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Virtual water flows associated with food trade and implications for efficient utilization of global and regional water resources

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1. Interpretation on global water saving associated with virtual water trade and implications for global water policy

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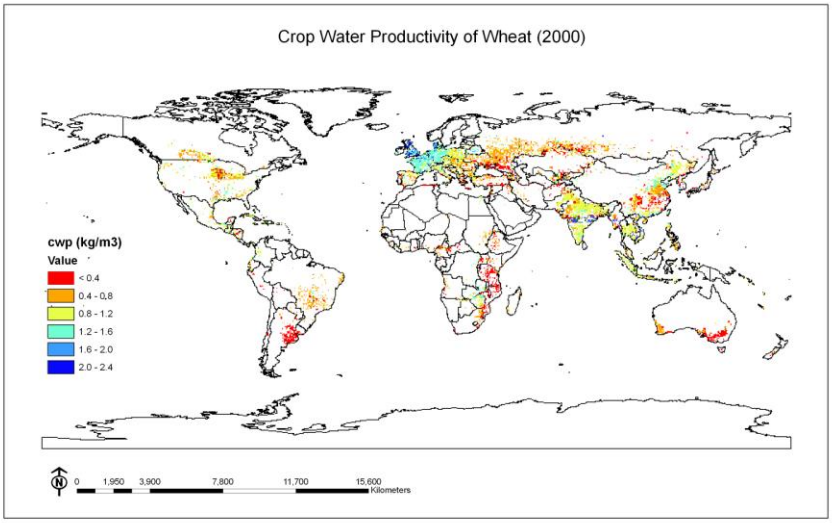
Virtual water content **(m^3/kg)** is a function of climate conditions, agronomic practices, field management, etc. (the inversion of crop water productivity)

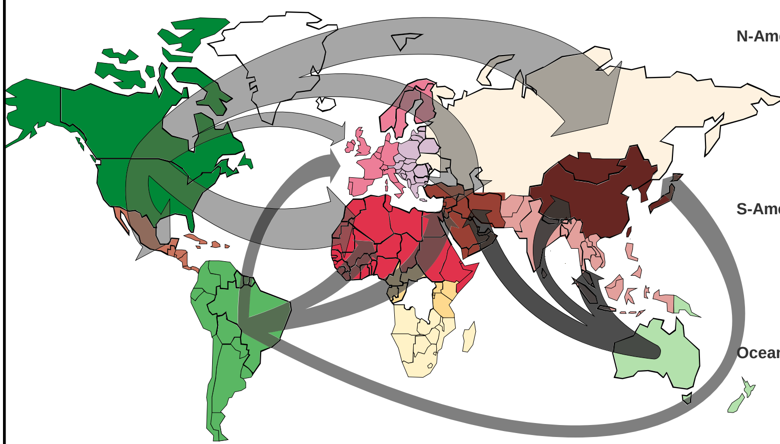
		VWC(m^3/kg)	WP(kg/m^3)
Wheat:	USA	1.30	0.77
	Morocco	4.14	0.24
	Algeria	7.22	0.14
Maize:	France	0.35	2.85
	USA	0.38	2.63
	Mexico	1.34	0.75
Rice:	China	1.07	0.94
	Thailand	4.05	0.25
	USA	1.33	0.75

2

Global map of water productivity of wheat, estimated with GEPIC (GIS based EPIC model) (1998-2002)



Virtual water flows (food crops) from export and import perspectives (Yang et al., 2006)



Exporter	VW (km^3)	Importer	VW (km^3)
N-America	73	E-Asia	149
	30	C-Am.	64
	22	N-W-Af.	58
	17	M-East	55
	12	W-Eur.	17
	27	Others	71
S-America	30	W-Eur.	26
	21	E-Asia	25
	18	M-East	35
	12	N-W-Af.	21
	15	Others	38
Oceania	15	E. Asia	20
	11	S-E-Asia	24
	10	M-East	14
	13	Others	24

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Global virtual water trade from import and export perspectives (1998-2002)

Crops	Global gross virtual water import (km^3 $year^{-1}$)	Global gross virtual water export (km^3 $year^{-1}$)	Global water saving	
			Volume (km^3 $year^{-1}$)	Ratio of water saving to virtual water import
Wheat	318.8	188.4	130.3	40.9
Rice	53.5	63.2	-10.1	-18.8
Maize	97.3	39.5	57.4	59.0
Barley	55.1	31.7	20.1	36.4
Soybean	104.9	67.3	37.1	35.3
Others**	351.1	249.2	101.9	29.0
Total	980.7	644.0	336.8	34.3

5

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Impact of WP change on the volume of water saving

WP change	Export virtual water (km^3/year)	Import virtual water (km^3/year)	Water saving (km^3/year)
-20%	644.1	1225.9	581.8
-10%	644.1	1089.7	445.6
-5%	644.1	1032.3	388.2
Baseline 100%	644.1	980.7	336.6
5%	644.1	932.0	287.9
10%	644.1	882.9	238.8
20%	644.1	784.8	140.7

6

Questions and implications:

- Is the volume of global water saving *per se* a indicator for global water use efficiency associated with trade?
- What is the appropriate context within which the virtual water trade may be promoted as a means of improving global water use efficiency?

2. Niche of virtual water trade in the international trade systems

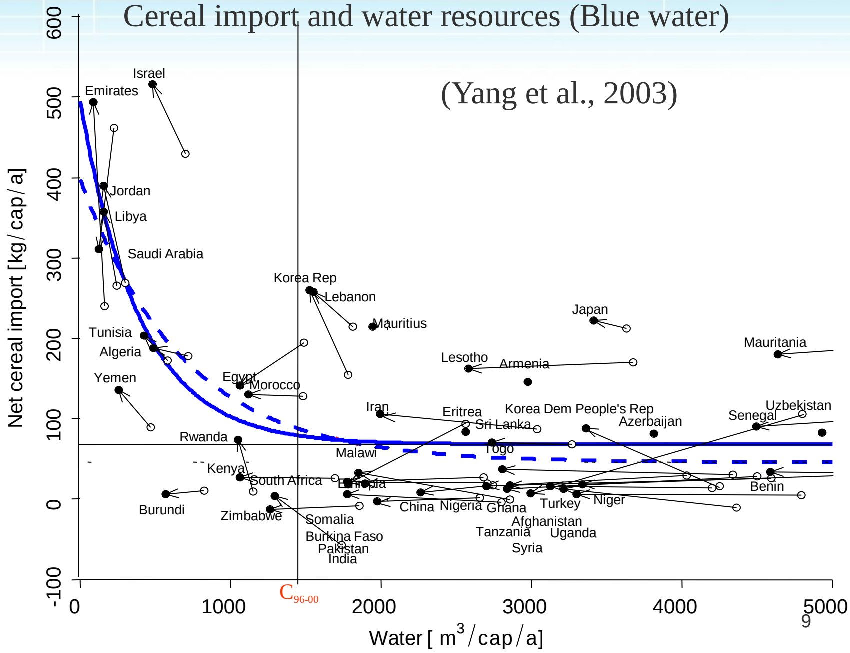
Net virtual water import by country groups, average of 1997-2001 (importing side).

	All net virtual water import countries	Of which, Countries with water availability below 1700m^3/capita. year	Of which, Countries with water availability between 1700-2500m^3/capita. year	Of which, Countries with water availability above 2500m^3/capita. year
Net virtual water import, km^3/year	715.5	145.8	82.1	487.1
As percentage of total net virtual water import, %	100	20.4	11.5	68.1

Not all the food trade is related to water scarcity

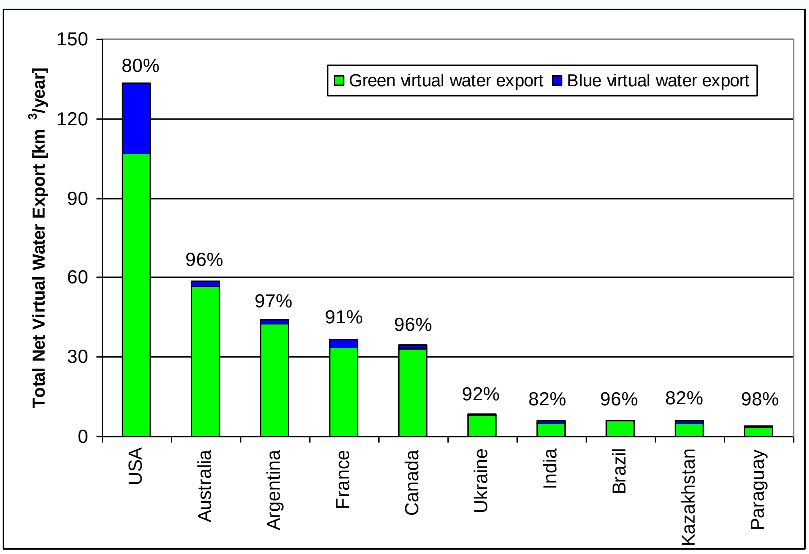
Cereal import and water resources (Blue water)

(Yang et al., 2003)



9

Blue and green virtual water export



10

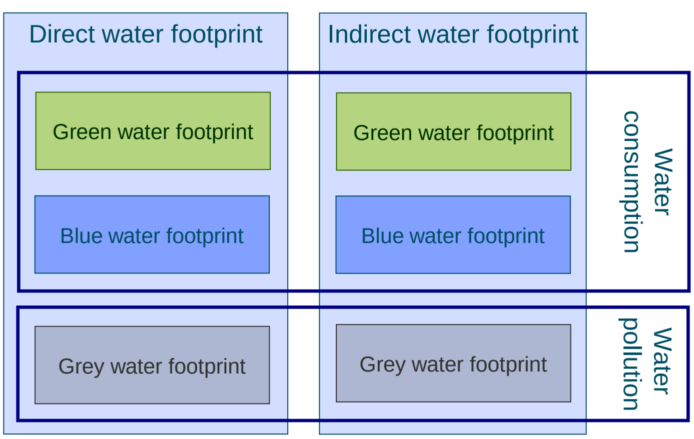
Questions and implications:

- How can or should we differentiate virtual water trade from international food trade?
- What is the scope and niche of virtual water study?
- How to address the special characteristics of water resources as an economic good in virtual water study?

11

3. Grey water in WFP accounting

TWFP = GreenWFP+BlueWFP+GreyWFP?



Different dimensions

12

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Water pollution is one of the contributors to water scarcity

As a world 'Manufacture factory', China is making a big 'dirty' footprint on its water bodies

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Questions and implications:

- How to appropriately incorporate grey water in water footprint accounting?
- Blue, green and grey separately?

14

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Thank you!

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