การอบรมเชิงปฏิบัติการ

“การประเมินค่า Water Footprint ในอุตสาหกรรมอาหารของไทย”

วันที่ 30 – 31 มีนาคม 2558 เวลา 09.30 – 15.30 น.

ณ ห้องกรุงธนบอลรูม โรงแรมรอยัลริเวอร์





โดย มหาวิทยาลัยธรรมศาสตร์ และมหาวิทยาลัยเกษตรศาสตร์

และสถาบันอาหาร (National Food Institute)

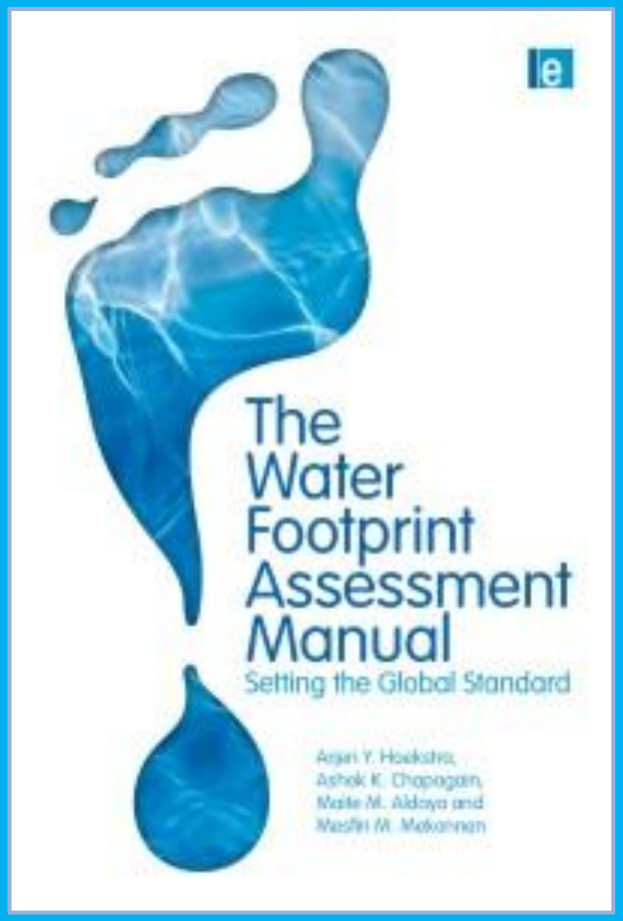
หัวข้อการบรรยาย

30 มีนาคม 2558

- ที่มาและหลักการประเมินวอเตอร์ฟุตพริ้นท์ของผลิตภัณฑ์
- หลักการประเมินวัฏจักรชีวิตของผลิตภัณฑ์ (LCA)
- การกำหนดเป้าหมายและขอบเขตของการประเมินวัฏจักรชีวิต
- การเก็บข้อมูลและจัดทำบัญชีรายการสิ่งแวดล้อม

31 มีนาคม 2558

- การประเมินวัฏจักรชีวิตผลิตภัณฑ์และการแปรผล
- การสัมมนาเชิงปฏิบัติการ



Water Footprint

Water Footprint

Growing scarcity of water

While global renewable water resources availability are not changing much over time, global water use has been continuously growing, ...and in the last Century has been growing at more than twice the rate of population increase

Expressions/Indicators:

"*stress conditions*" = 1000-1700 $m^3\ y^{-1}$ $person^{-1}$

"*chronic water scarcity*" = 500-1000 $m^3\ y^{-1}$ $person^{-1}$

"*absolute water scarcity*" <500 $m^3\ y^{-1}$ $person^{-1}$

By 2025: 1.8 B people - in "absolute water scarcity"

Water Footprint

Factors affecting Supply

1. Climatic variability
2. Climate change
3. Degradation of water quality
   - Eutrophication:
   - Municipal and industrial waste streams
   - Animal manure and waste
   - Chemicals, pesticides, pharmaceuticals, heavy metals, etc.

MOSTLY IN URBAN ENVIRONMENT

Water Footprint

Drivers of Demand

1. Population Growth

Basic Water Needs

	(Liters d^{-1} p^{-1})
Drinking	2-4
Domestic	40-400
Food	1000-5000

Water Footprint

Drivers of Demand

2. Urbanization

in 1960	in 2007	in 2050
1/3 Urban	1/2 Urban	2/3 Urban
2/3 Rural	1/2 Rural	1/3 Rural

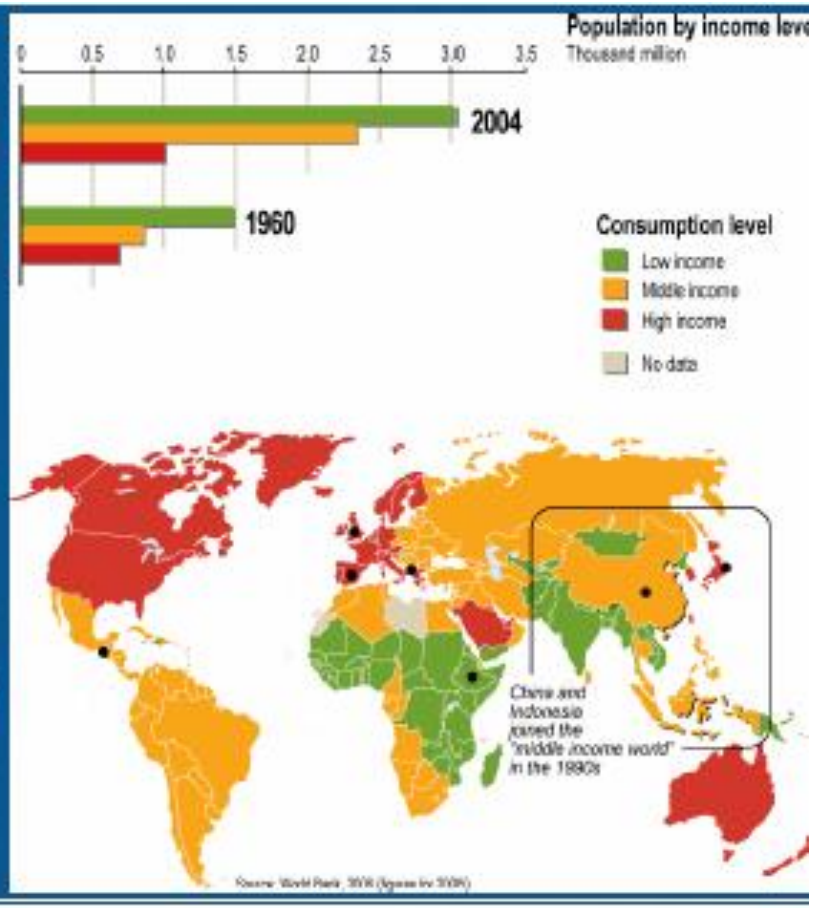
- Changes in dietary preferences
- Concentration of water demand
- Increased per capita water use

Water Footprint

Drivers of Demand

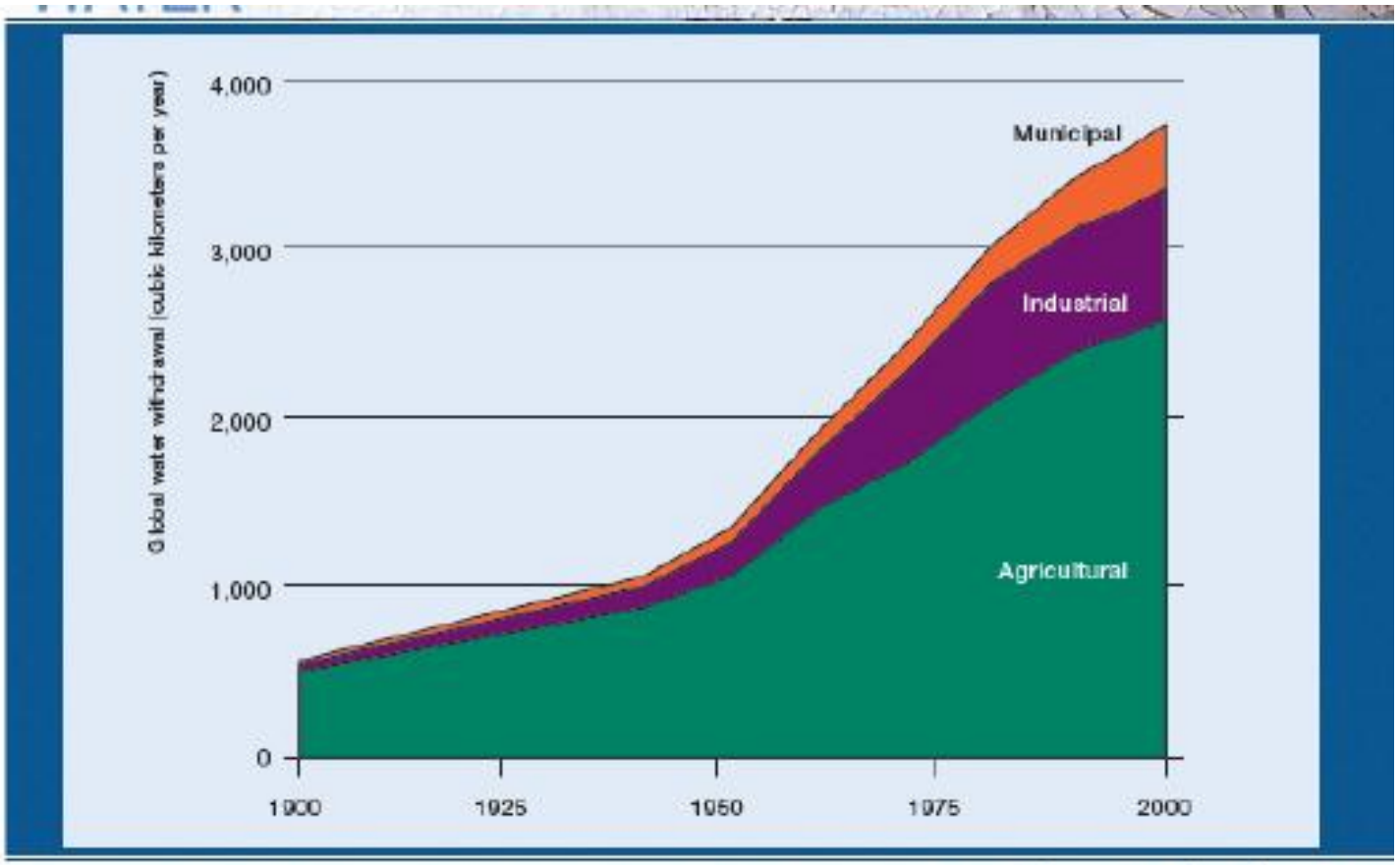
3. Income

- Change in food habits toward richer diets
- Overall increase of demand in products and services
- Higher consumption (including luxury cons.)
- Increase of waste



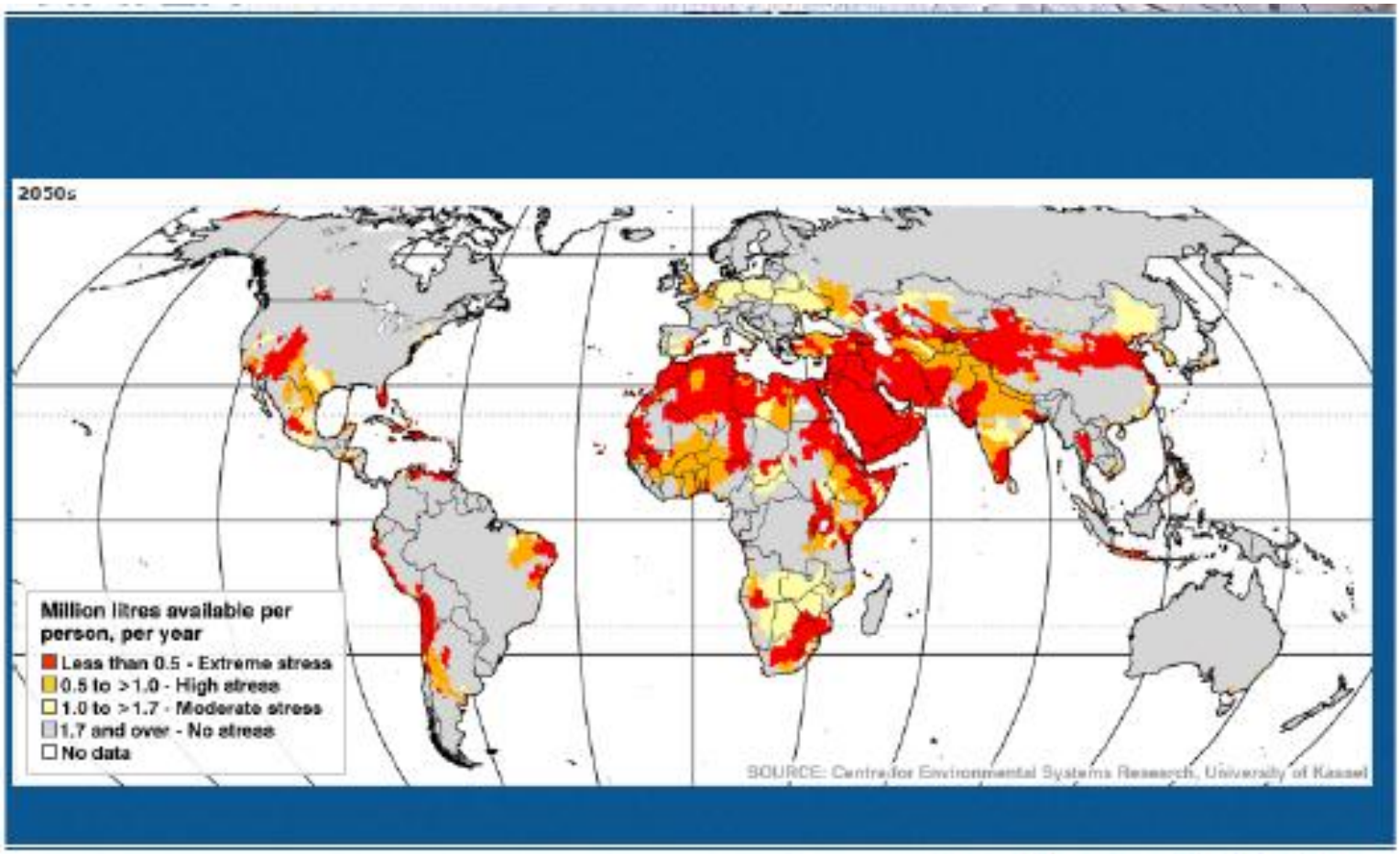
Water Footprint

Demand for water

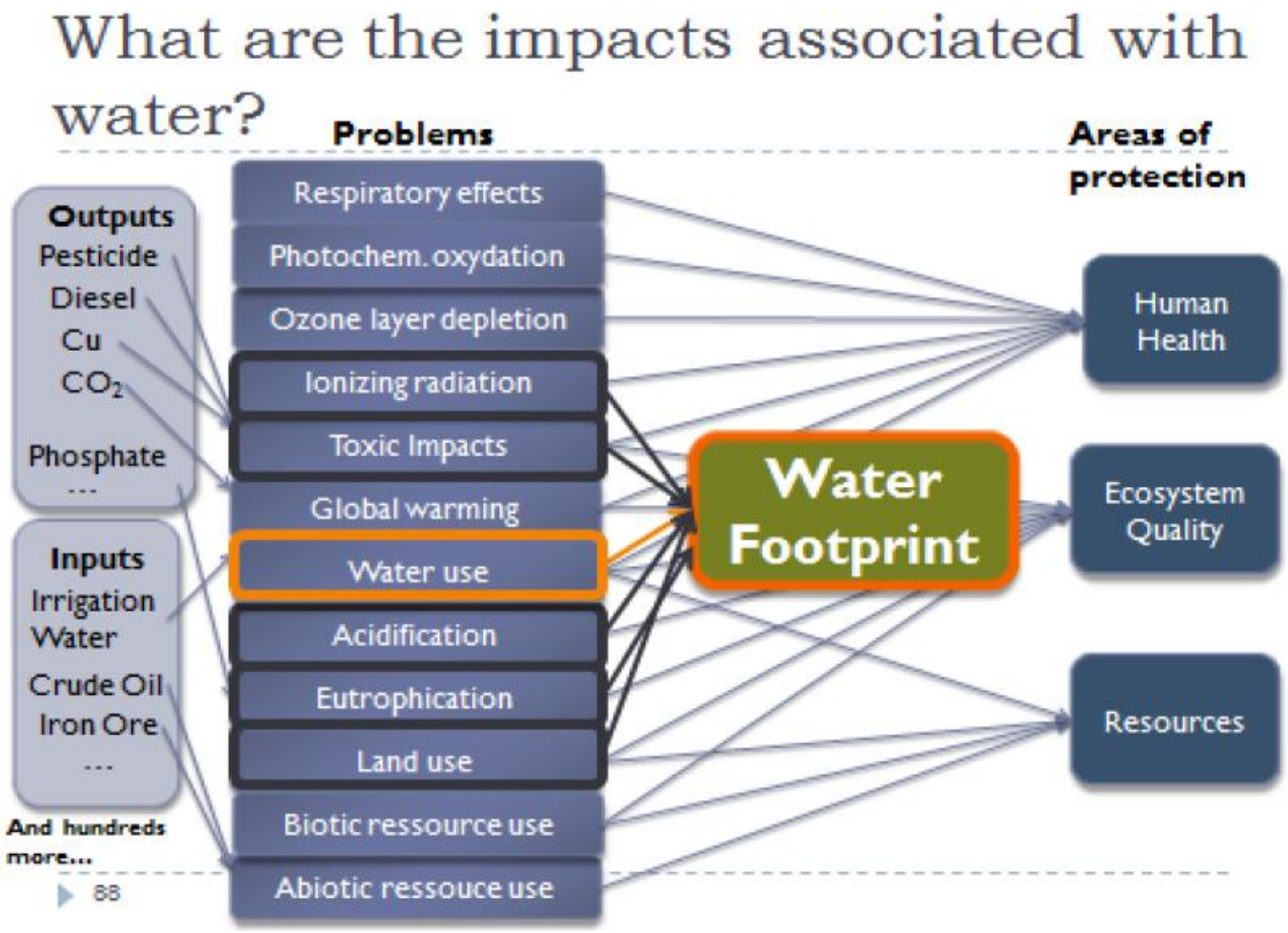


Water Footprint

Level of water stress



Water Footprint

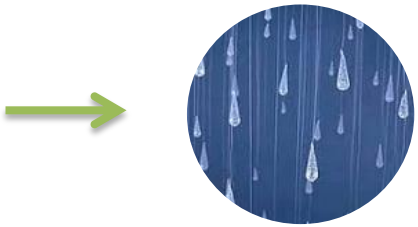


Water Footprint is ?

- **The WF is an indicator of freshwater use that looks at both direct and indirect water use of consumer or producer.**
- **The WF is a geographically and temporally.**

Water Footprint

Green Water Footprint : is the volume of rainwater consumed during the production process.



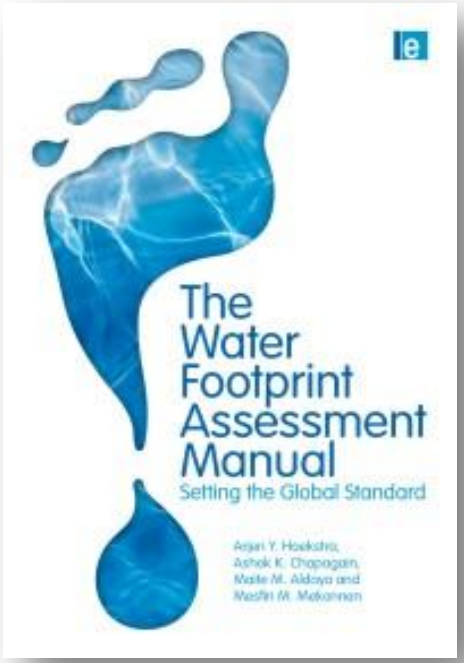
Blue Water Footprint : is an indicator of consumptive use of so-called blue water, i.e. fresh surface or groundwater.

Grey Water Footprint : is an indicator of the degree of freshwater pollution that can be associated with the process step.

Water Footprint

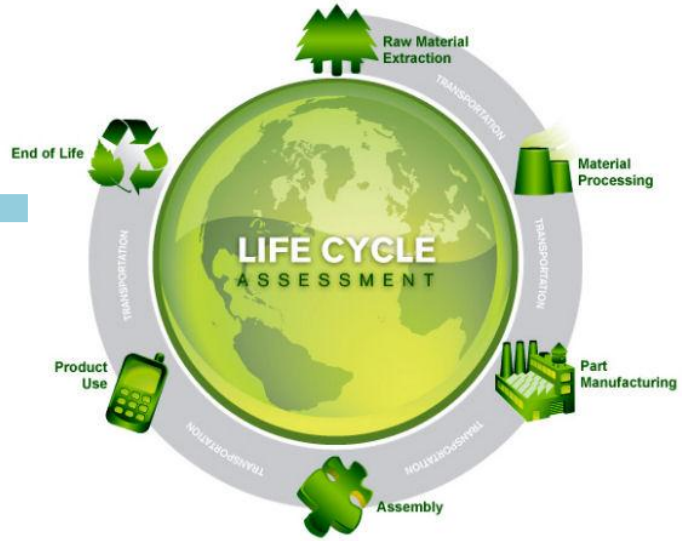
Water Footprint:

WF



Life Cycle Assessment

LCA



Draft

ISO 14046

ISO

What advantages of Water footprint ?

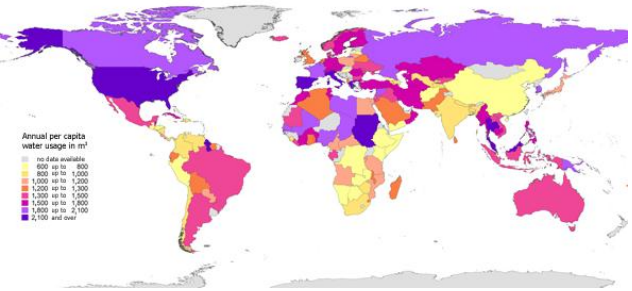
A strong tool for WM

- **Improvement of water management (WM) by**
  - decreasing water demand
  - water saving in HH
- **improving the efficiency of water use (water recycle)**
- **Concentrate more about water depletion or pollution through imported products (water used, leaching)**
- **Awareness raising, policy formulation**

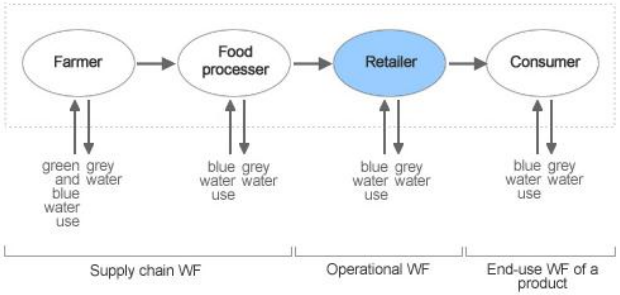
Source: Schreieret al., 2007, Hoekstra et al. 2011

Water Footprint

1. The water footprint of products

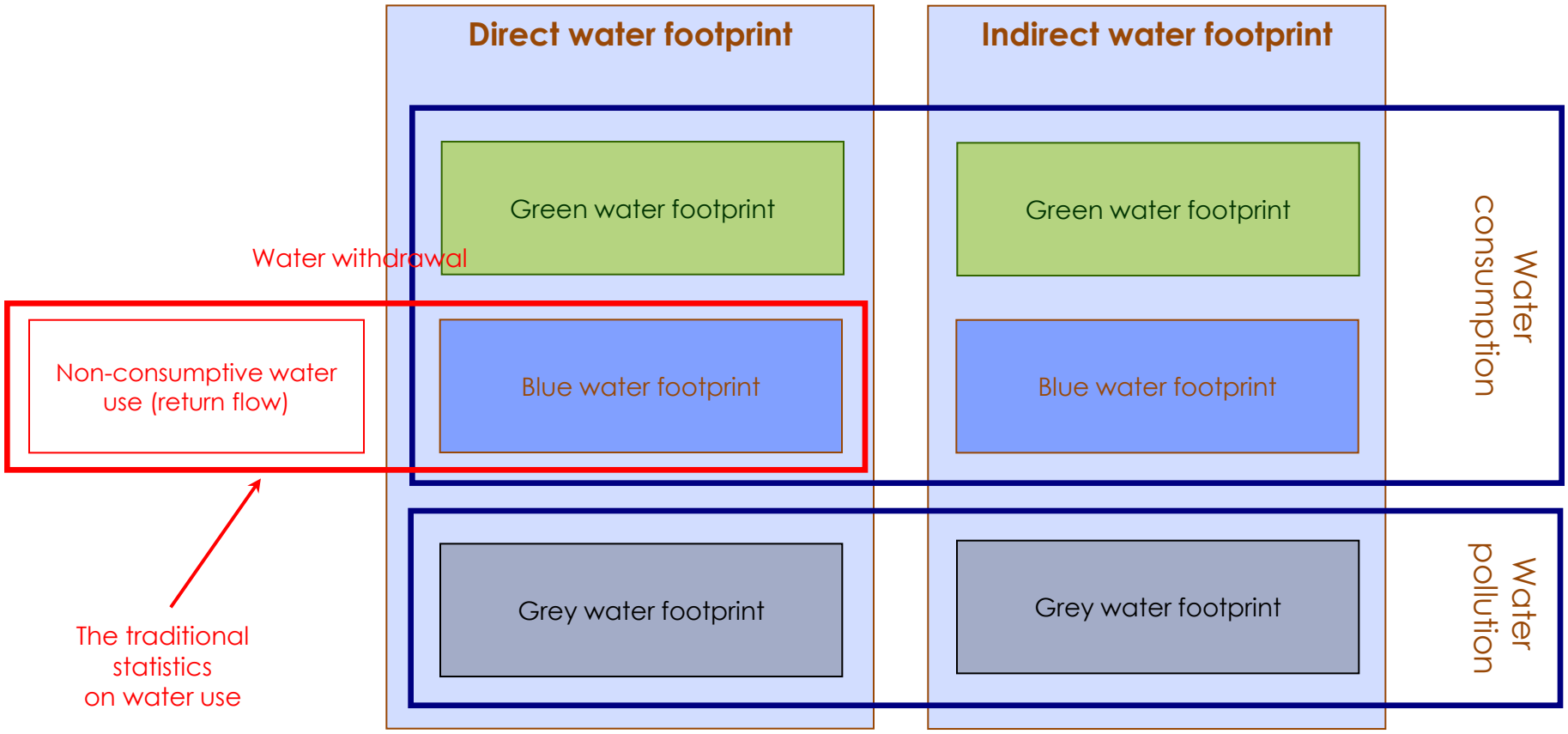


2. The water footprint of a nation



3. The water footprint of a business

Water Footprint of Products



[Hoekstra, 2008]

Water Footprint of Products: Crops

- **Water Footprint of Crops**

The total water footprint of the process of growing crops or trees (*WFproc*) is the sum of the green, blue and grey components:

$$WF_{proc,crop} = WF_{proc,blue} + WF_{proc,green} + WF_{proc,grey}$$

$$WF_{proc,blue} = \frac{CWU_{blue}}{Y}$$

$$WF_{proc,green} = \frac{CWU_{green}}{Y}$$

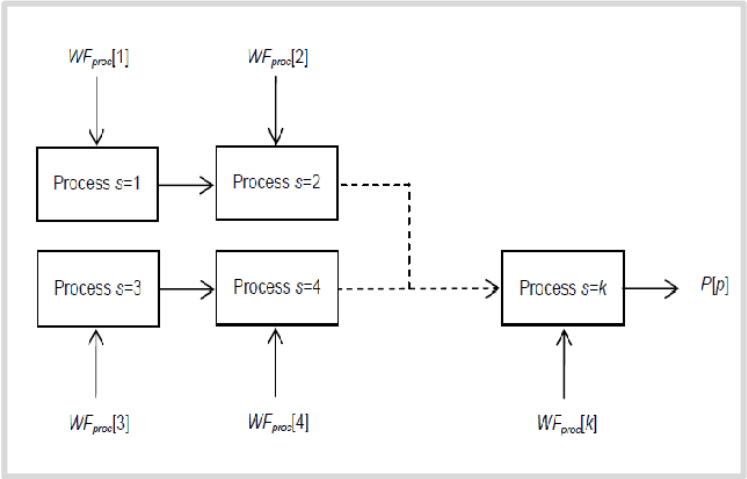
$$WF_{proc,gray} = \frac{(\alpha \times AR)/(C_{max} - C_{natural})}{Y}$$

Water Footprint of Products

- **Water Footprint of Product**

The water footprint of a product can be calculated in two alternative ways: 1) with the chain-summation approach

$$WF_{prod}[p] = \frac{\sum_{s=1}^{k} WF_{proc}[s]}{P[p]}$$

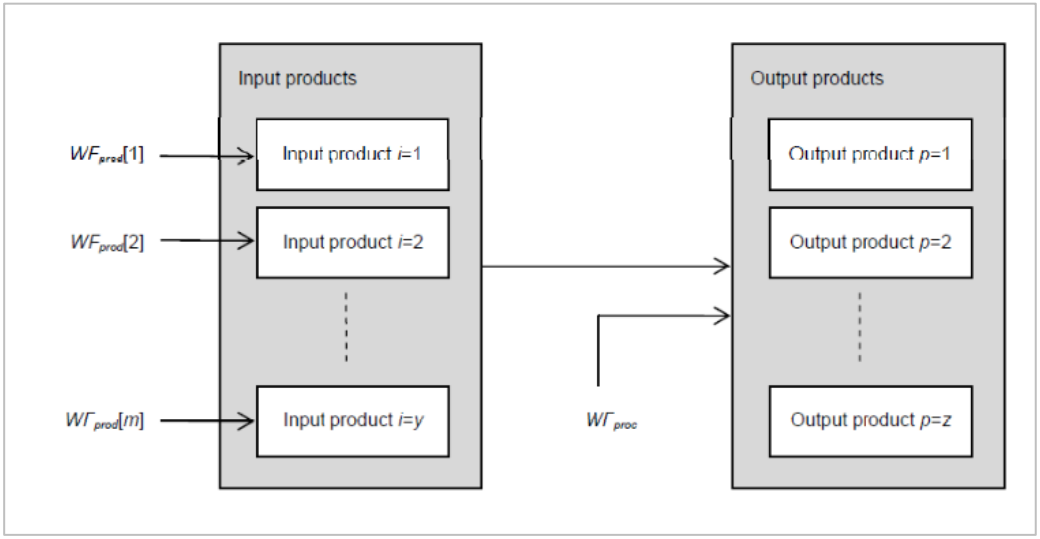


Source: Hoekstra, 2009

Water Footprint of Products

- **Water Footprint of Process**

2. The step-wise accumulative approach



$$WF_{prod}[p] = \left(WF_{proc}[p] + \sum_{i=1}^{y} \frac{WF_{prod}[i]}{f_p[p,i]} \right) \times f_v[p]$$

Source: Hoekstra, 2009

Production chain **cotton**

Cotton plant —Harvesting→ Seed-cotton — Ginning

Ginning → 0.63/0.18 → Cotton seed → Hulling/extraction

Hulling/extraction → 0.16/0.47 → Cotton seed oil → 1.07/1.00 → Cotton seed oil, refined

Hulling/extraction → 0.51/0.33 → Cotton seed cake

Hulling/extraction → 0.10/0.20 → Cotton linters

Ginning → 0.35/0.82 → Cotton lint → 1.00/1.00 → Cotton, not carded or combed → Carding/Spinning

Carding/Spinning → 0.05/0.10 → Garnetted stock

Carding/Spinning → 0.95/0.99 → Cotton, carded or combed (yarn) → Knitting/weaving

Knitting/weaving → 0.95/0.99 → Grey fabric → Wet processing → 1.00/1.00 → Fabric → Finishing → 1.00/1.00 → Final textile

Knitting/weaving → 0.05/0.10 → Yarn waste

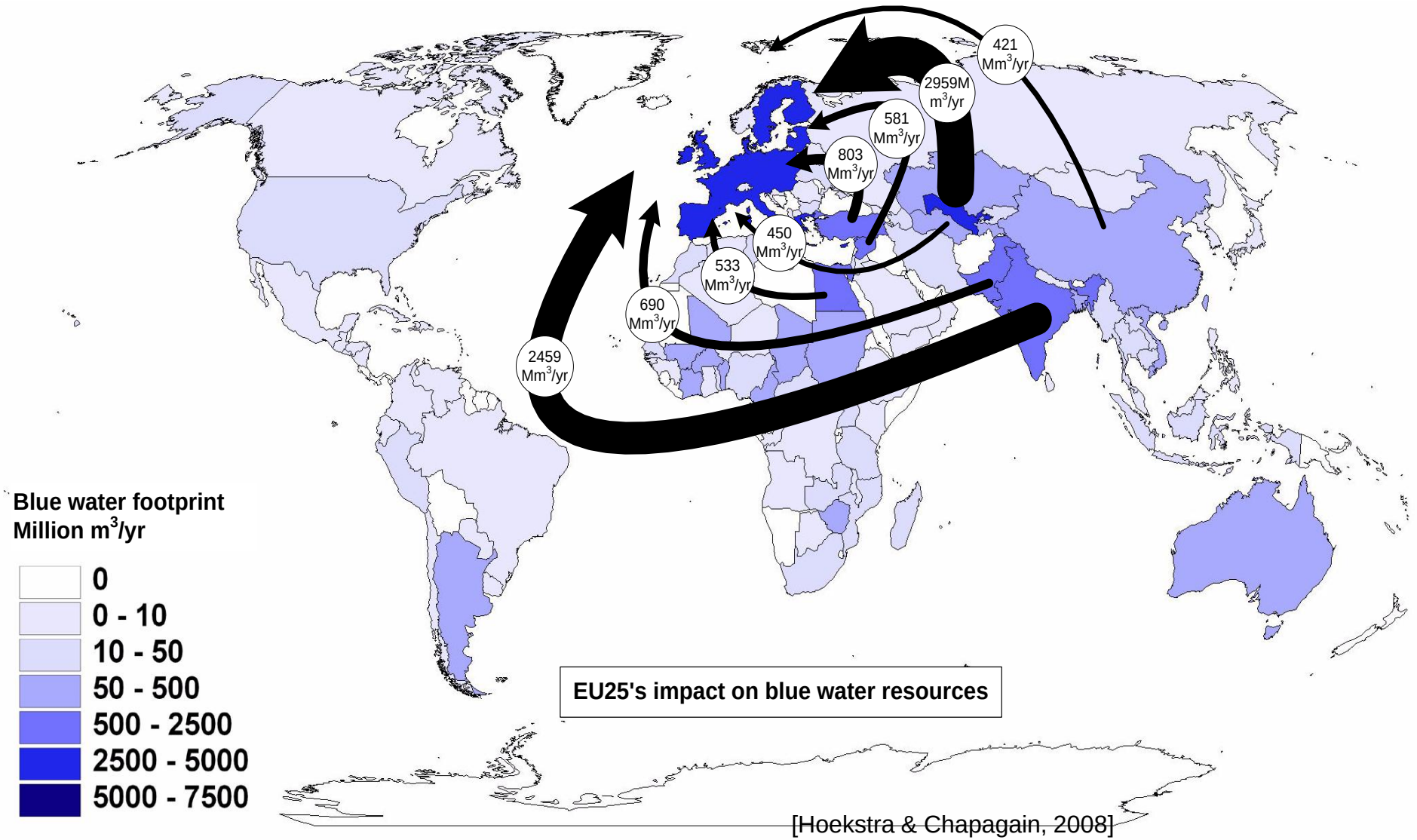
Legend

$\frac{0.35}{0.82}$ ← Product fraction

$\frac{0.35}{0.82}$ ← Value fraction

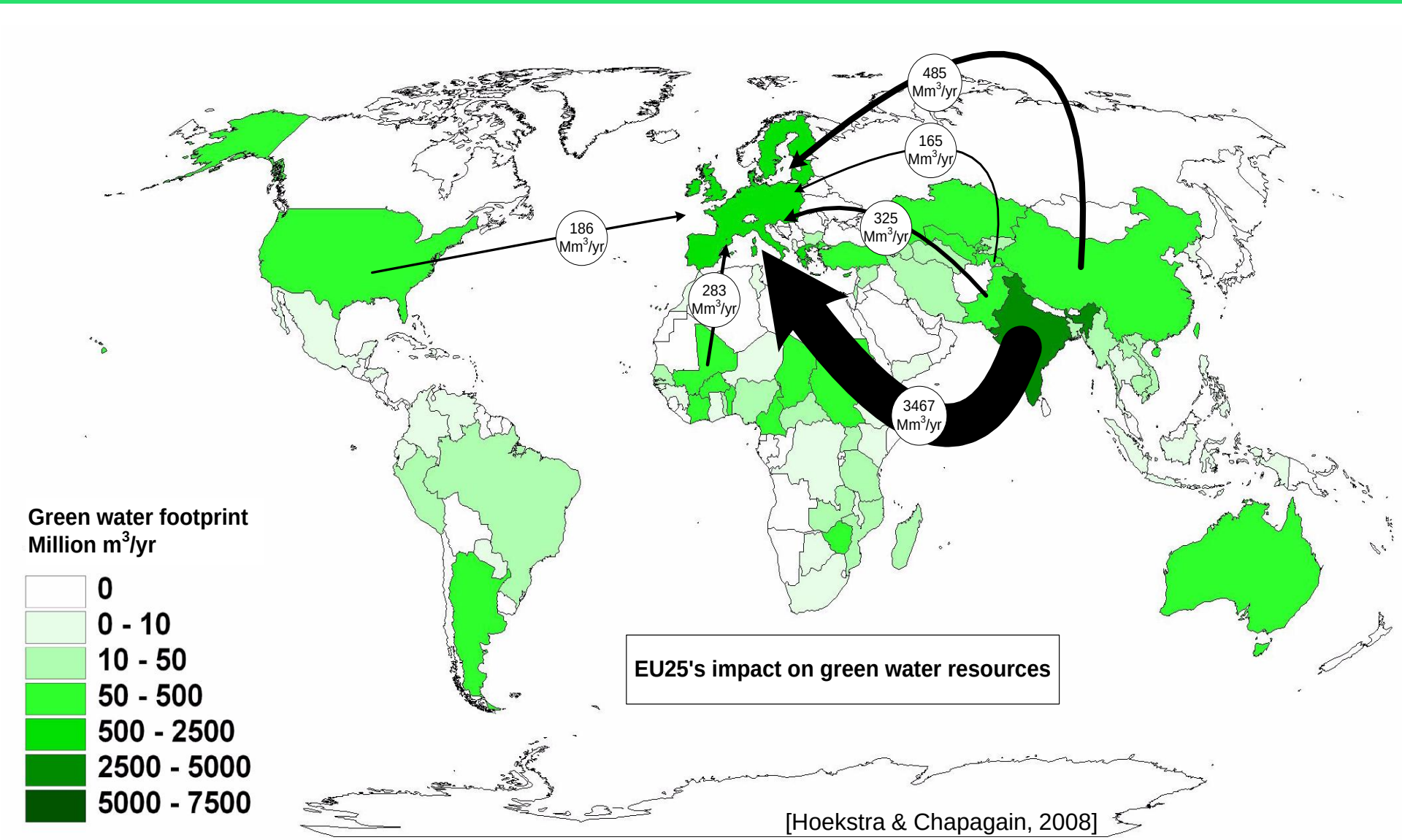
[Hoekstra & Chapagain, 2008]

Water footprint of EU's cotton consumption (blue water)



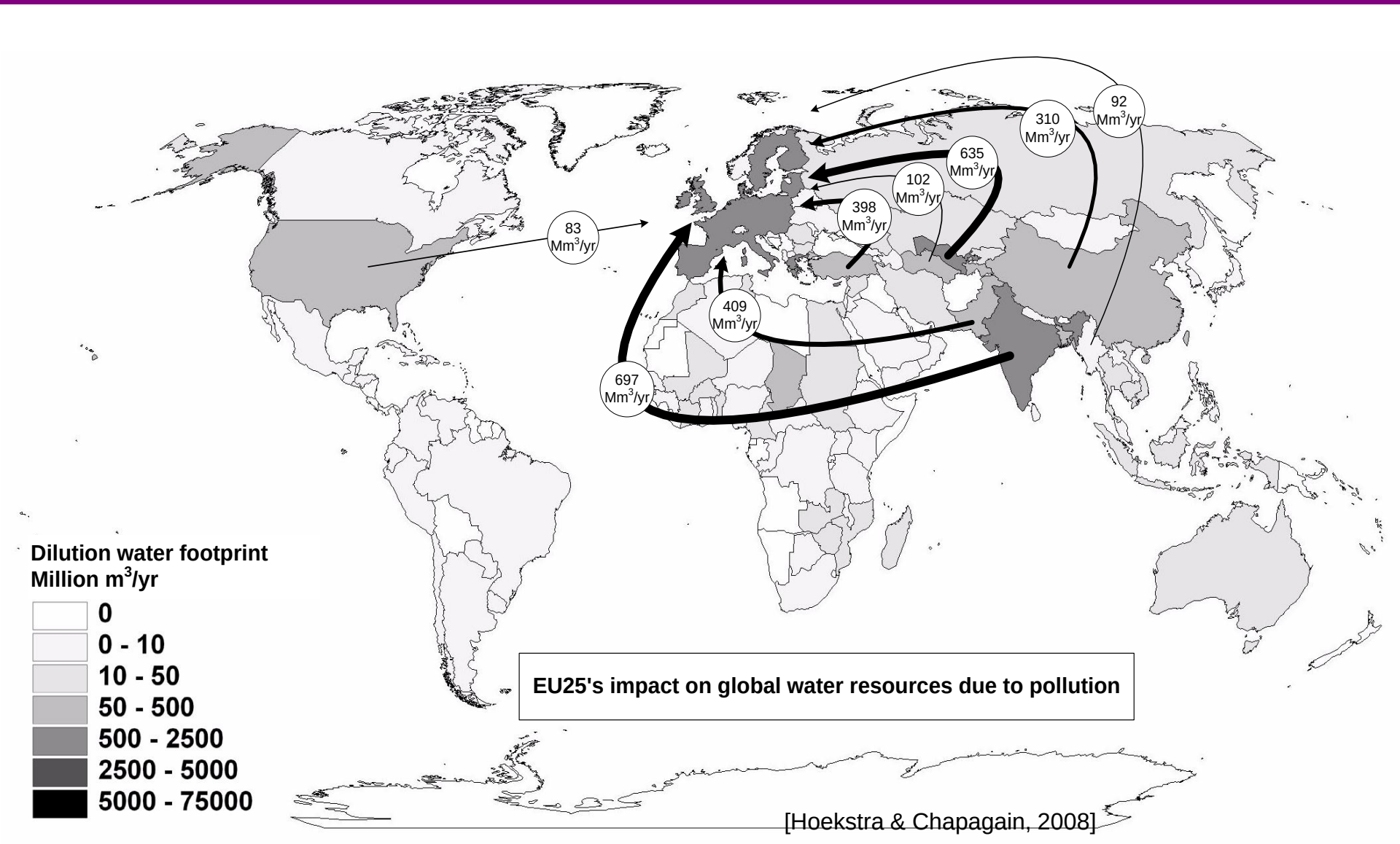
[Hoekstra & Chapagain, 2008]

Water footprint of EU's cotton consumption (green water)



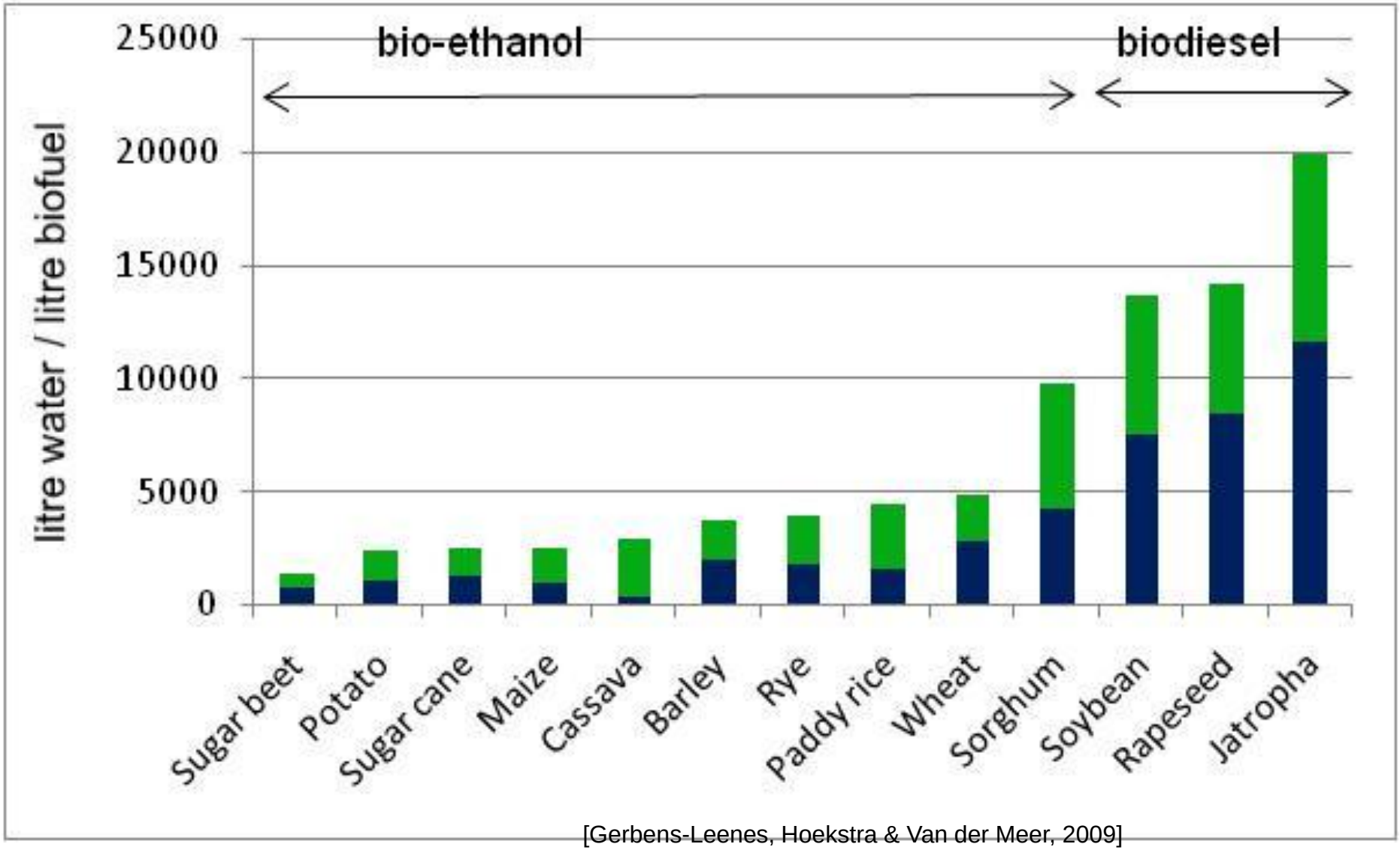
[Hoekstra & Chapagain, 2008]

Water footprint of EU's cotton consumption (grey water)



[Hoekstra & Chapagain, 2008]

Water footprint of biofuels from different crops [litre/litre]



[Gerbens-Leenes, Hoekstra & Van der Meer, 2009]

Example for Water Footprint of Paddy Rice

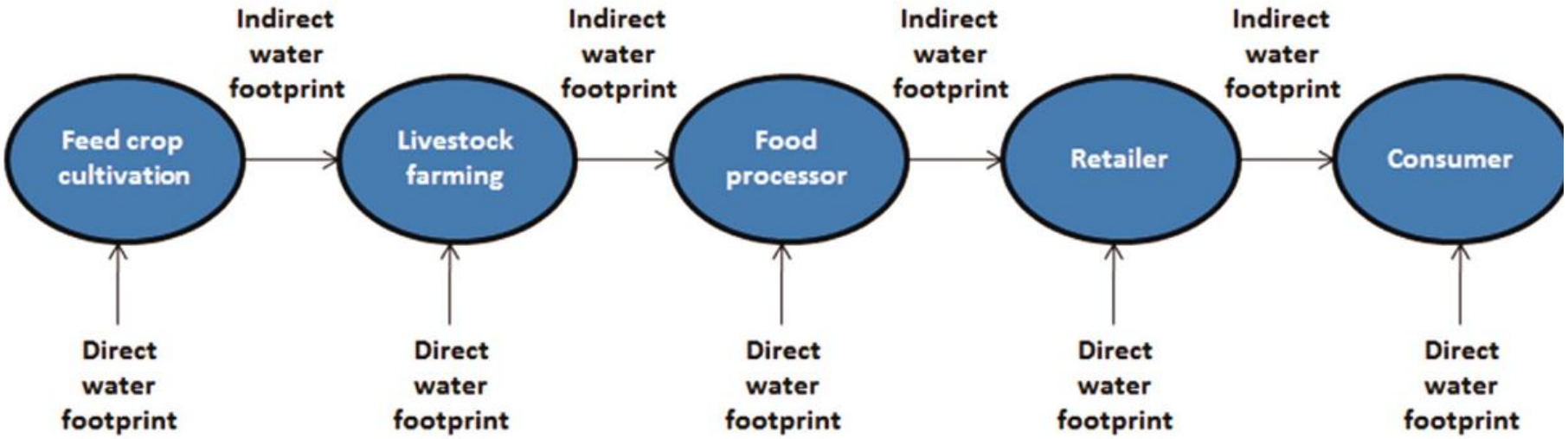
Top-15 of countries with the largest WF of rice consumption during 2000-2004

	Total water footprint (Mm^3/yr)				Water footprint per capita
	Green	Blue	Grey	Total	($m^3/cap/yr$)
India	133,494	102,425	14,385	250,305	239
China	65,154	86,050	20,680	171,884	134
Indonesia	31,097	26,005	6,262	63,364	299
Bangladesh	20,560	21,574	3,846	45,980	317
Thailand	19,640	11,654	2,421	33,714	547
Myanmar	18,989	8,483	1,118	28,591	612
Viet Nam	9,860	6,496	4,074	20,430	256
Philippines	11,736	6,020	1,137	18,893	238
Brazil	9,186	7,869	757	17,812	99
Pakistan	2,480	13,935	521	16,936	117
Japan	4,084	4,923	748	9,755	77
USA	1,924	5,779	719	8,422	29
Egypt	3,467	3,203	599	7,269	105
Nigeria	3,478	3,005	548	7,031	54
Korea, R	2,491	2,732	592	5,814	122

Source: Chapagain *et al.* (2010b)

Example for Water Footprint

The hidden water resource use behind meat and dairy



Example for Water Footprint

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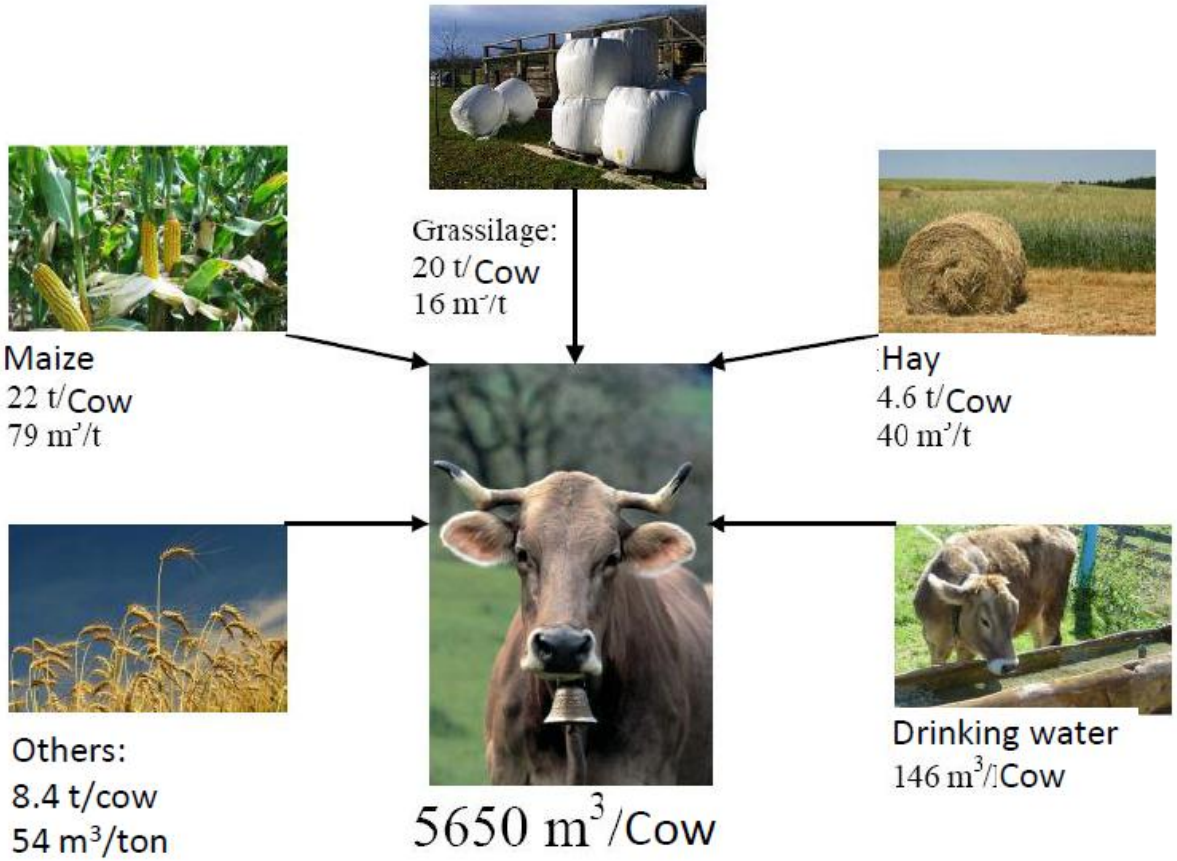
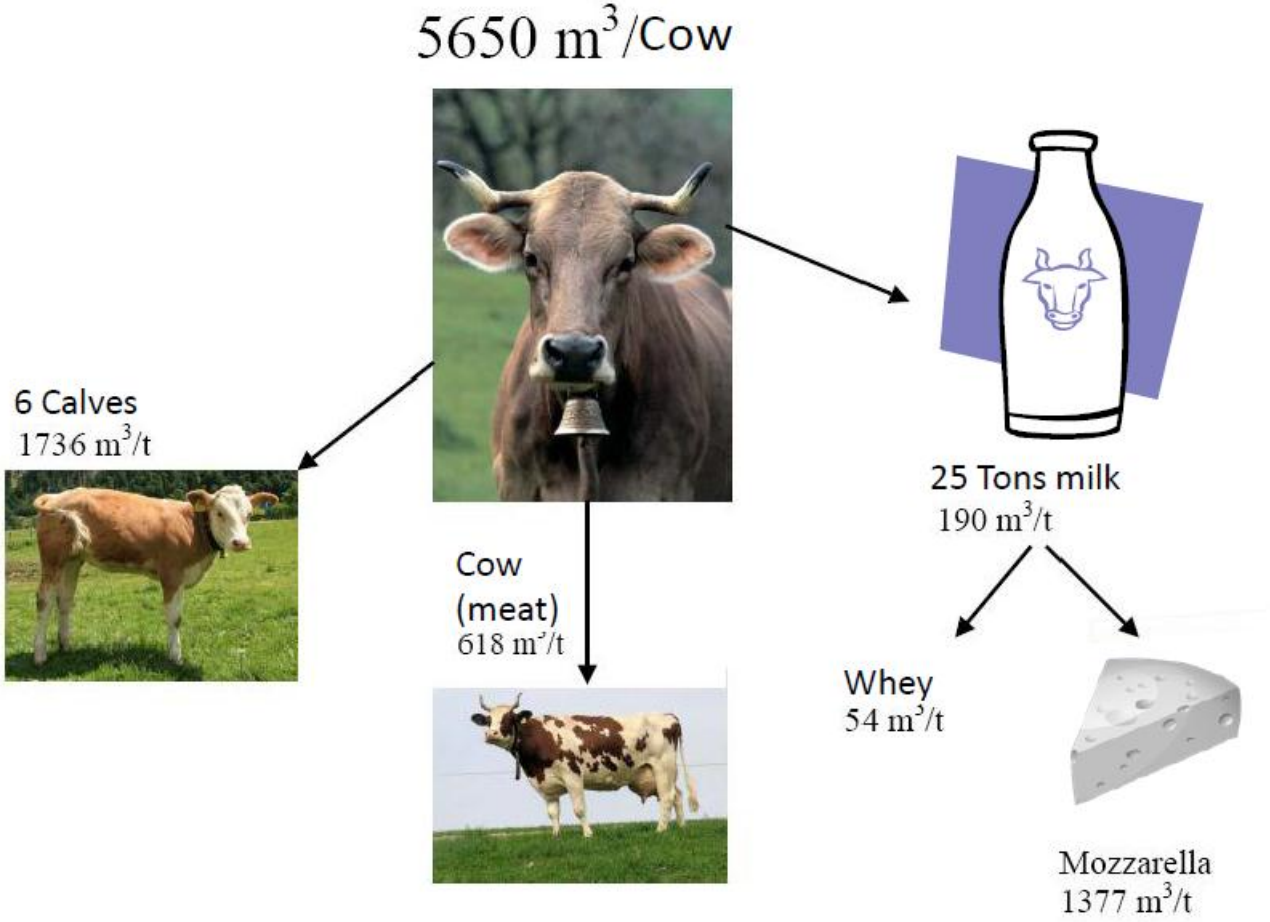


From Dr. Stephan Pfister and Anne-Marie Boulay (2013)

Example for Water Footprint

The hidden water resource use behind meat and dairy



Example for Water Footprint

Table 1. The global-average water footprint of crop and animal product[1]

	Water footprint per unit of weight, L/kg				Nutritional content			Water footprint per unit of nutritional value		
Food item	Green	Blue	Gray	Total	Calories, kcal/kg	Protein, g/kg	Fat, g/kg	Calories, L/kcal	Protein, L/g of protein	Fat, L/g of fat
Sugar crops	130	52	15	197	285	0.0	0.0	0.69	0.0	0.0
Vegetables	194	43	85	322	240	12	2.1	1.34	26	154
Starchy roots	327	16	43	387	827	13	1.7	0.47	31	226
Fruits	726	147	89	962	460	5.3	2.8	2.09	180	348
Cereals	1,232	228	184	1,644	3,208	80	15	0.51	21	112
Oil crops	2,023	220	121	2,364	2,908	146	209	0.81	16	11
Pulses	3,180	141	734	4,055	3,412	215	23	1.19	19	180
Nuts	7,016	1,367	680	9,063	2,500	65	193	3.63	139	47
Milk	863	86	72	1,020	560	33	31	1.82	31	33
Eggs	2,592	244	429	3,265	1,425	111	100	2.29	29	33
Chicken meat	3,545	313	467	4,325	1,440	127	100	3.00	34	43
Butter	4,695	465	393	5,553	7,692	0.0	872	0.72	0.0	6.4
Pig meat	4,907	459	622	5,988	2,786	105	259	2.15	57	23
Sheep or goat meat	8,253	457	53	8,763	2,059	139	163	4.25	63	54
Bovine meat	14,414	550	451	15,415	1,513	138	101	10.19	112	153

Source: Mekonnen and Hoekstra (2010). Reprinted with permission of the authors.

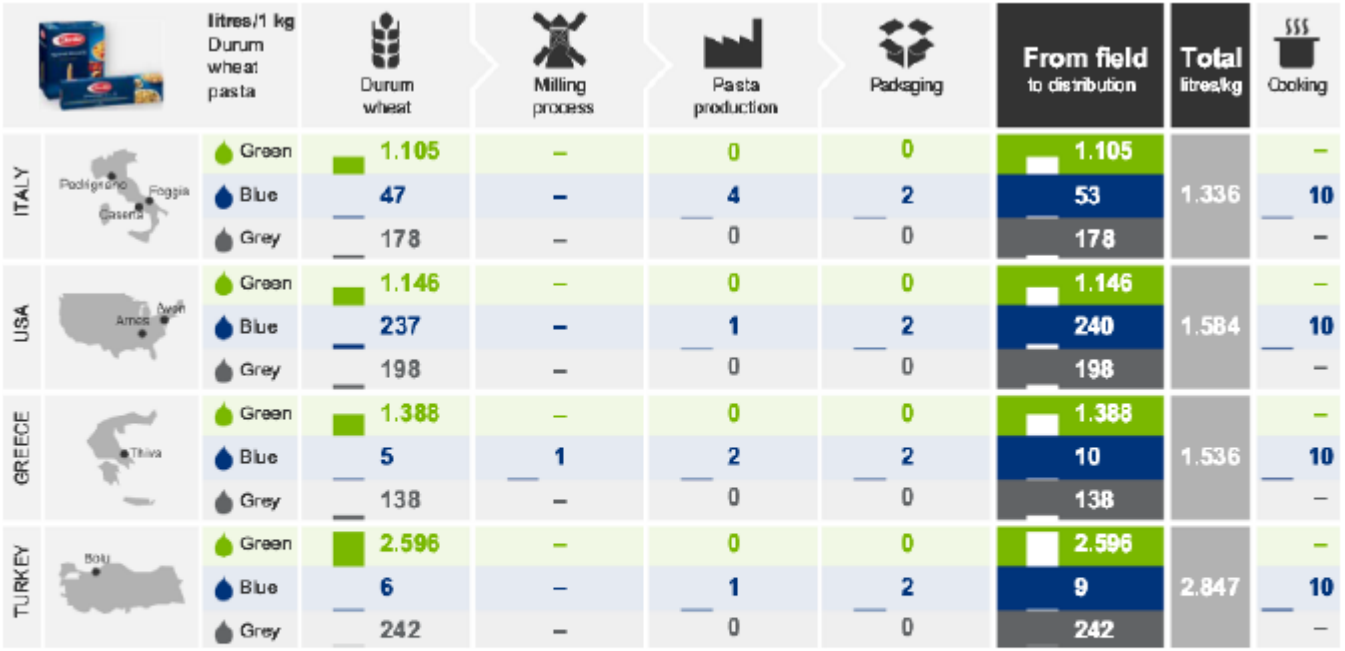
Example for Water Footprint

Table 2. The water footprint of 2 different diets in industrialized countries

Item	Meat diet			Vegetarian diet		
	kcal/day[1]	L/kcal[2]	L/day	kcal/day[3]	L/kcal[2]	L/day
Animal origin	950	2.5	2,375	300	2.5	750
Vegetable origin	2,450	0.5	1,225	3,100	0.5	1,550
Total	3,400		3,600	3,400		2,300

[1]The numbers are taken equal to the actual daily caloric intake of people in the period from 1997 to 1999 (FAO, 2011).
[2]For each food category, a rough estimate has been made by taking the weighted average of the water footprints (L/kg) of the various products in the food category (from Hoekstra and Chapagain, 2008) divided by their respective caloric values (kcal/kg). The estimate for food of vegetable origin coincides with the estimate made by Falkenmark and Rockström (2004); for food of animal origin, Falkenmark and Rockström (2004) use a greater value of 4 L/kcal.
[3]This example assumes that the vegetarian diet still contains dairy products.

Example for Water Footprint of Product



		litres/1 kg Durum wheat pasta	Durum wheat	Milling process	Pasta production	Packaging	From field to distribution	Total litres/kg	Cooking
ITALY		Green	1.105	–	0	0	1.105	1.336	–
		Blue	47	–	4	2	53		10
		Grey	178	–	0	0	178		–
USA		Green	1.146	–	0	0	1.146	1.584	–
		Blue	237	–	1	2	240		10
		Grey	198	–	0	0	198		–
GREECE		Green	1.388	–	0	0	1.388	1.536	–
		Blue	5	1	2	2	10		10
		Grey	138	–	0	0	138		–
TURKEY		Green	2.596	–	0	0	2.596	2.847	–
		Blue	6	–	1	2	9		10
		Grey	242	–	0	0	242		–

ค่า Water Footprint ของผลิตภัณฑ์พาสต้า ประเทศอิตาลี สหรัฐอเมริกา กรีซ และตุรกี ปี ค.ศ. 2009-2011

ที่มา : ฐานข้อมูลจาก Water Footprint Network

Example for Water Footprint of Product

Water footprint of a Coke

Water footprint of a 0.5 litre PET-bottle coke
as produced in the Dongen factory, the Netherlands

0.44 litre water content
27.6 litre for sugar
5.3 litre for PET bottle and closure
3.0 litre for other ingredients & overheads

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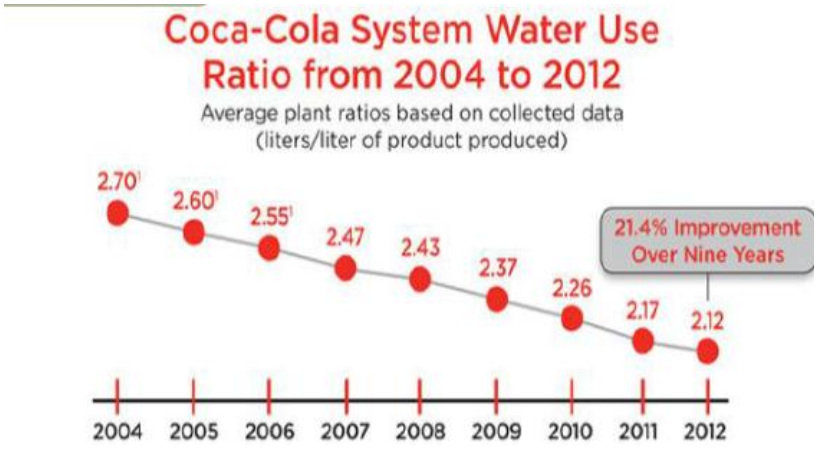
36 litre total

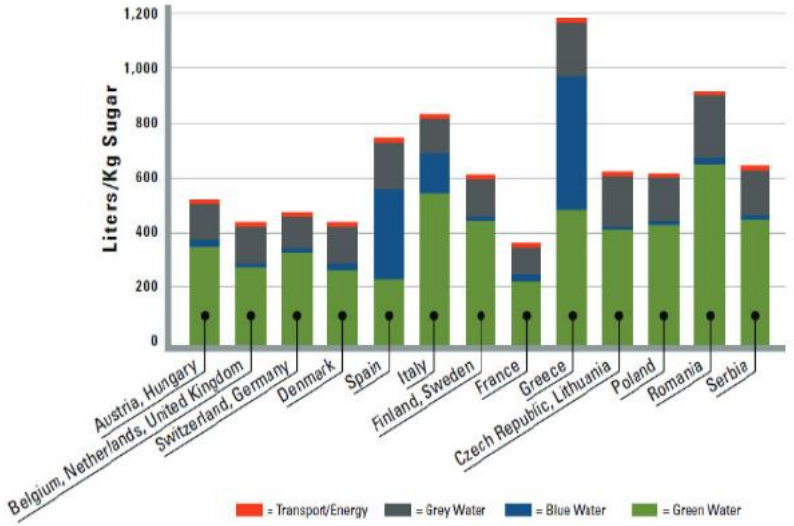
- industry certification?
- water disclosure?

Example for Water Footprint of Product



ปริมาณการใช้น้ำในกระบวนการผลิต “โค้ก” ปี ค.ศ. 2004-2012

ที่มา : www.coca-colacompany.com/setting-a-new-goal-for-water-efficie



ปริมาณการใช้น้ำในการผลิตบีทรูทสำหรับใช้ในผลิตภัณฑ์ “โค้ก” ปี ค.ศ. 2010 รายประเทศ

http://www.waterfootprint.org/Reports/Hastings-Pegram-2012.pdf

Example for Water Footprint Of Product

ตัวอย่าง ผลิตภัณฑ์อาหาร ที่มีการระบุฉลาก Water Footprint ได้แก่ ผลิตภัณฑ์อาหารเข้าจากข้าวโอ๊ต แบรนด์ “Elovena” ผลิตโดยบริษัทในเครือ Raisio ประเทศฟินแลนด์ เป็นผลิตภัณฑ์แรกในโลกที่มีการระบุฉลาก Water Footprint เมื่อปี ค.ศ. 2009 โดยระบุการผลิตสินค้า 100 กรัม จะใช้น้ำเฉลี่ยอยู่ที่ 101 ลิตร

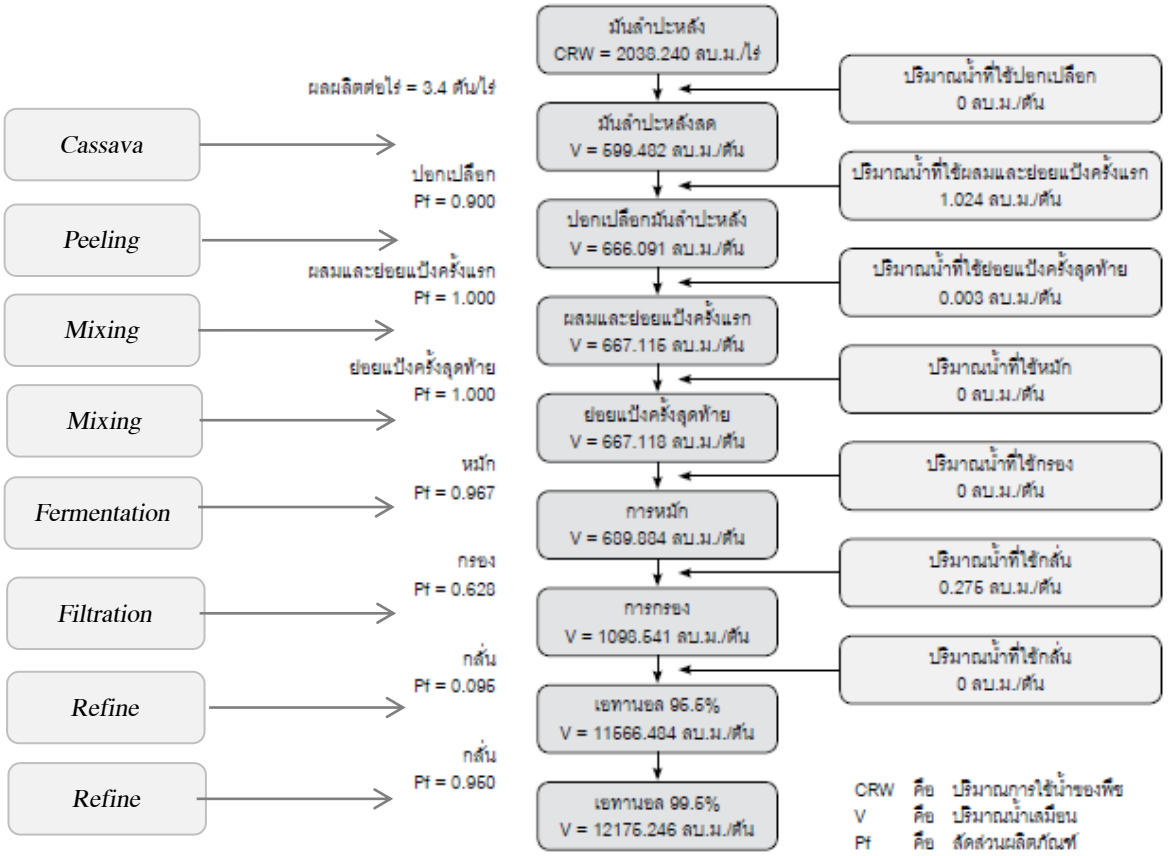
Elovena Oat Flakes
Water consumption 101 litres/100g

- Cultivation 99.3%
- Manufacturing 0.57%
- Packaging materials 0.16%

ที่มา : www.raisio.com

Example for Water Footprint:

Bioethanol Production from Cassava in Thailand

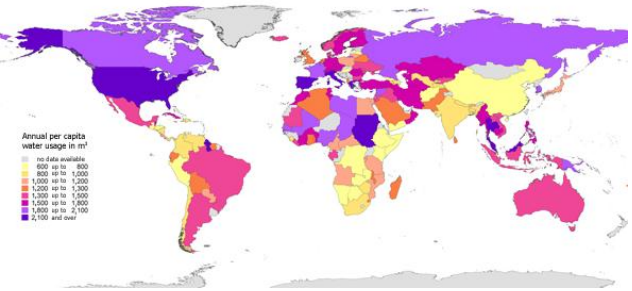


รูปที่ 1 ห่วงโซ่ของกระบวนการผลิตเอทานอลจากมันสำปะหลัง และปริมาณน้ำเสมือนกับสัดส่วนผลิตภัณฑ์ในแต่ละขั้นตอนที่ผลผลิตมันสำปะหลัง 3.4 ตันต่อไร่

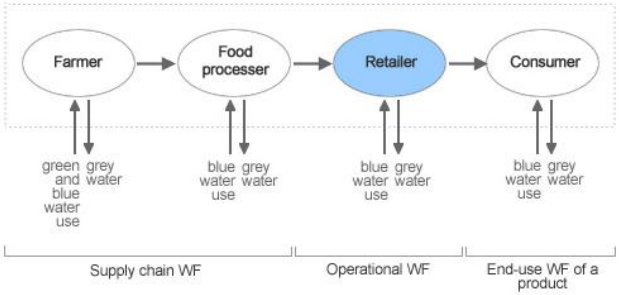
Source: Shinatiphkorn Pongpinyopap and Thumrongrut Mungcharoen, 2011

Water Footprint

1. The water footprint of products



2. The water footprint of a nation



3. The water footprint of a business

Water Footprint of A Nation

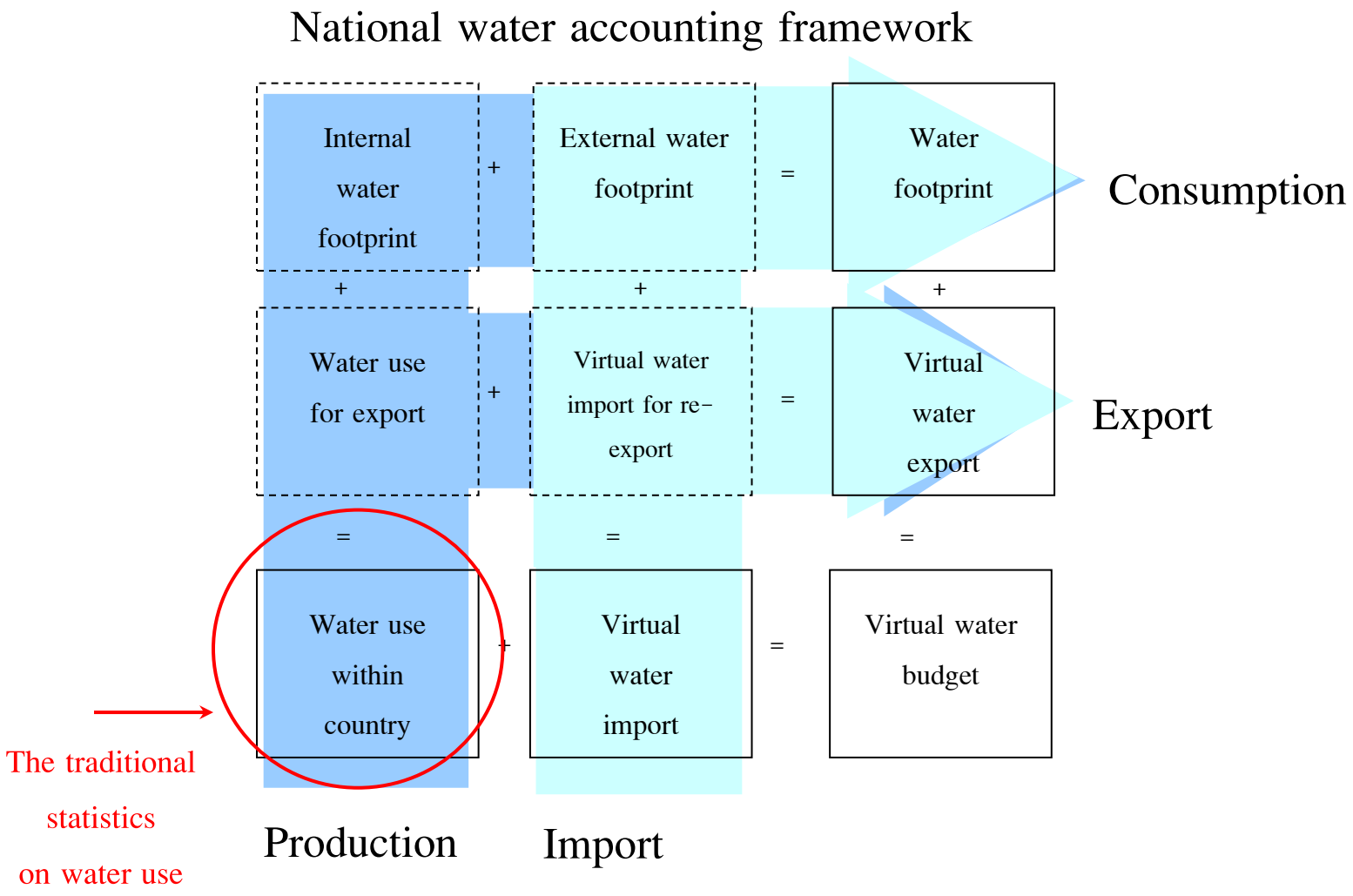
- total amount of water that is used to produce the goods and services consumed by the inhabitants of the nation.
- two components:

  internal water footprint – inside the country.

  external water footprint – in other countries.

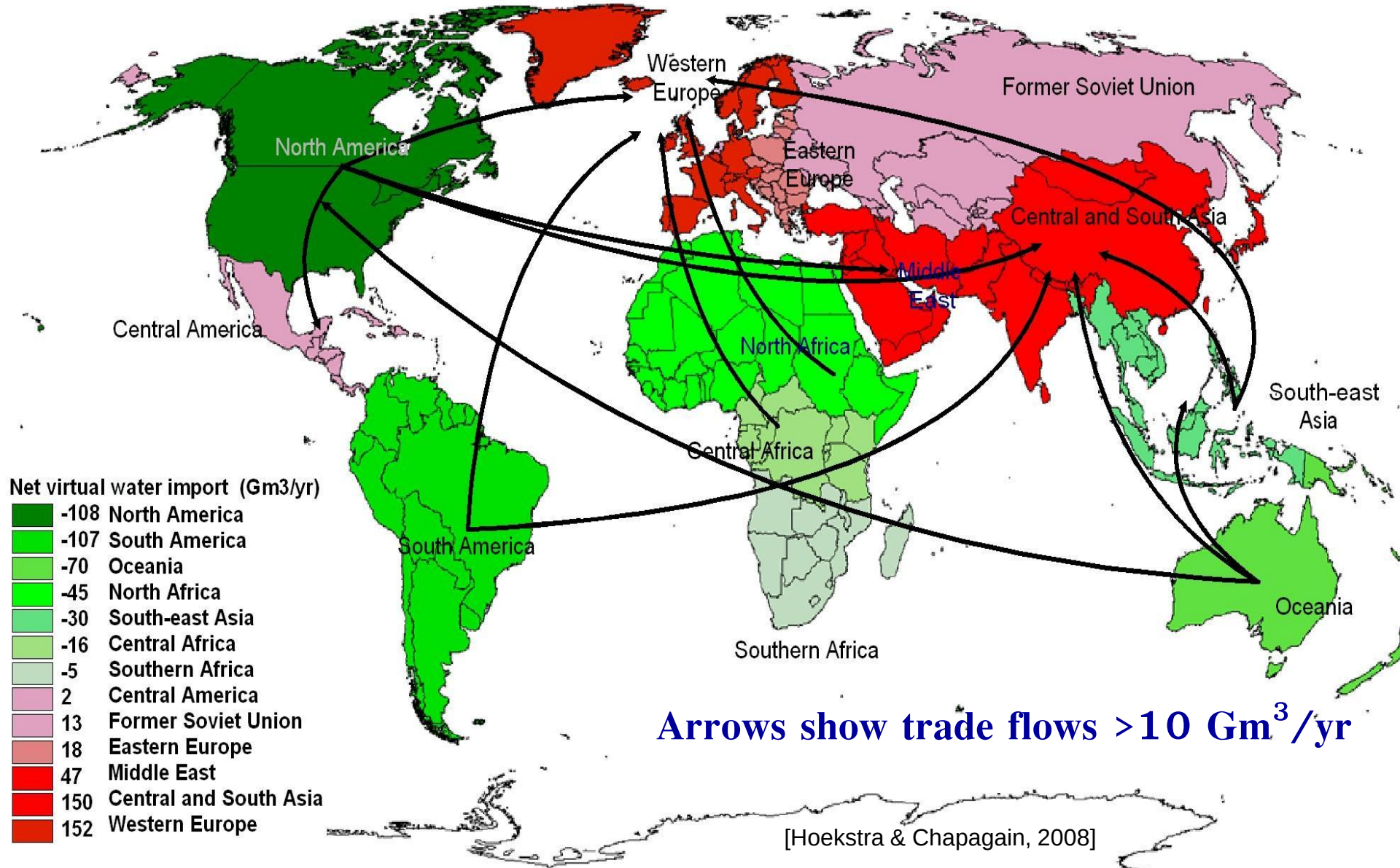
National water footprint = national water use
+ virtual water import
– virtual water export

Water Footprint of A Nation



Regional virtual water balances

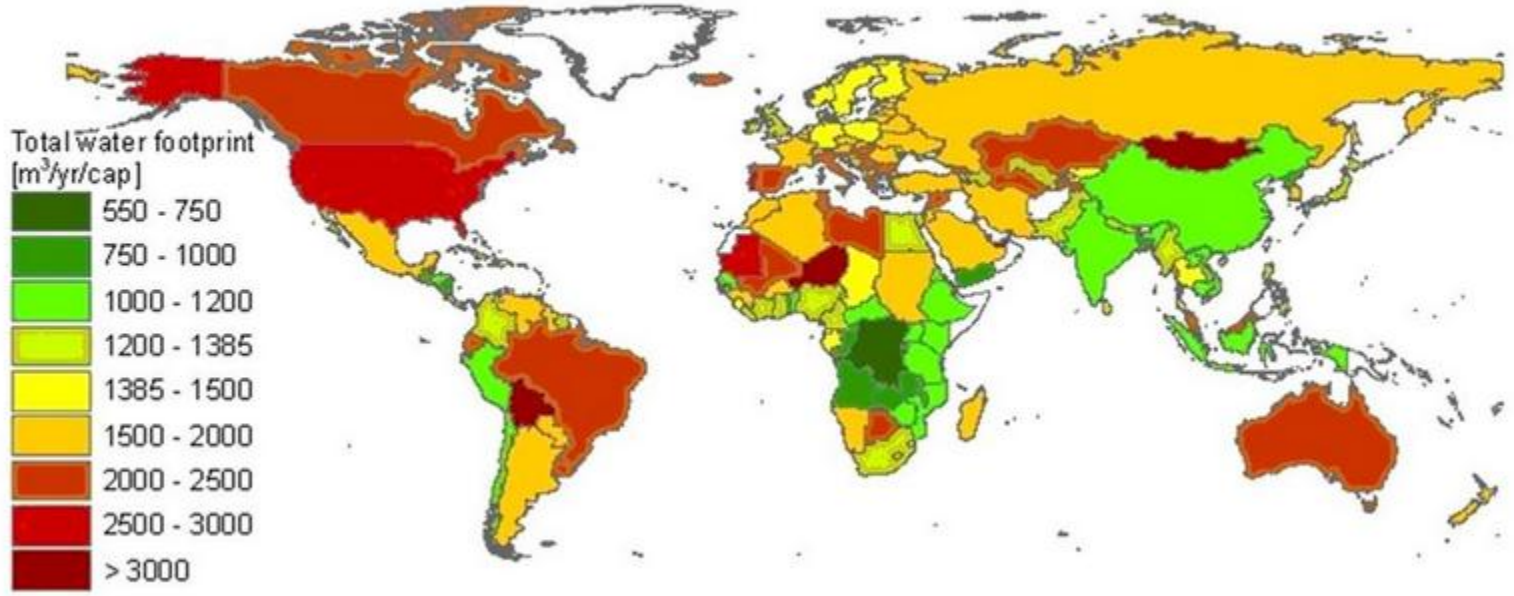
(only agricultural trade)



[Hoekstra & Chapagain, 2008]

Water Footprint

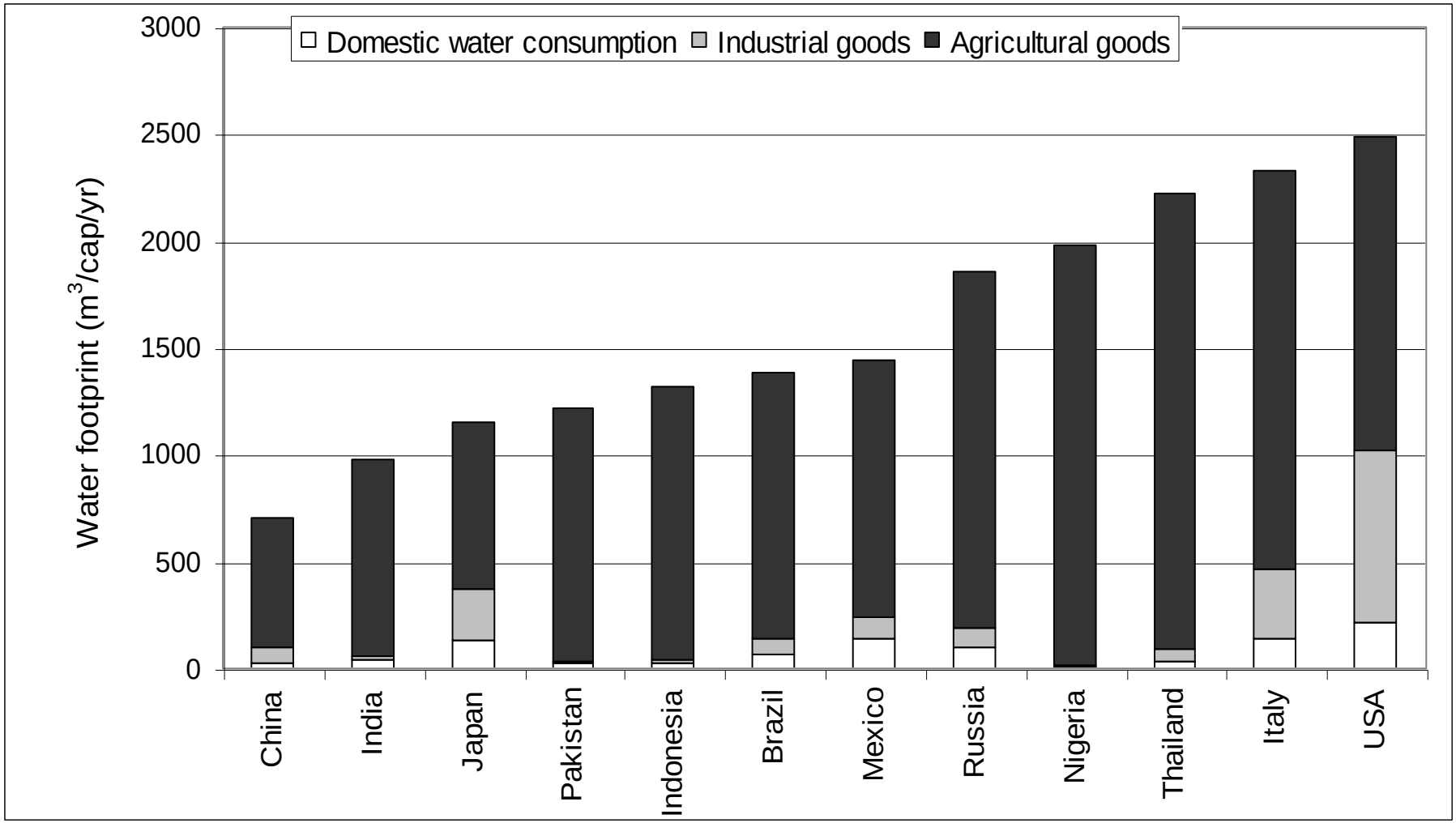
Average water footprint of national consumption in m^3 per year per capita in the period 1996-2005. Countries shown in green have a water footprint that is smaller than the global average; countries shown in yellow-red have a water footprint larger than the global average. Source: Mekonnen and Hoekstra (2011).



The global average water footprint is 1,385m3/cap/yr

Water Footprint of A Nation

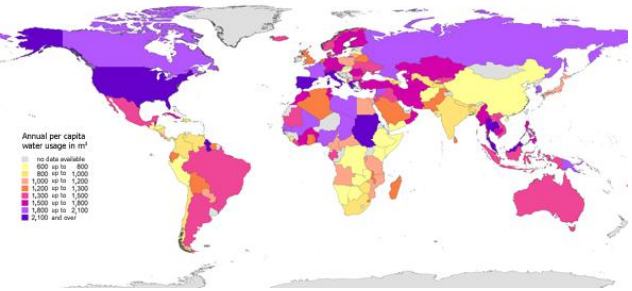
Water footprint per capita



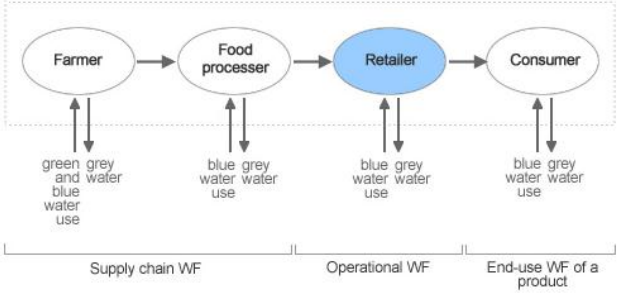
[Hoekstra & Chapagain, 2008]

Water Footprint of A Business

1. The water footprint of products



2. The water footprint of a nation



3. The water footprint of a business

Water Footprint

Why businesses are interested

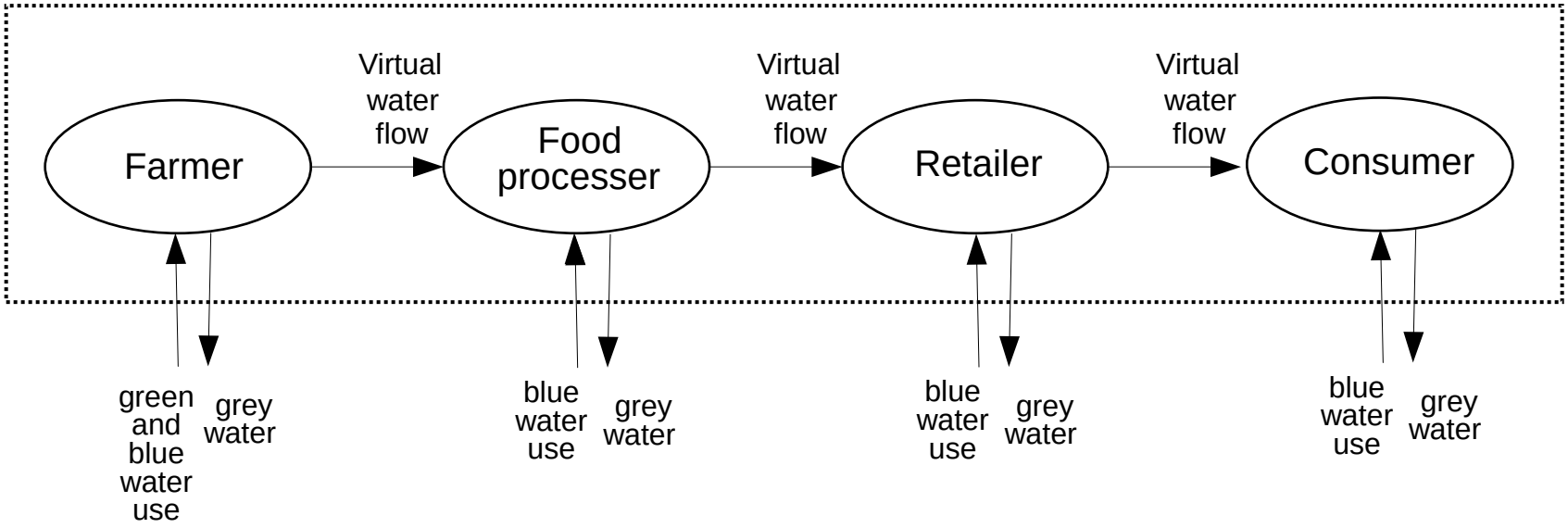
- corporate social responsibility
- corporate image / marketing perspective
- business risks related to

  freshwater shortage for own operations

  freshwater shortage in supply chain
- anticipate regulatory control

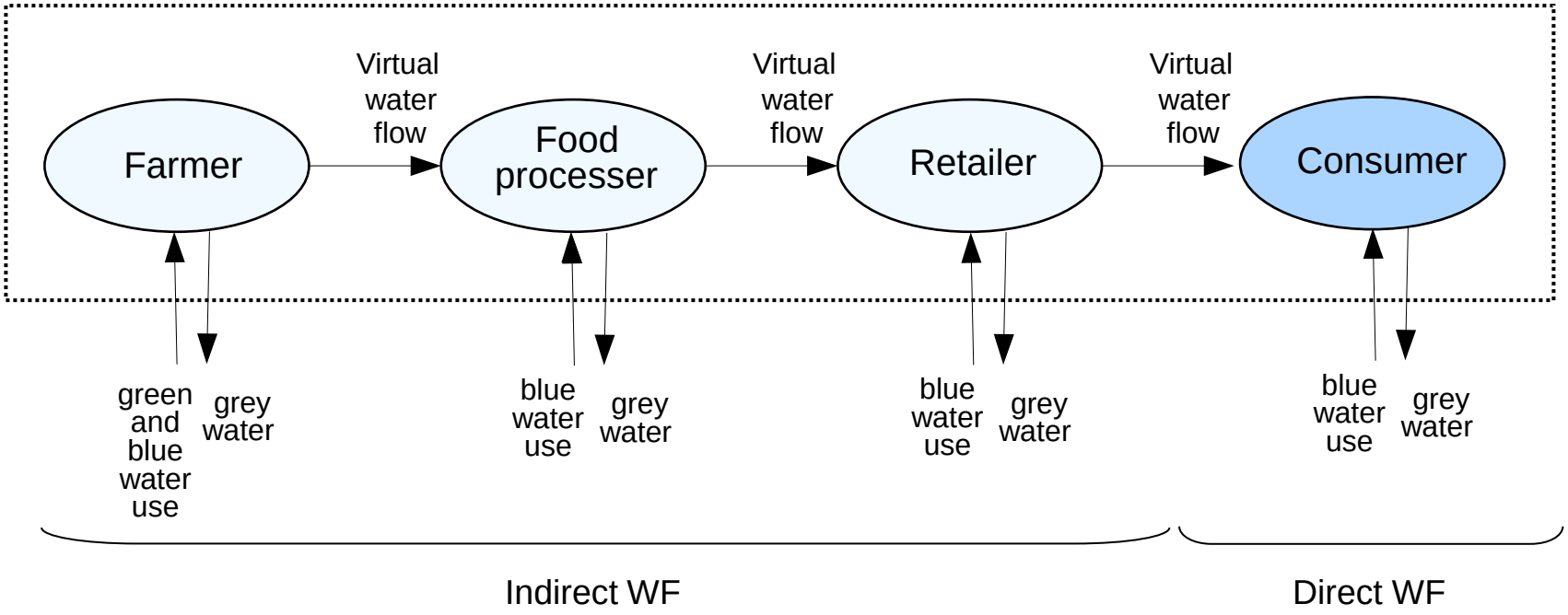
Water Footprint of A Nation

The virtual water chain



Water Footprint of A Nation

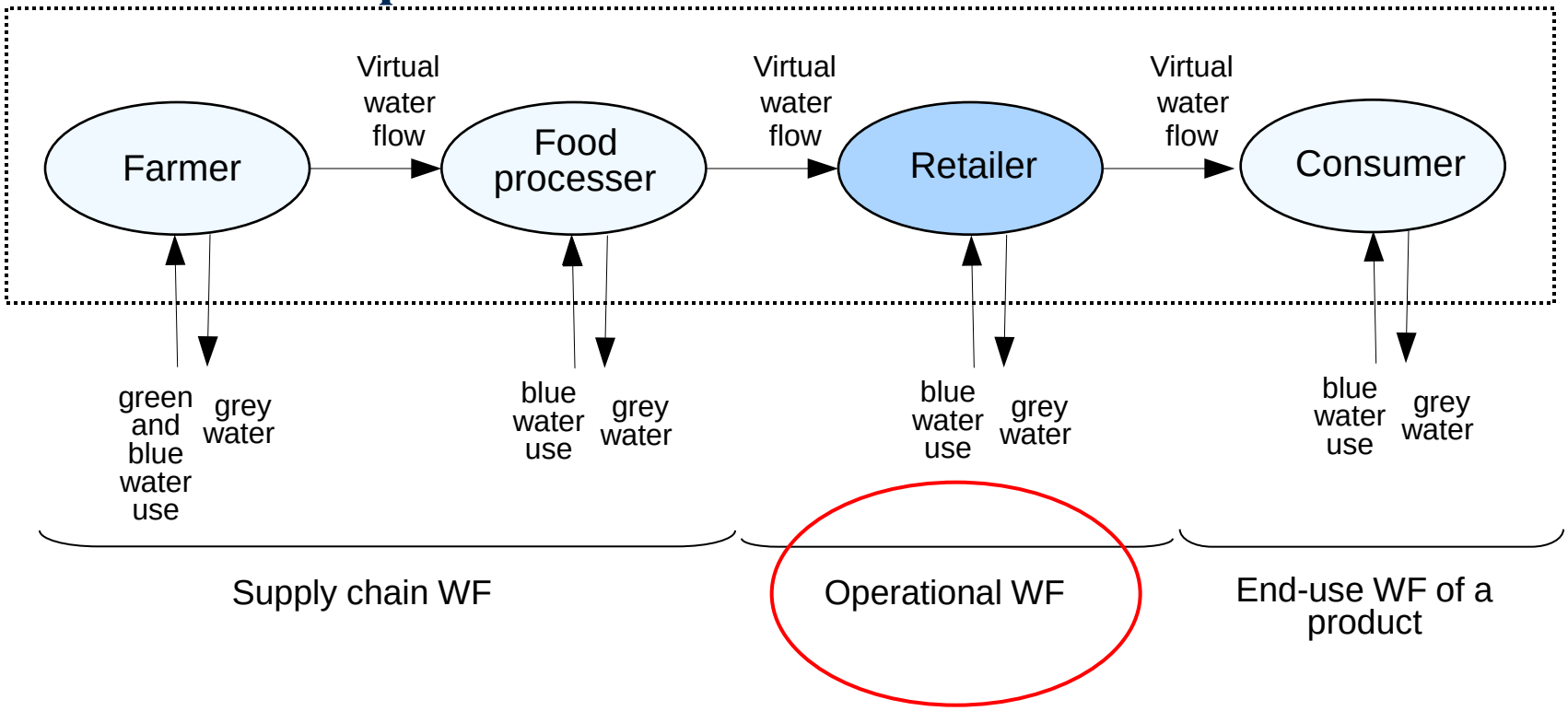
The water footprint of a consumer



[Hoekstra, 2008]

Water Footprint of A Nation

The water footprint of a retailer

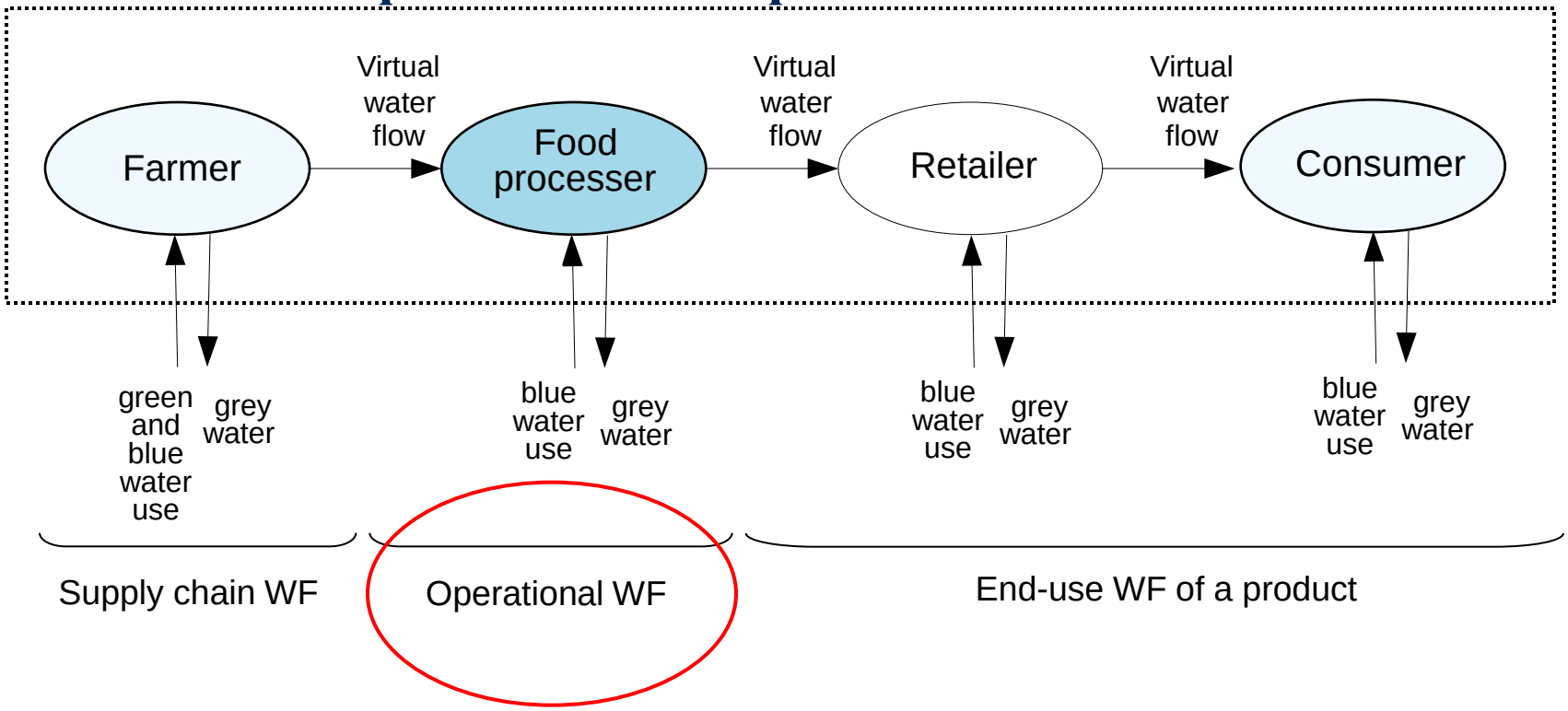


The traditional statistics on corporate water use

[Hoekstra, 2008]

Water Footprint of A Nation

The water footprint of a food processor



The traditional statistics on corporate water use

[Hoekstra, 2008]

THANKS YOU