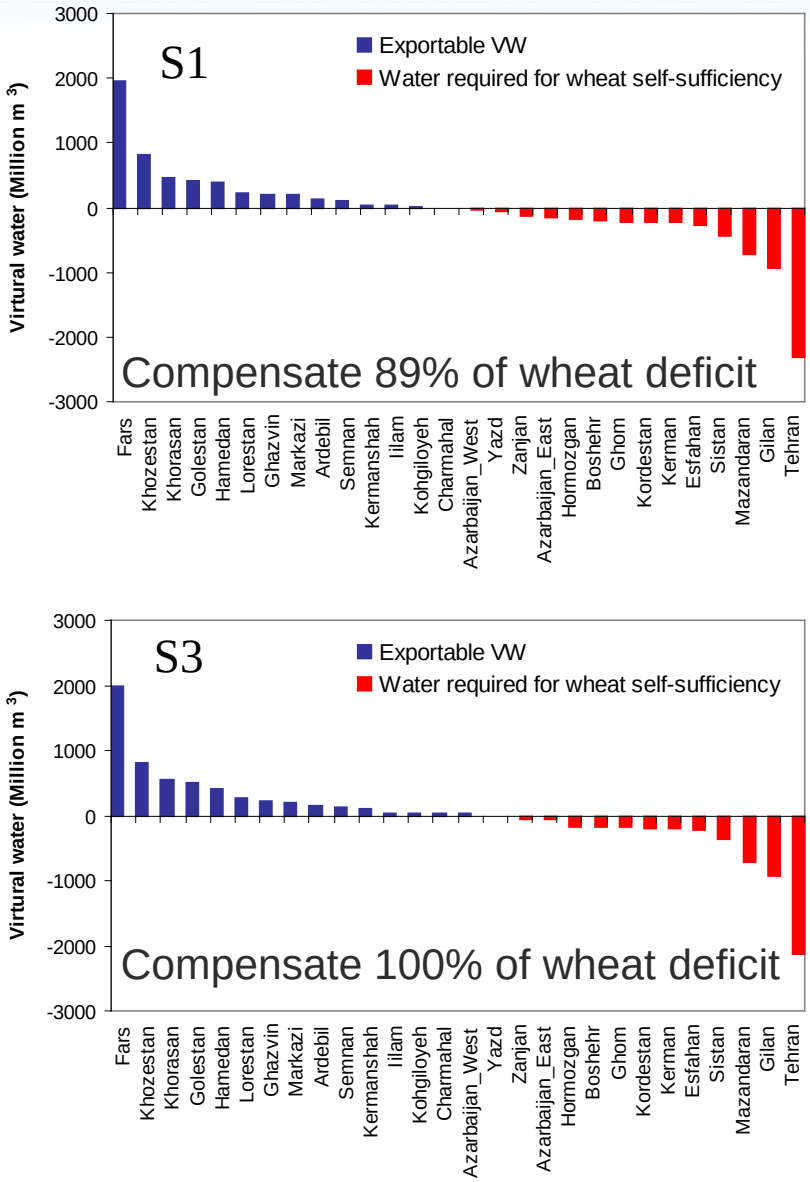


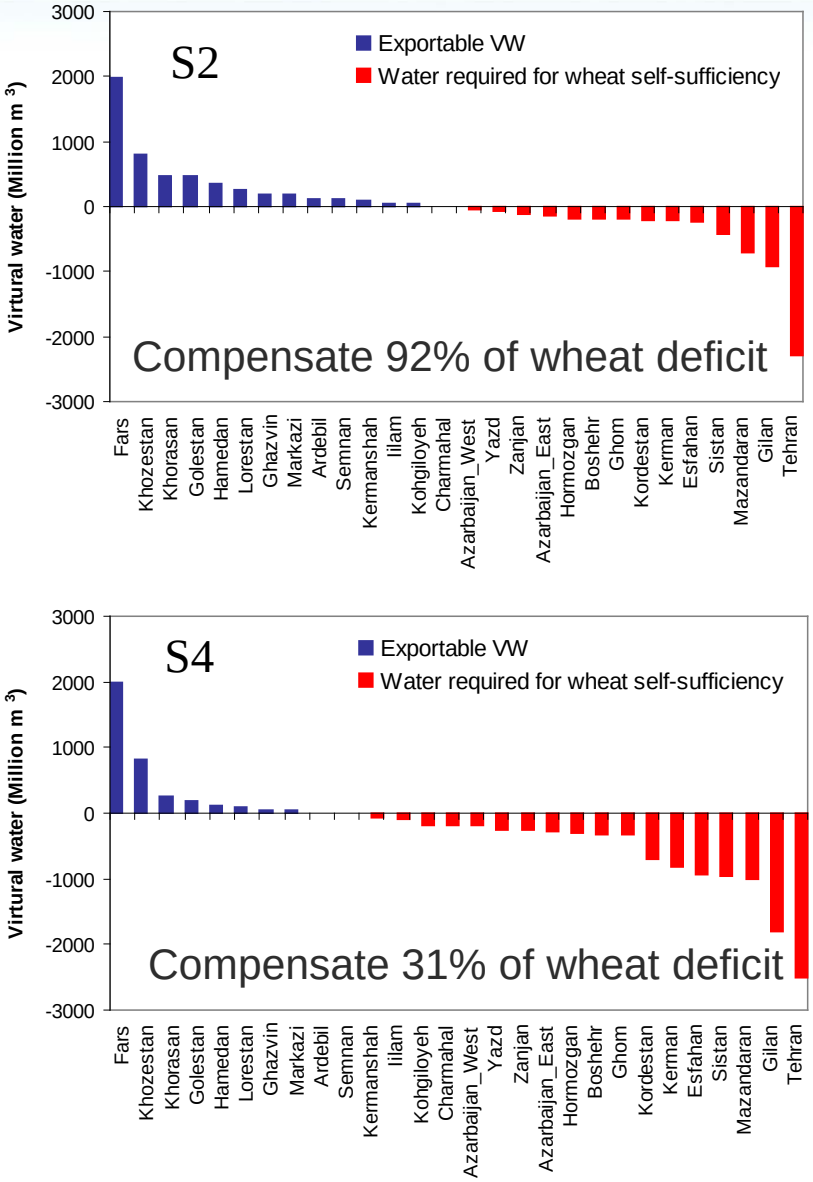




The blue areas show a decrease in water use.

Long-term (1990-2004) average virtual water exported through wheat trade in provinces where excess wheat is produced (blue) and the amount of water required to produce wheat in the importing provinces (red).





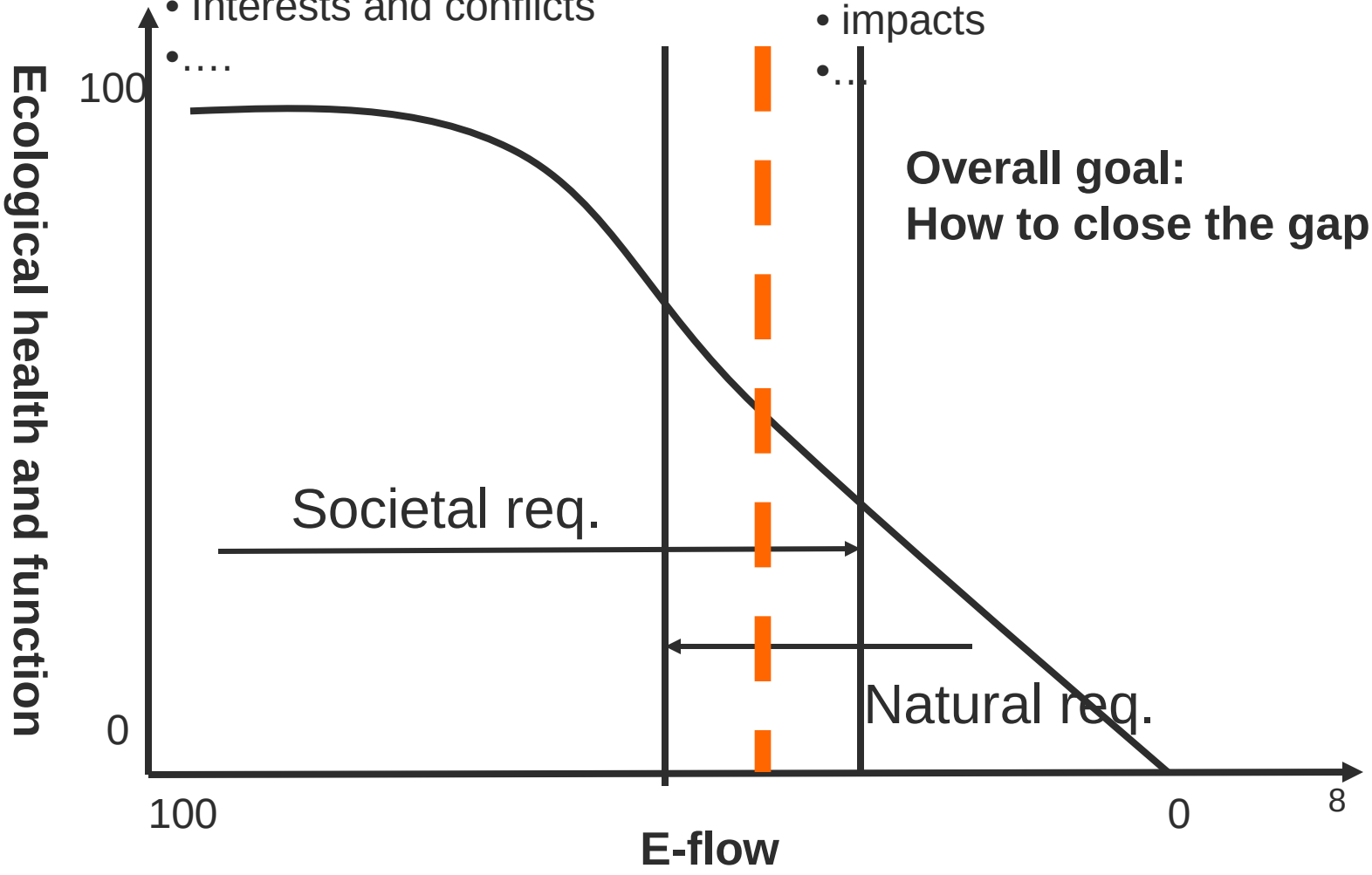
1.3 E-flow requirement

Societal preference and Acceptance

- Institutions (e.g. regulations),
- Policies (market and non-market incentives, price, fee)
- Economic development
- Interests and conflicts
- ….

Manipulate e-flow for sustainable ecosystem service

- reservoir operation
- dam operation
- flow adjustment
- water transfer
- impacts
- …



Overall goal:
How to close the gap

Publications in 2010

Zhao, X, Yang, H., Yang, Z.F., Chen, B., Qin, Y., 2010. 'Applying the input-output method to account for water footprint and virtual water trade in the Haihe River basin in China'. ***Environmental Science & Technology***. doi:/10.1021/es1008.86r.

Faramarzi, M., Yang, H., Mousavi, J., Schulin, R., Binder, C., Abbaspour, K., 2010. 'Analysis of Intra-country Virtual Water Trade Strategy to Alleviate Water Scarcity in Iran'. ***Hydrology and Earth Systems Sciences***. 14: 1417-1433, 2010.

Faramarzi, M., Yang, H. Schulin, R., Abbaspour, C.A., 2010. 'Modeling wheat yield and crop water productivity in Iran: Implications of agricultural water management for wheat production'. ***Agricultural Water Management***, 97(11): 1861-1875.

Liu, J. G., Yang, H., 2010. 'Spatially explicit assessment of global consumptive water uses in cropland: green and blue water. ***Journal of Hydrology***. 384: 187-197.

Liu, J.G., You, L.Z., Amini, M., Obersteiner, M., Herrero, M., Zehnder, A.J.B., Yang, H. 2010. A high-resolution assessment on global nitrogen flows in cropland. ***PNAS***. doi:/10.1073/pnas.0913658107.

Wei, S.K., Yang, H., Abbaspour, K., Mousavi, J., Gnauck, A., 2010. 'Game theory based modes to analyze water conflicts in the Middle Route of the South-to-North Water Transfer Project in China'. ***Water Research***. doi:10.1016/j.watres.2010.01.021.

Yang, H., Zhou, Y., Abbaspour, K., 2010.'An analysis of economic growth and

2. Other activities

Strategic workshop on 'accounting for water scarcity and pollution in rules of international trade'.

Organizer: University of Twente, UNEP and European Science Foundation.

Time: 25-26, November 2010, Amsterdam

Objectives:

- To develop guidelines on how to incorporate virtual-water trade knowledge into international trade regulations in order to increase global water-use efficiency and achieve a sustainable water management at a global level;
- Publication of the main scientific and policy-relevant conclusions of the strategic workshop as an ESF Science Policy Briefing.

Other activities :

Guest editor of a special issue on Water for the journal Economic Systems Research: Input-Output approaches to quantify water and virtual water flows across sections and regions.

A report on water footprint of consumption of goods and services and sources of the virtual water in Switzerland (EU?) (for public education)

EU projects, national projects, bilateral collaborative projects, (EU proposal on drought adaptation)

Research on climate change adaptation, focus on water scarcity and drought in Africa and China,

'Socialization of research' – knowledge dissemination on behalf of GWSP, workshops, training courses, side event in conferences