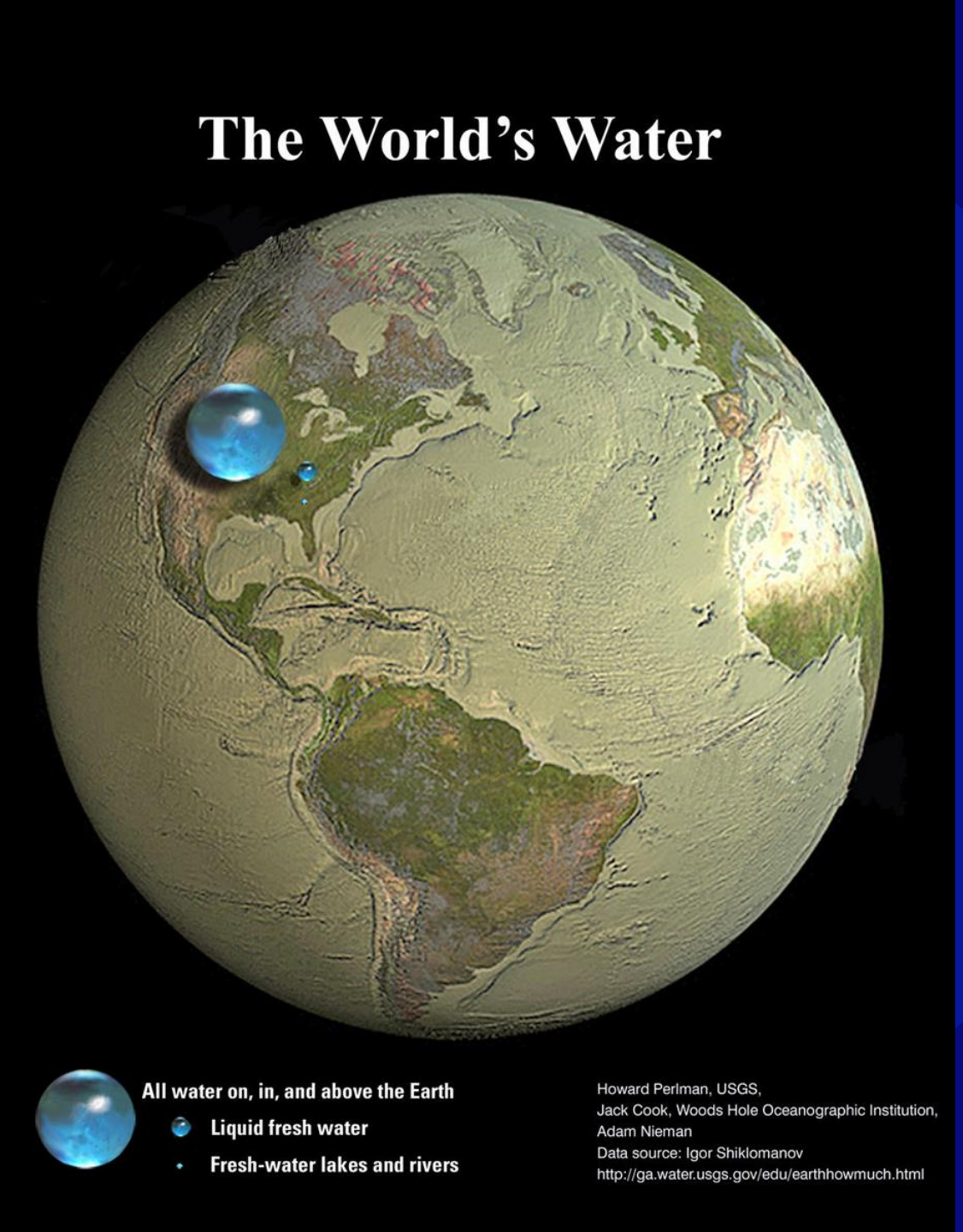

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Water Security is Indeed a Global Issue

Jaap Kwadijk

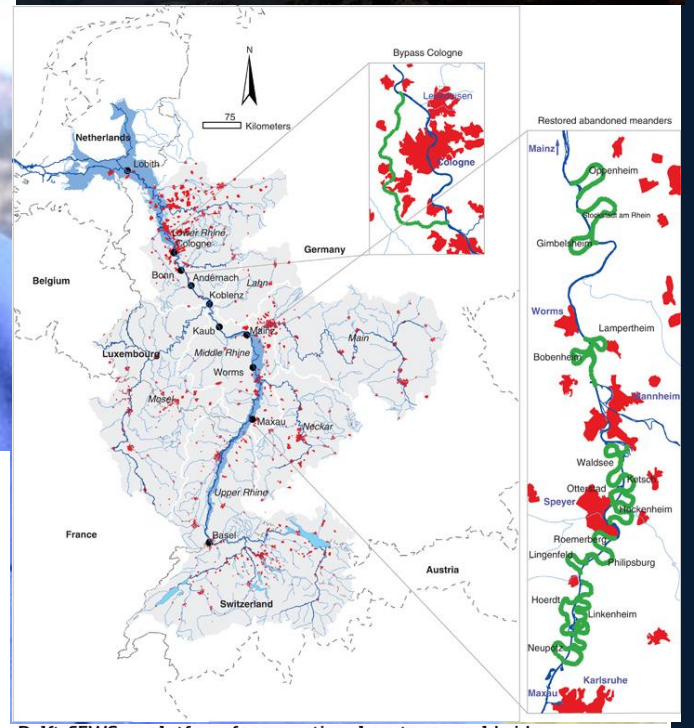
Science Director Deltares

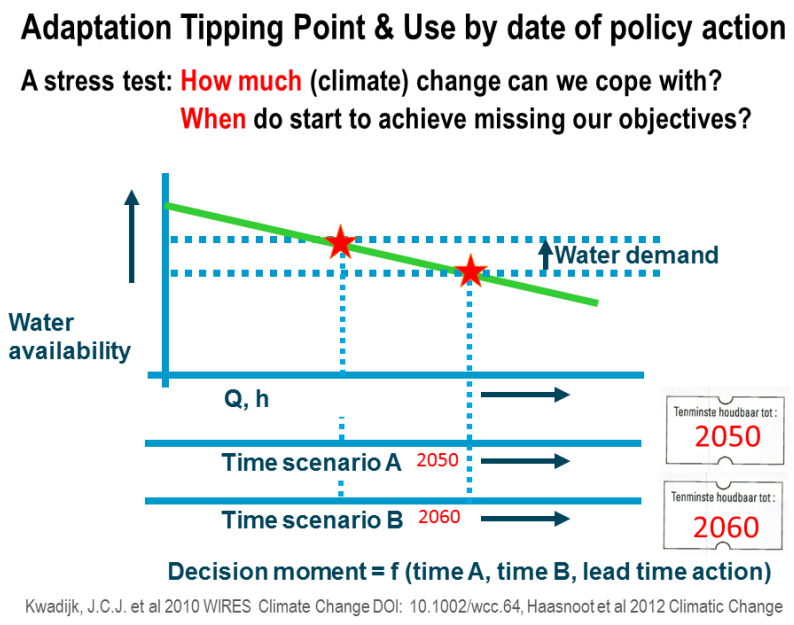
Contributions from Joep Schyns, Rick Hogeboom, Arjen Hoekstra †, Marc Bierkens, Eelco van Beek

September 10, 20120

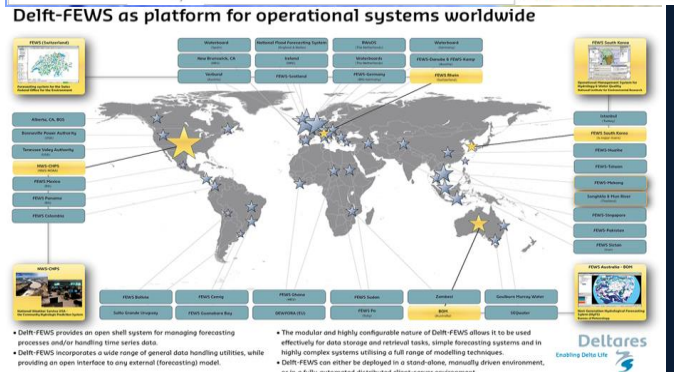
Who am I

- **Research Director Deltares, NL**
- **Professor Modelling Climate and water management. University Twente, NL**
- MSc Quaternary Geology (Alps) (U-AMS, NL)
- PhD Effect of Climate change on the discharge of the River Rhine (UU, NL)
- Research: Water and flood management, Hydrology, Forecasting, sea level rise, climate adaptation
- Worked in: EU, Surinam, Egypt, Iran, HK, Mongolia, Bangladesh.
- Current topic of interest: Speed up climate adaptation





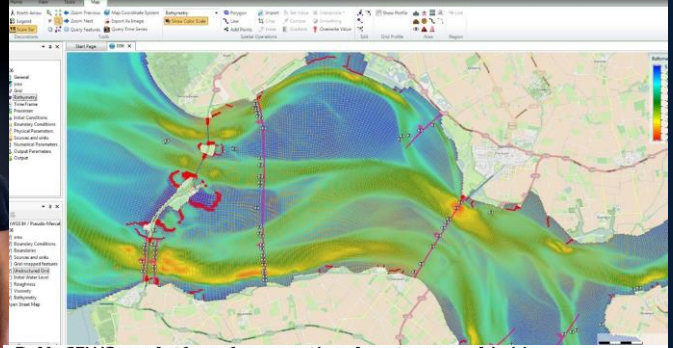
Kwadijk, J.C.J. et al 2010 WIRES Climate Change DOI: 10.1002/wcc.64, Haasnoot et al 2012 Climatic Change

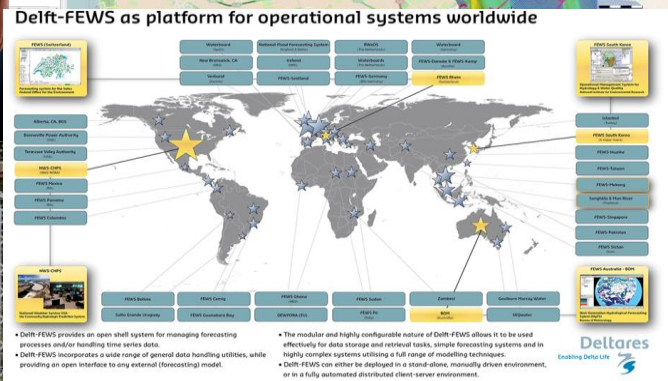


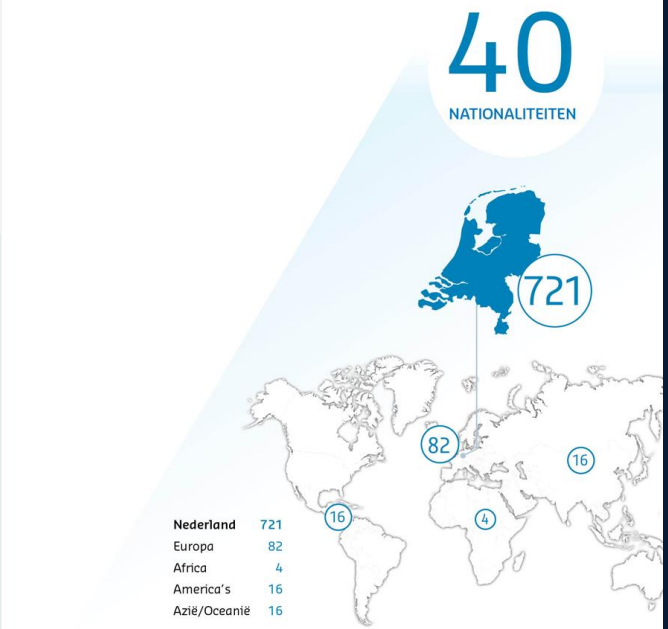
Water Security is Indeed a Global Issue

I work at Deltares:

- **Independent** research institute on water, soil and infrastructure
- 800 people, 114 M€ annual turnover
- Legal form: **foundation** under Dutch law (no shareholders)
- Activities targeted at extending our knowlegde (**Not4Profit**)
- Doing **applied research** and specialized consultancy
- Working **(inter)nationally** for public and private sector
- Making use of large in-house **research facilities and software**
- Strong links with the Academia
- **Open source policy**

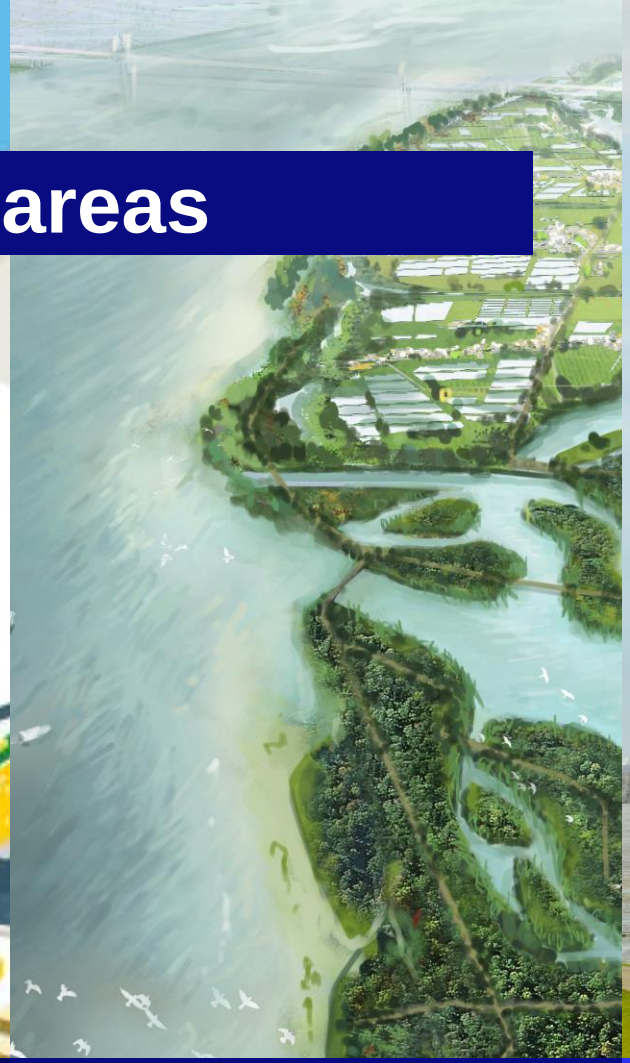




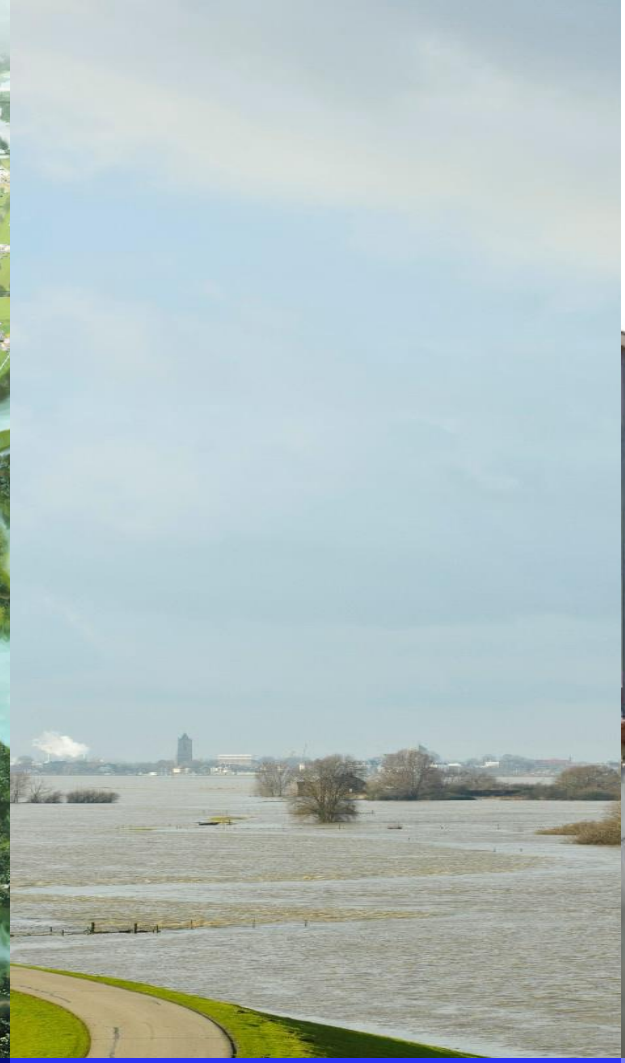


Our mission areas

Future deltas



Sustainable deltas



Safe deltas

Resilient infrastructure

Water management for security, many perspectives

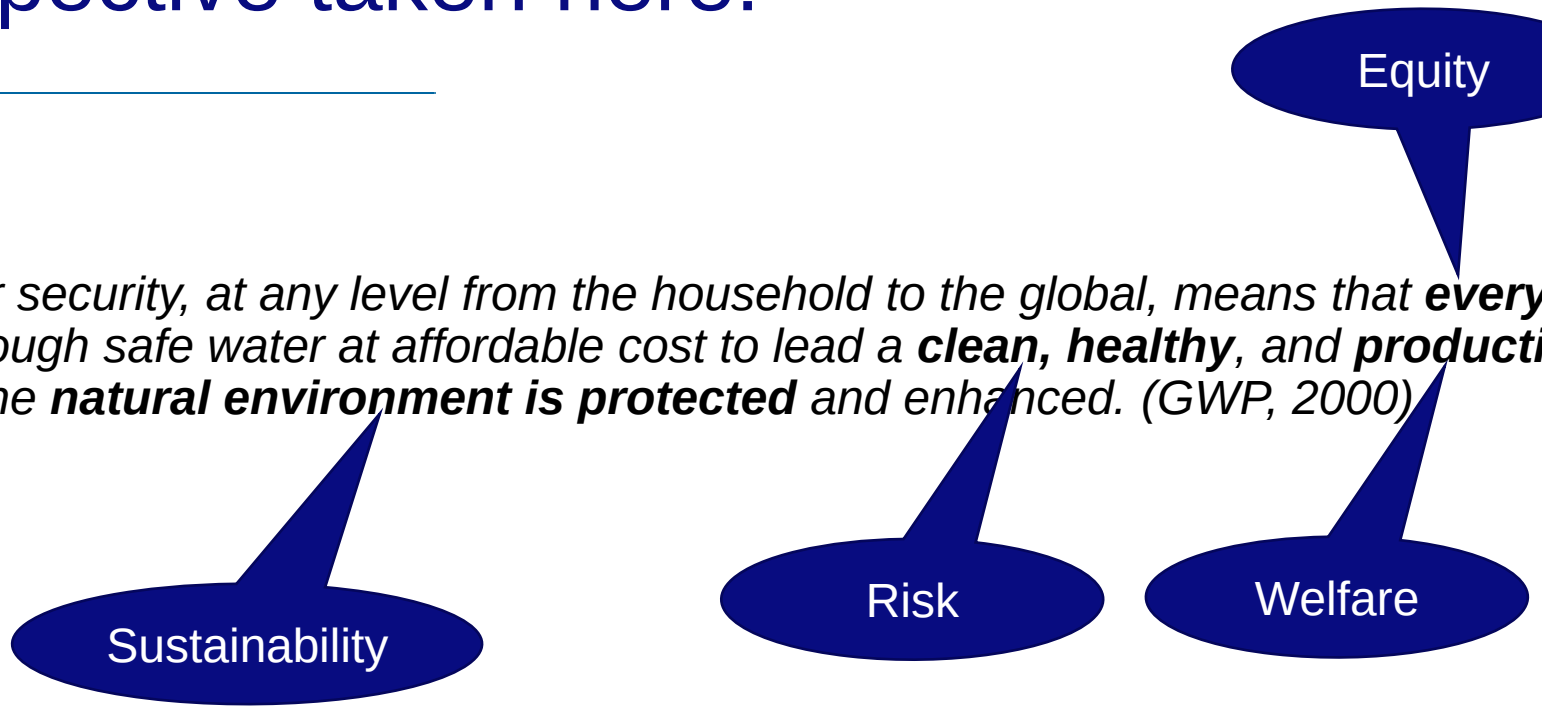
- 1980s : Integrated Water Management (=> understanding that you need to assess an entire system (demand, supply, scale: basin/territory/country)
- 1990s : Sustainable water management (=> understanding that there are future needs (Brundtland))
- 2007: Adaptive water management (=> understanding that you need flexibilty to adapt (Climate Change and other pressures)
- 2007-> Focus on future: Water-Food Nexus, Resilient water, Water-Proof, Water Risk

- Water Security: *Towards Water Security: A Framework for Action by the Global Water Partnership* (GWP 2000).
- Focus can be on: welfare, equity, sustainability and risk
- Scale can be from household, urban, basin, to global

Courtesy: Arjen Y Hoekstra et al 2018 Environ. Res. Lett. 13 053002

Perspective taken here:

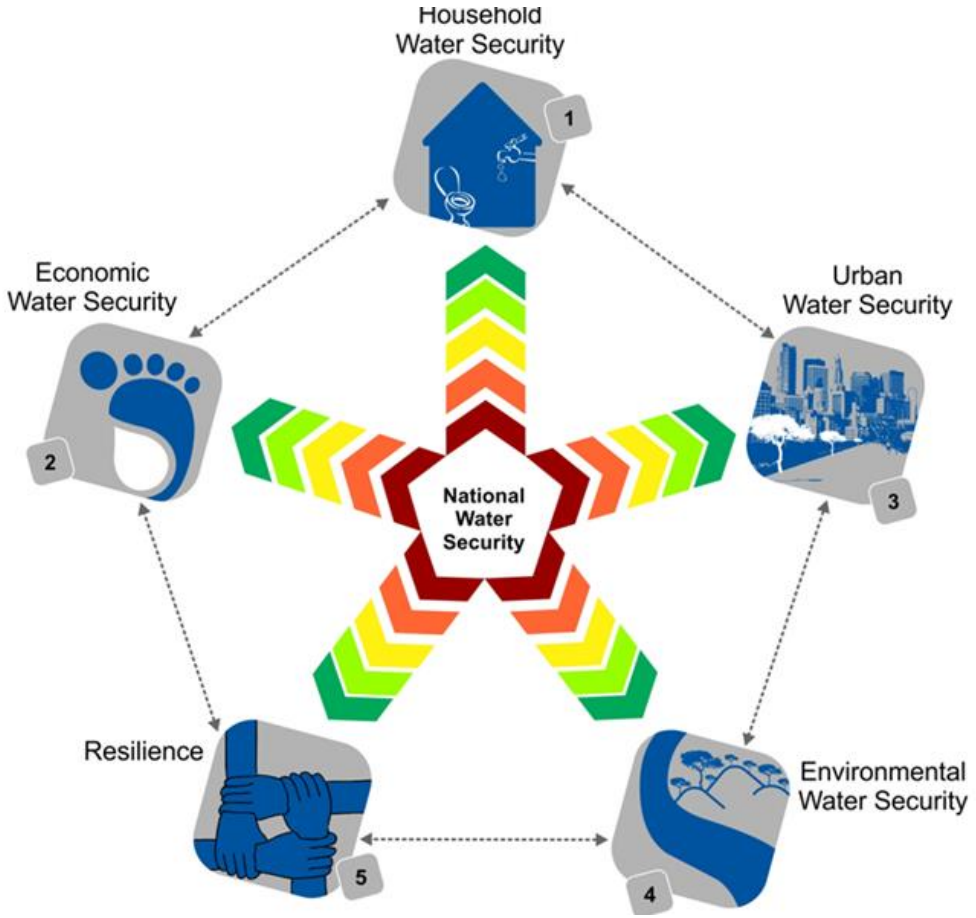
- *Water security, at any level from the household to the global, means that **every person** has access to enough safe water at affordable cost to lead a **clean, healthy**, and **productive** life, while ensuring that the **natural environment is protected** and enhanced. (GWP, 2000)*



Courtesy: Eelco van Beek and WL Arriens, 2014. *Water Security: Putting the Concept into Practice . GWP* Tec background papers no. 20

Adopted by the Asian Development Bank

- Satisfy household water and sanitation needs in all communities
- Support productive agriculture and industry
- Develop vibrant, liveable cities and towns
- Restore healthy rivers and ecosystems
- Build resilient communities that can adapt to change



Asian Water Development Outlook (2013)

Key Dimensions of Water Security

KD1 – household water security

- Access to piped water supply, improved sanitation and hygiene

KD2 – economic water security

- Broad economic development, water for agriculture, industry and energy

KD3 – urban water security

- Urban water supply, wastewater collection, drainage, urban river health

KD4 – environmental water security

- River health, flow alteration, environmental governance

KD5 – resilience to water-related disasters

- Floods and windstorms, droughts, storm surges and coastal floods

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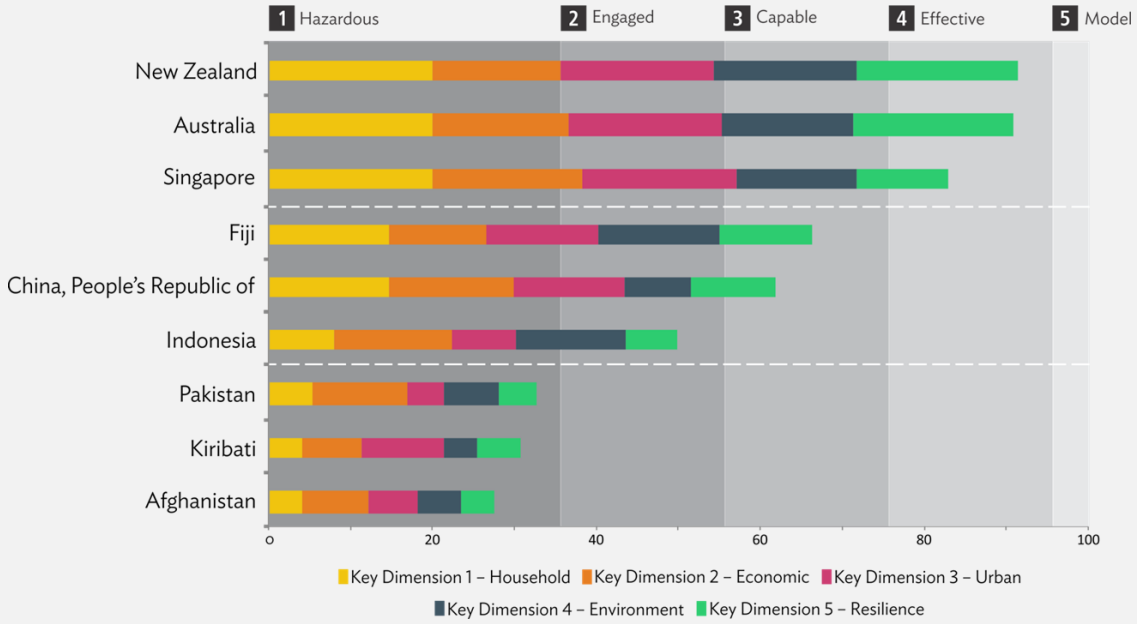
Fullfils the needs for application

- **Goal.** A broad statement of a desired, usually longer-term, outcome of a programme/intervention.
- **Key dimensions.** The main components of the goal.
- **Indicators.** A quantitative or qualitative variable that provides a valid and reliable way to measure achievement, assess performance, or reflect changes connected to an intervention for each of the key dimensions.
- **Targets.** The objective a programme/intervention is working towards, expressed as a measurable value; the desired value for an indicator at a particular point in time.
- **Monitoring.** Routine tracking and reporting of priority information about a programme/ project, its inputs and intended outputs, outcomes and impacts



Water Security is Indeed a Global Issue

Why this perspective

The innovation is not the science or the technology, it is what people do with it.

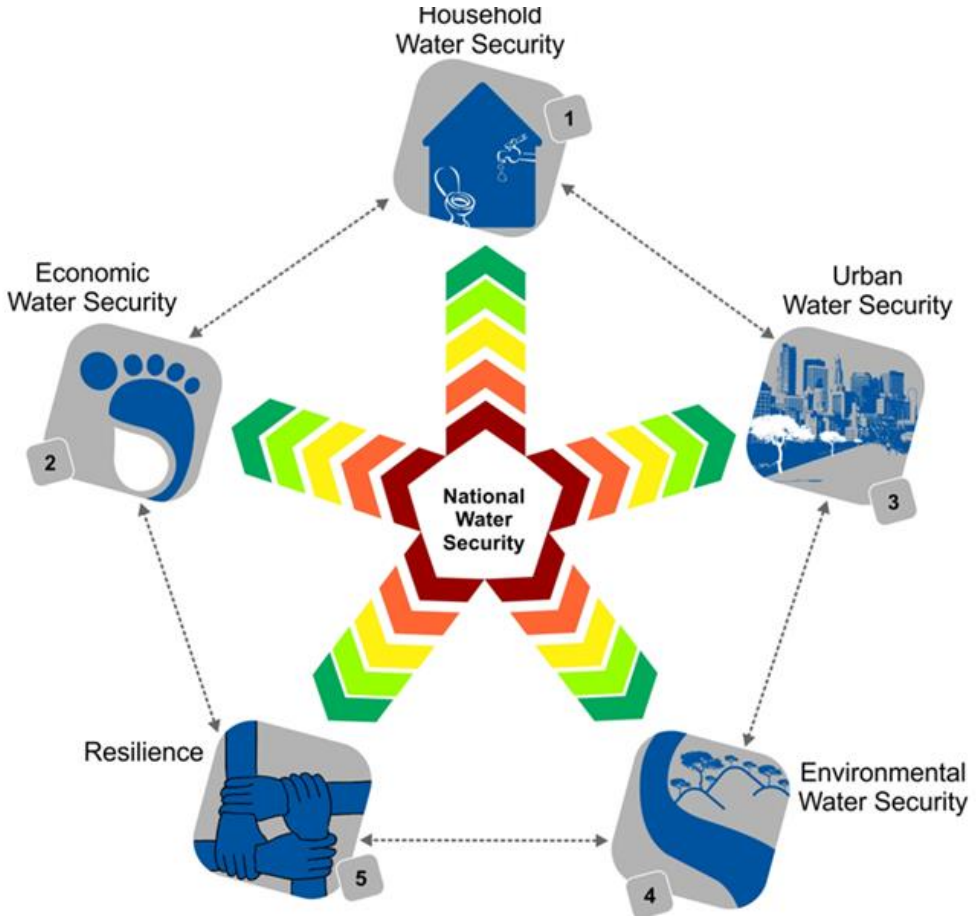
Free after Steve Jobs, at the release of the I-Phone

Strong

- It is a broad perspective on water
- Can be easily connected to well known Integrated Water Resources Management
- It has been put into practice
- It is adopted (although slightly different) by organizations (ADB, WB, UN) that can make a difference

Weak (/not that strong)

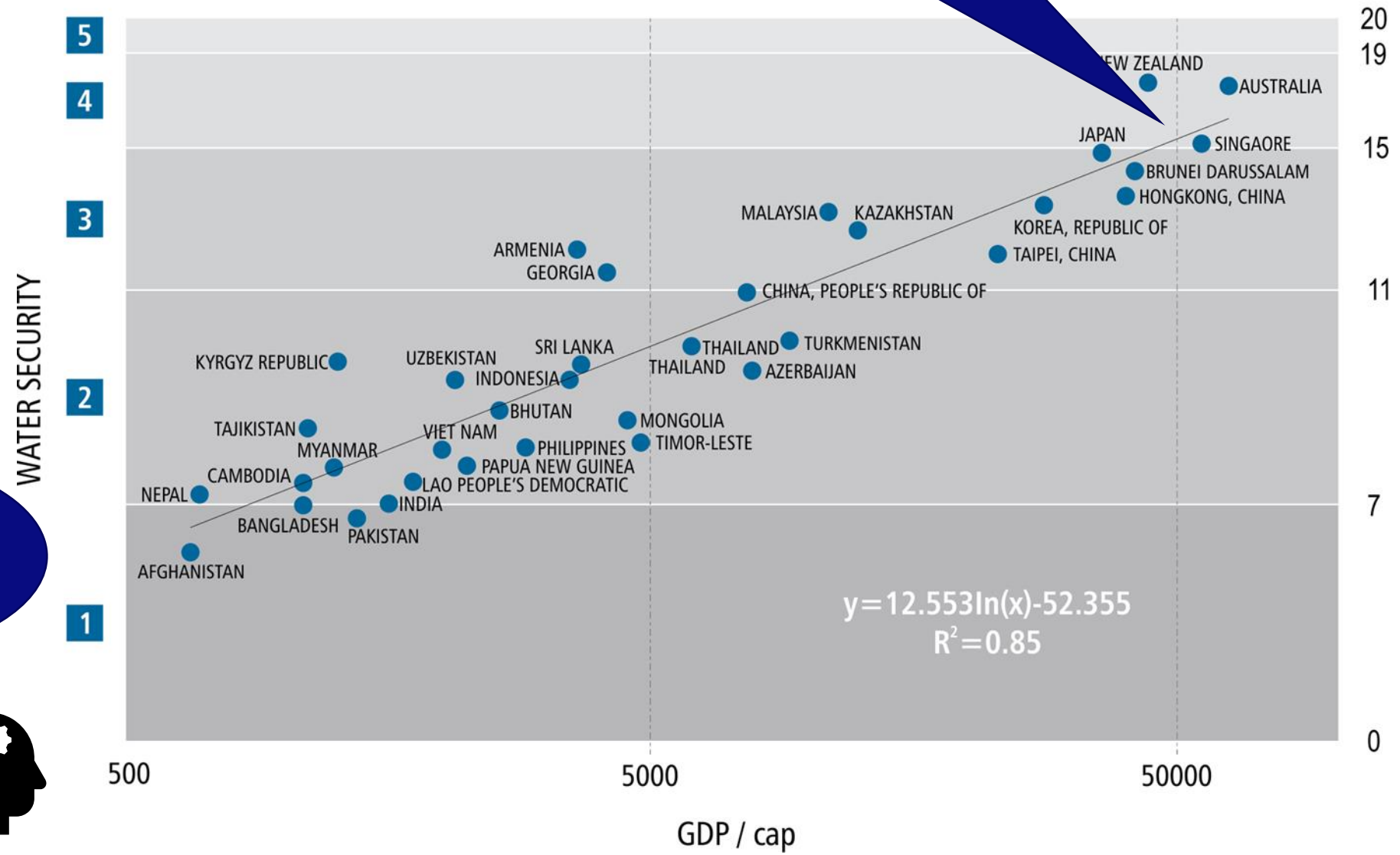
- It is about national water security, Global and river basin perspective is missing
- It is a snapshot, Future is not specifically addressed



What about the weaker points, the global dimension

Water Security and GDP

Probably The Netherlands would be plotted near here



Does that proof that they are doing well??

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It is about this, indirect consumption of water

132 litre per cup of 125 ml

96% green, 1% blue, 3% grey

17196 litre/kg

98% green, 1% blue, 1% grey

1 sheet of A4 paper: 10 litres
1 slice of bread: 40 litres
1 egg: 140 litres
1 pair of leather shoes:8,000 litres
1 pair of blue jeans: 11,000 litres
1 kg of beef: 15,400 litres
1 car: 150,000 litres

Source: Hoekstra and Chapagain (2008)

Production uses water, three colors (source)

Green water footprint

volume of rainwater evaporated or incorporated into a product

Blue water footprint

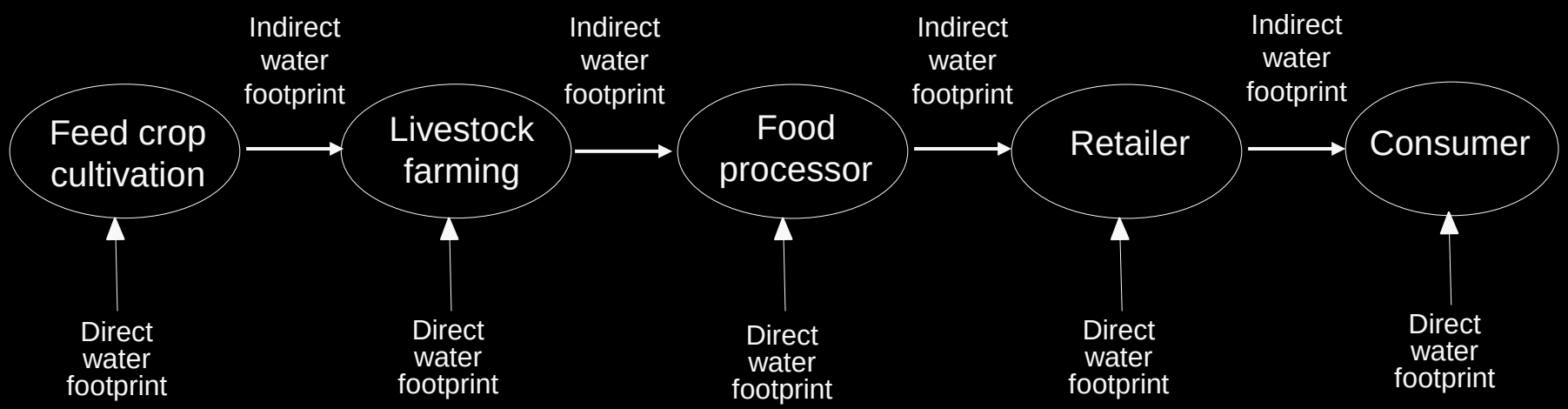
volume of surface or groundwater evaporated or incorporated into a product

Grey water footprint

volume of polluted water

Source: Hoekstra et al. (2011) *The Water Footprint Assessment Manual*, Earthscan, London, UK

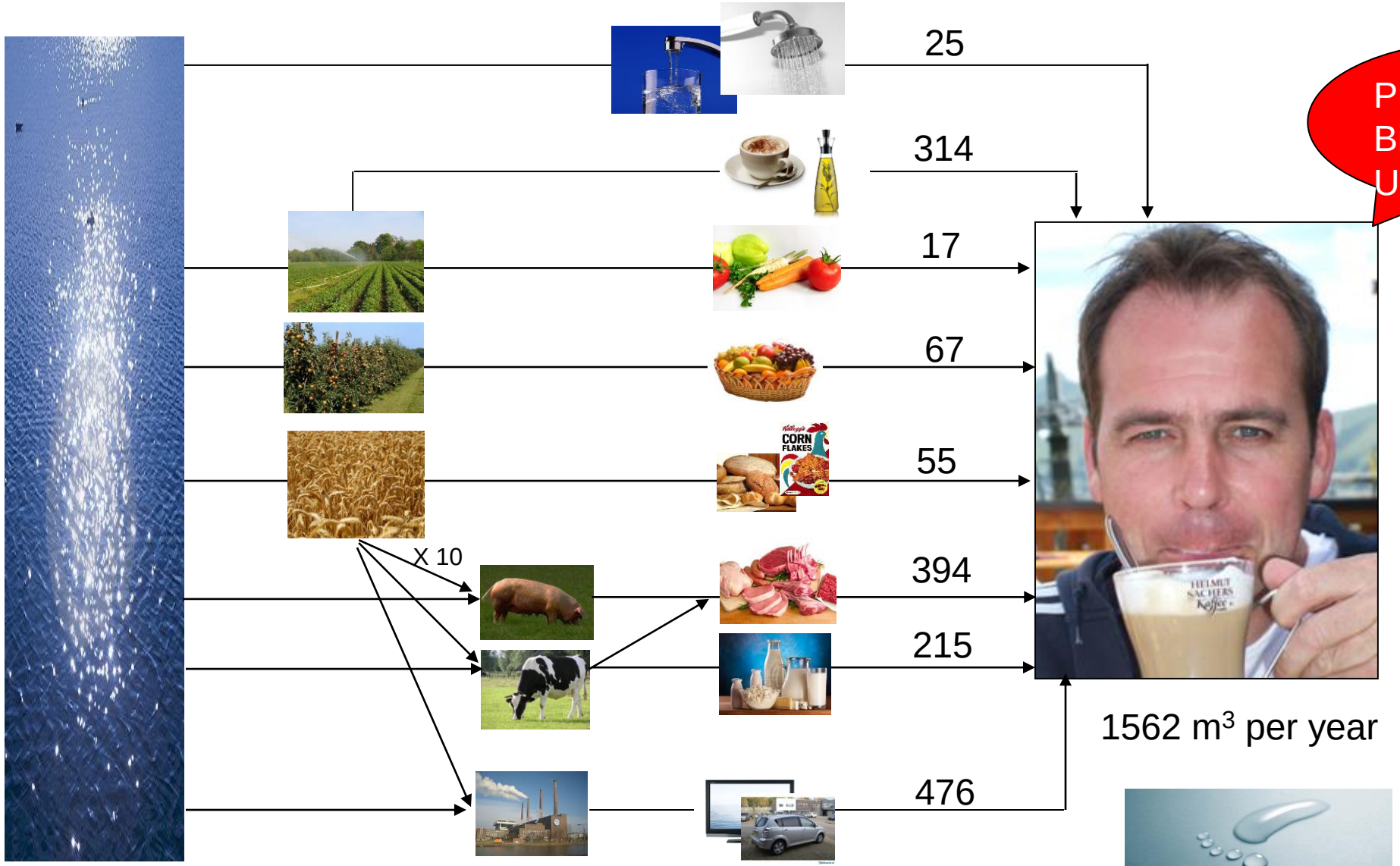
Direct and indirect use, example meat



Source: Hoekstra et al. (2011) *The Water Footprint Assessment Manual*, Earthscan, London, UK

How much water do the Dutch use per person?

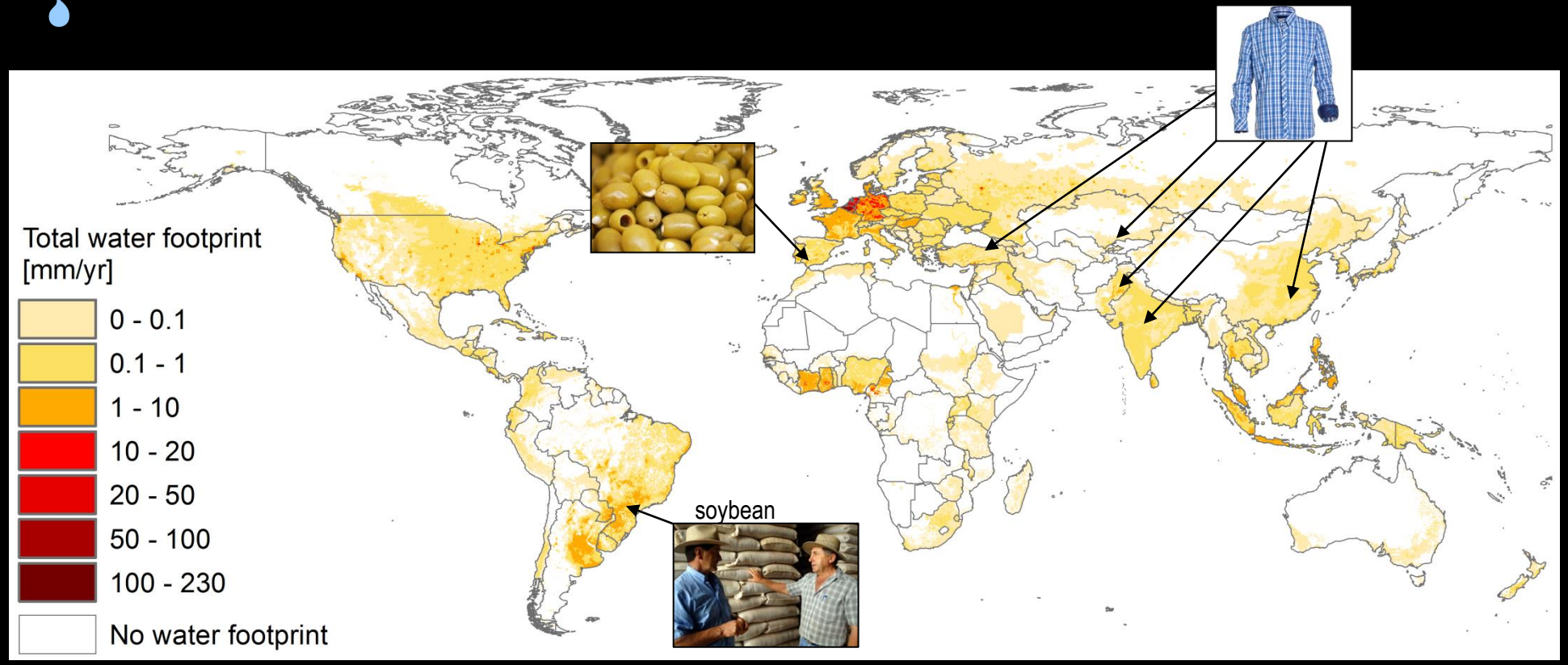
www.waterfootprint.org



Water Security is Indeed a Global Issue

Deltare

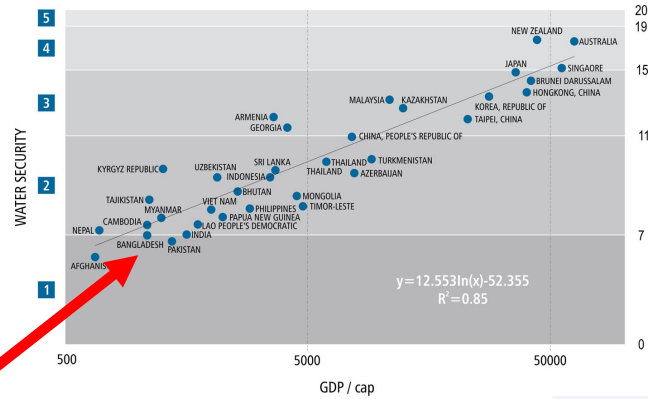
Global water footprint of Dutch consumption



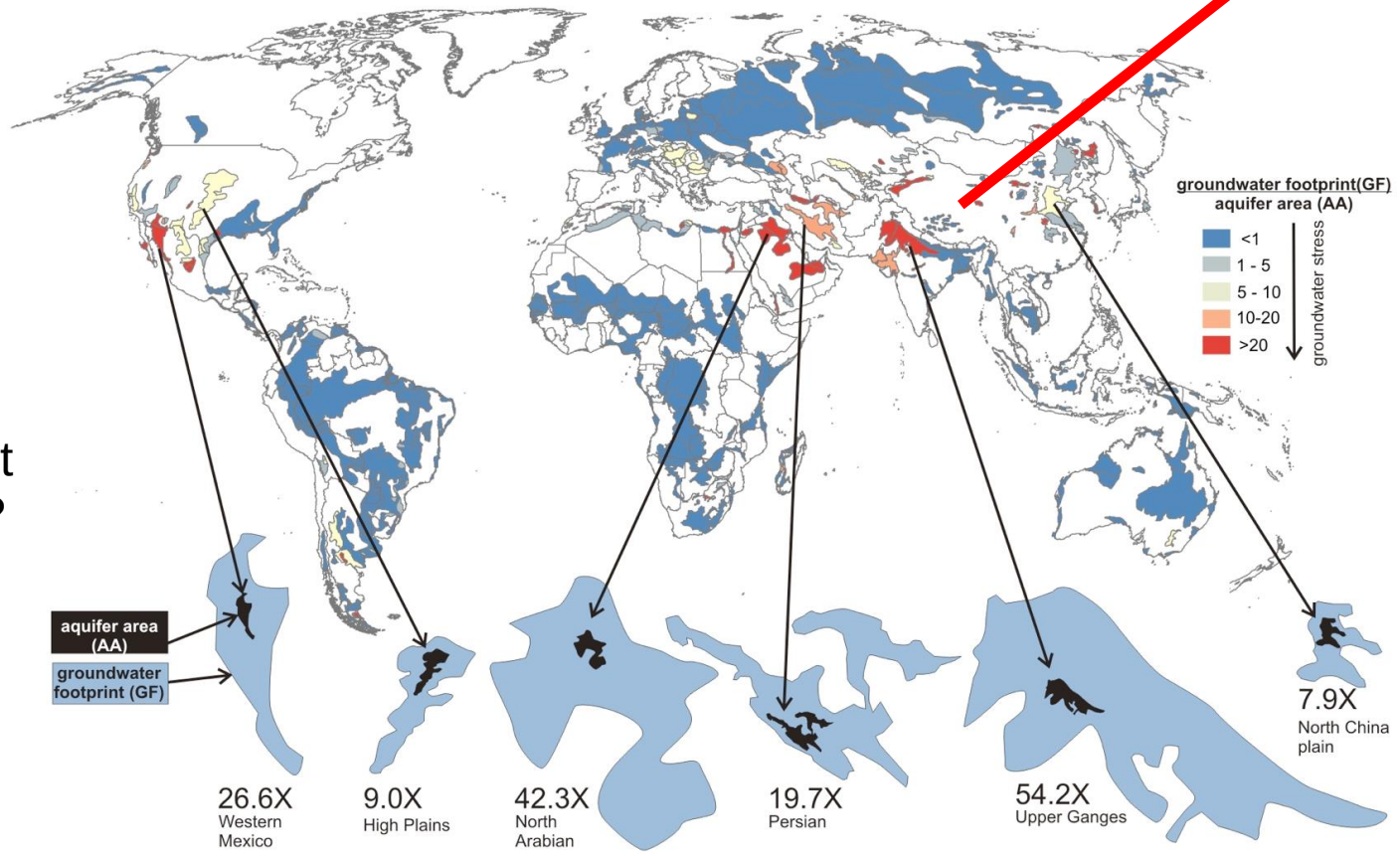
Source: Mekonnen & Hoekstra (2011) *National Water Footprint Accounts*, UNESCO-IHE

95% of the water footprint of Dutch consumers lies outside the Netherlands

The Netherlands get their cotton from heavily depleted groundwater resources



So, at the national level The Netherlands score high at water security, but on a global scale……..??



Gleeson, Wada, Bierkens and van Beek, Nature, 2012.

Water saving through trade

National water saving (e.g. the Dutch)

A nation can save water by importing a water-intensive commodity instead of producing it domestically.

Global water saving

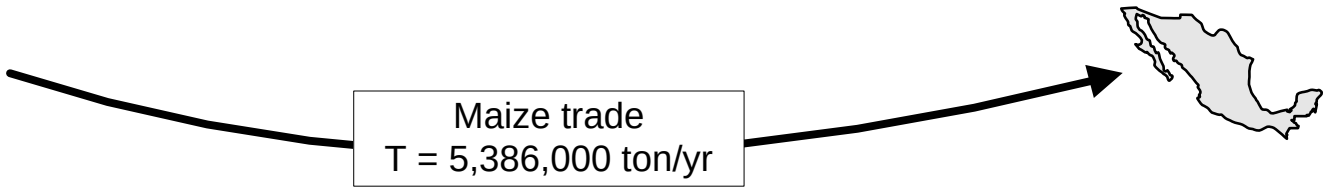
International trade can save water globally if a water-intensive commodity is traded from an area with high to an area with low water productivity.

Hoekstra et al. (2011)

Example Global water saving through maize trade from USA to Mexico

USA
Water footprint, WF_{USA} = 760 m^3/ton

Mexico
Water footprint, WF_{Mexico} = 2270 m^3/ton



National water loss
$\Delta S_n = WF_{USA} \times T$
= 760 x 5,386,000
= 4.09 x 10^9 m^3/yr

Global water saving
$\Delta S_g = T\,(WF_{USA} - WF_{Mexico})$
= 5,386,000 x (2270 - 760)
= 8.13 x 10^9 m^3/yr

National water saving
$\Delta S_n = WF_{Mexico} \times T$
= 2270 x 5,386,000
= 12.23 x 10^9 m^3/yr

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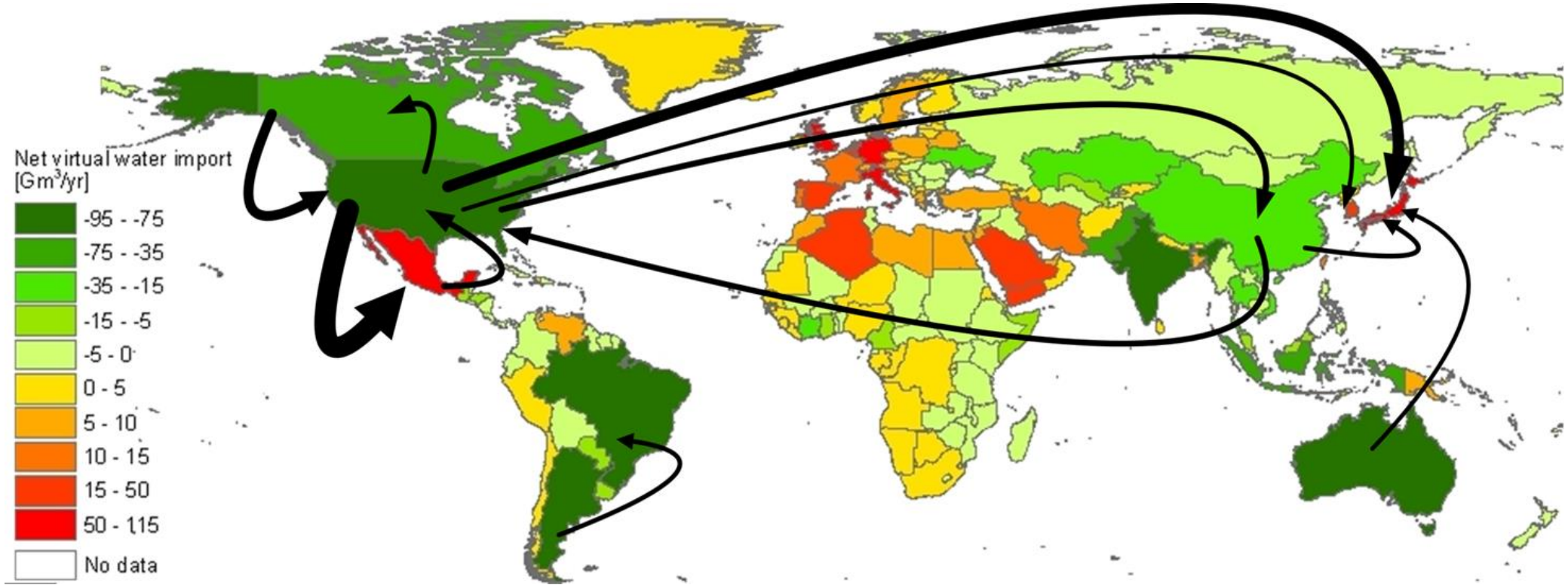
[Mekonnen & Hoekstra, 2011]

Water flows via international trade (virtual water)



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How much? International virtual water flows (1996-2005)

	Volume (billion m^3/yr)	Percentage (%)
Crop products	1766	76
Farm animal products	272	12
Industrial products	282	12
Total	2320	100

= 26% of global water footprint

UNIVERSITY OF TWENTE.

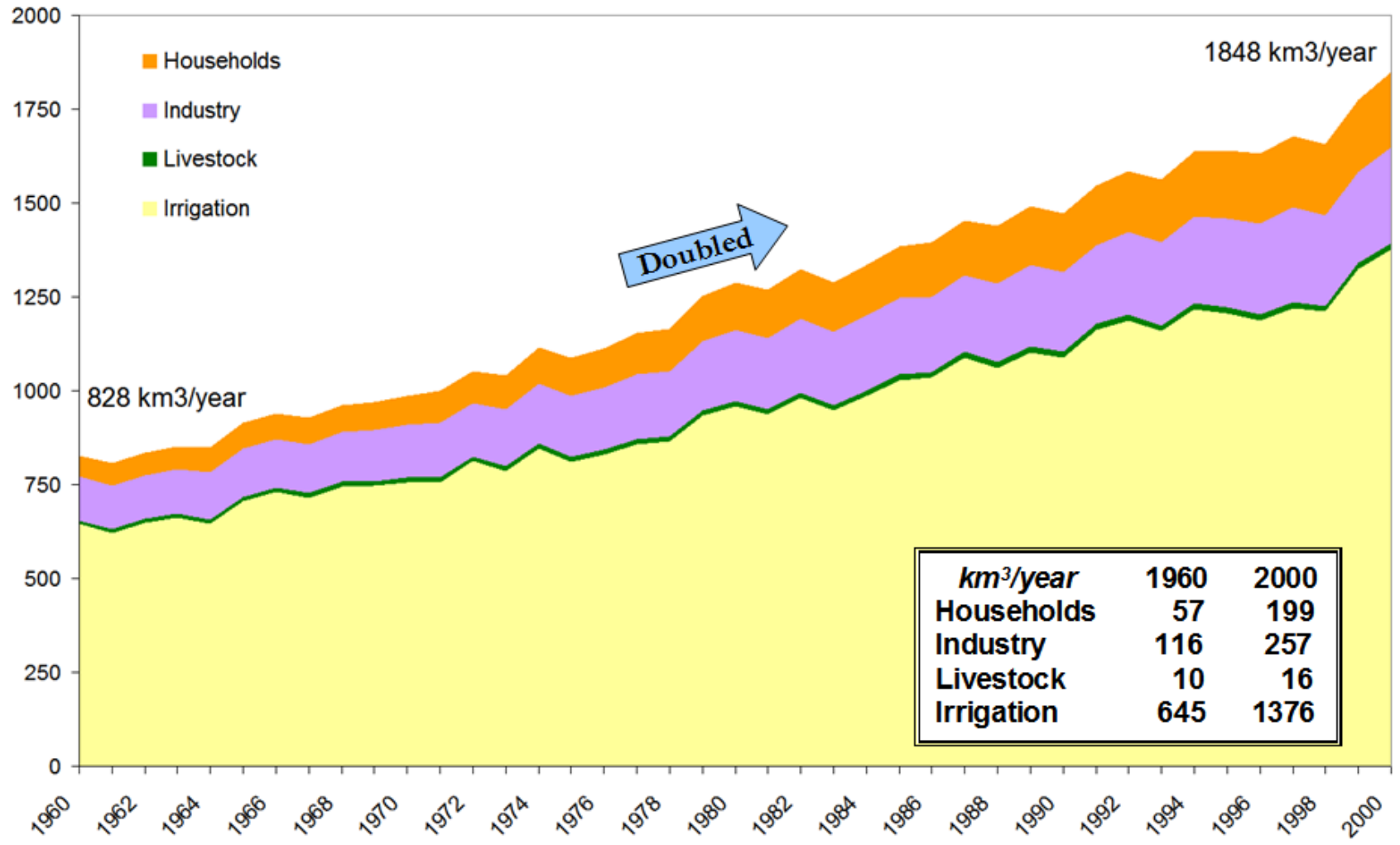
[Mekonnen & Hoekstra, 2011]

What about the weaker points, Future outlook

Deltares

Historical trends

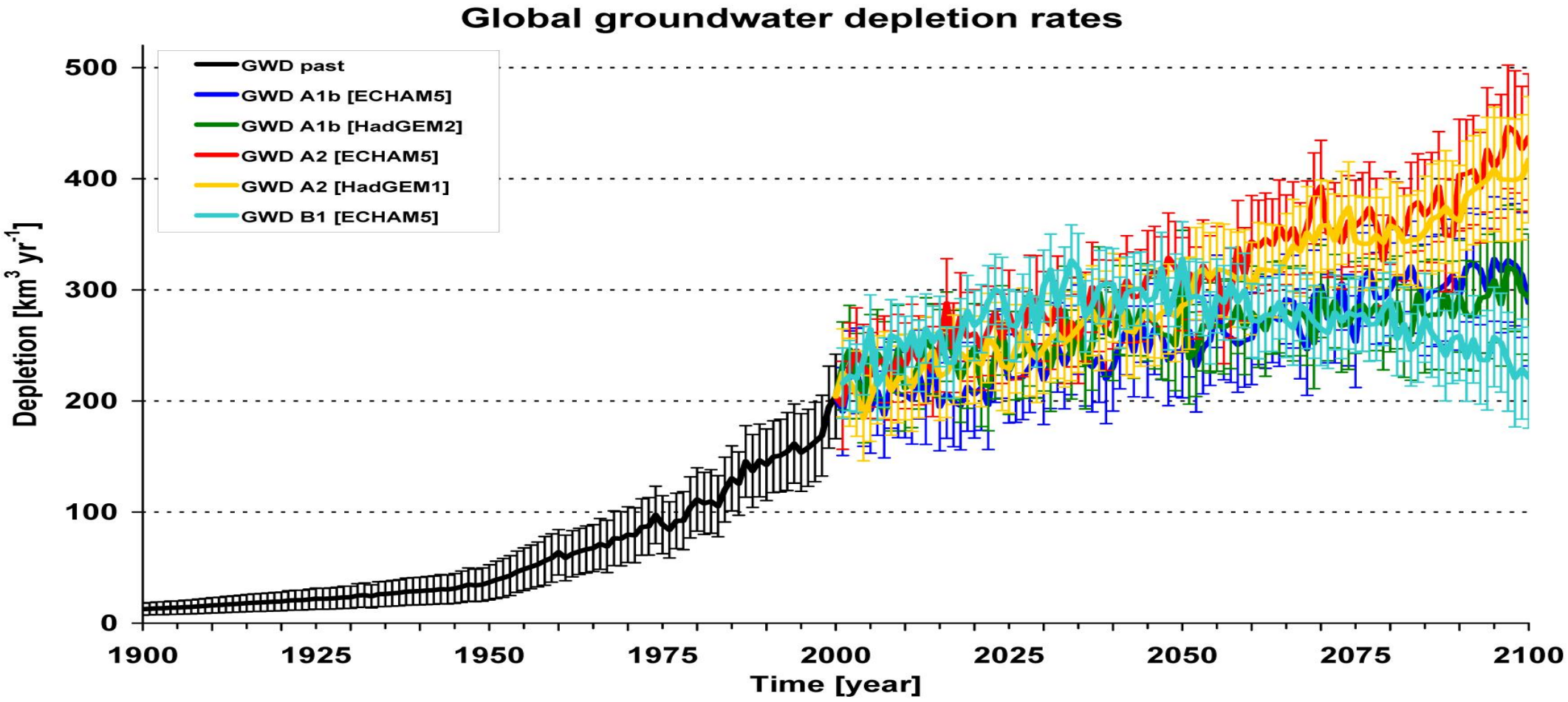
- Global water demand more than doubled during the period 1960-2000



km³/year	1960	2000
Households	57	199
Industry	116	257
Livestock	10	16
Irrigation	645	1376

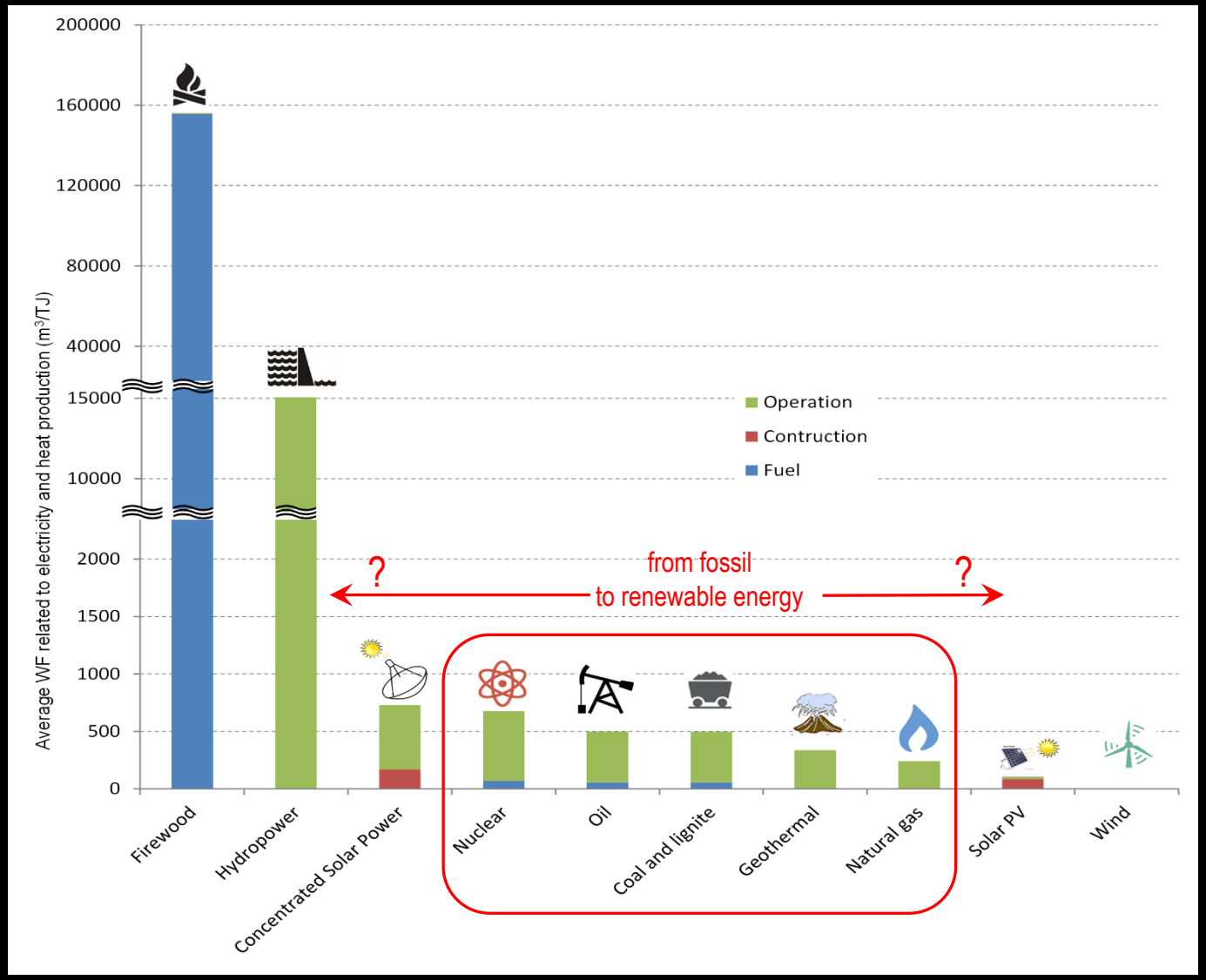
Wada et al., HESS, 2011

Expected Global Groundwater Depletion 1900-2100



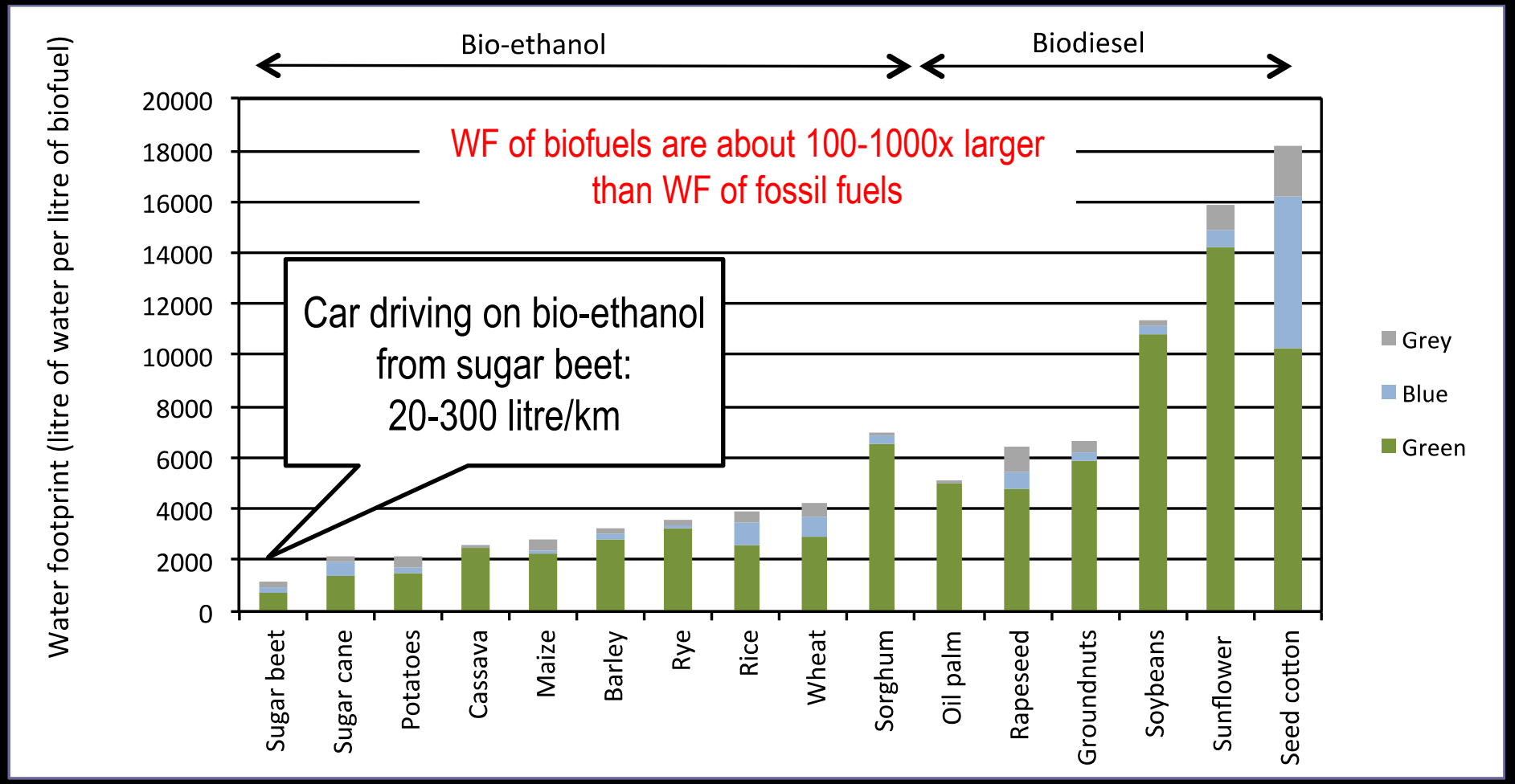
Wada et al., GRL, 2012

We are at the eve of the energy transition , The water efficiency of electricity. For the investments, should we turn left or right?



Source: Mekonnen, Gerbens-Leenes & Hoekstra (2015)

The water efficiency of biofuels from different crops [litre/litre]



Source: Mekonnen & Hoekstra (2011) The green, blue and grey water footprint of crops and derived crop products, *Hydrology and Earth System Sciences*

Take home messages

The GWP perspective on Water security is valuable but:

For sustainability a global perspective should be taken into account:

- Increasing water security for a specific country or basin should not be at the expense of decreasing water security elsewhere.
- Be aware on the virtual water flows through the supply chain, water footprints help to address these and answer the question ‘water security for who?’

In a rapidly changing world it may provide a false feeling of security

- Increasing water security requires decisions on interventions and investment over long periods. Making these decisions requires answers to questions such as – How much change can we handle? How much water will be needed and will be available? When should we be prepared?
- Be careful what are considered sustainable solutions in the energy transition.

Pathways to go

Industry:

Towards full water recycling in industries: zero blue water footprint

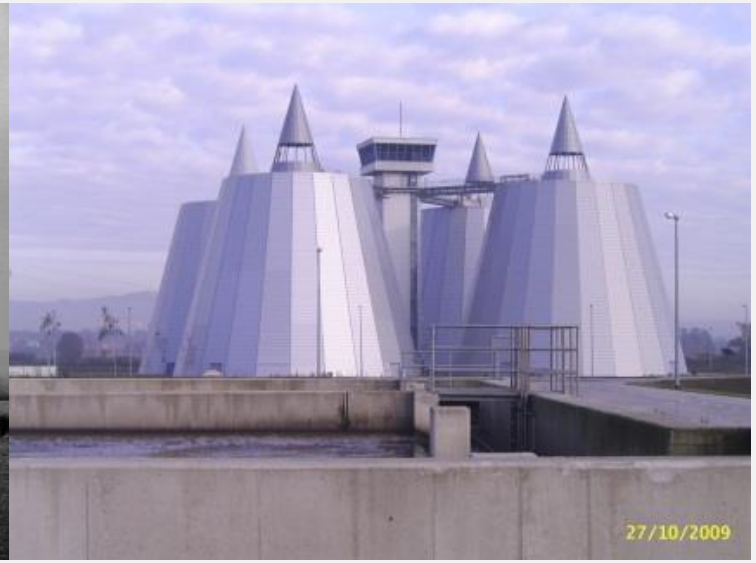
Towards full recycling of materials and heat: zero grey water footprint

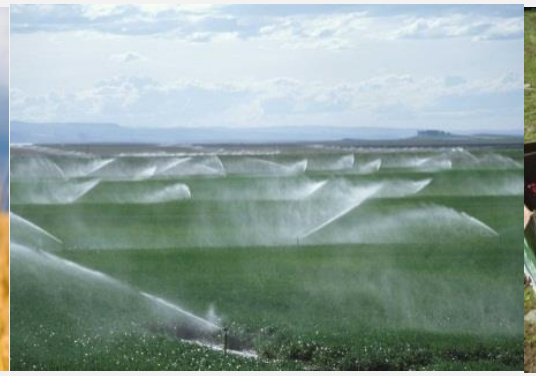
Agriculture:

Make rainwater more productive: lower green water footprint

Towards supplementary or deficit irrigation & application of precision irrigation techniques: lower blue water footprint

Towards organic or precision farming: zero grey water footprint





Courtesy, Joep Schyns

A lot we we know

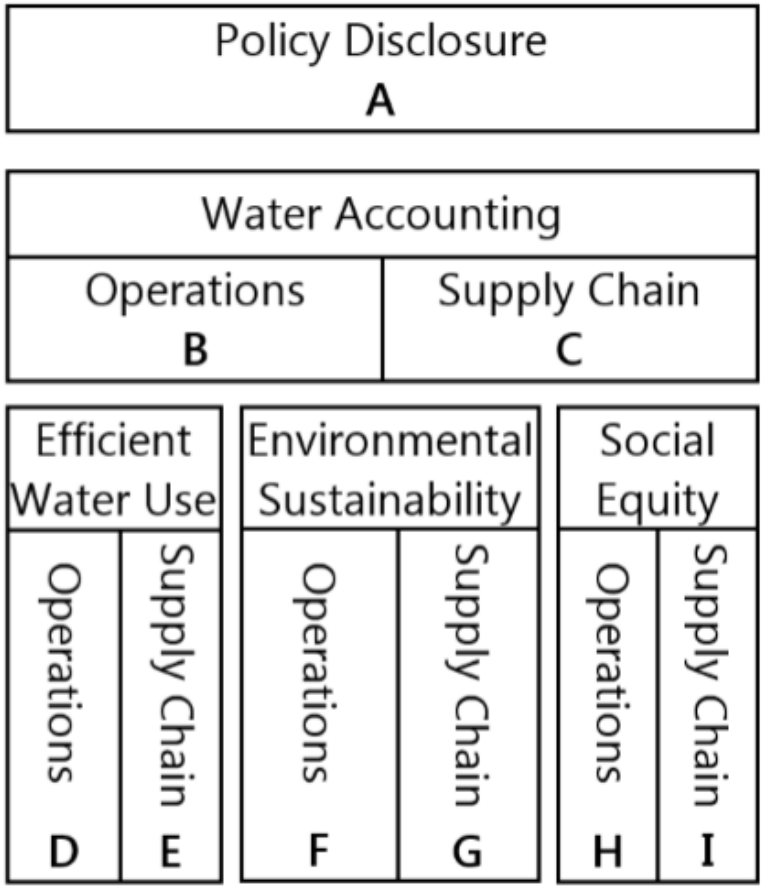
Water management and technology

- Rainwater harvesting
- Enhanced and/or artificial recharge
- Artificial recharge and recovery
- Conjunctive groundwater and surface water use
- Re-use, cascading and re-circulation

Economic measures

- Water pricing
- Subsidies
- Investment: financial arrangements (e.g. ppp)
- Investment: tax arrangements

A framework to consider for investment decisions on water



Hogeboom, et al (2018), Journal of Cleaner Production

What we eat is relevant

- The WF of animal production is 29% of the WF of the agricultural sector.
- The WF of the agricultural sector is 92% of the total WF of humanity.

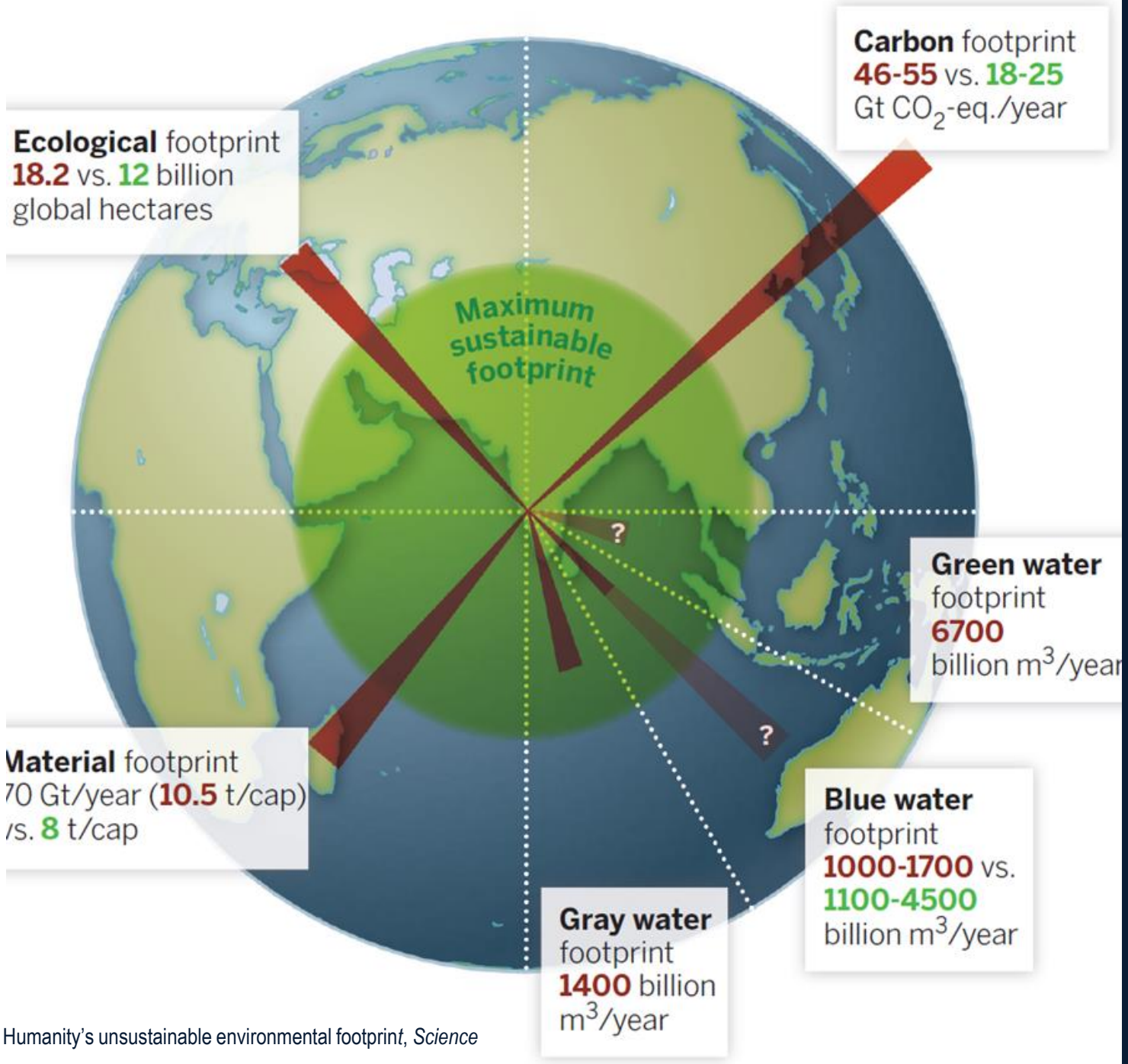
Courtesy, Joep Schyns

Planetary boundaries

But we better be quick as we are beyond our sustainable limits

We cannot afford this

THANKS



Source: Hoekstra and Wiedmann (2014) Humanity's unsustainable environmental footprint, *Science*