Responsibility of Japan for sustainable water use in the global supply chains

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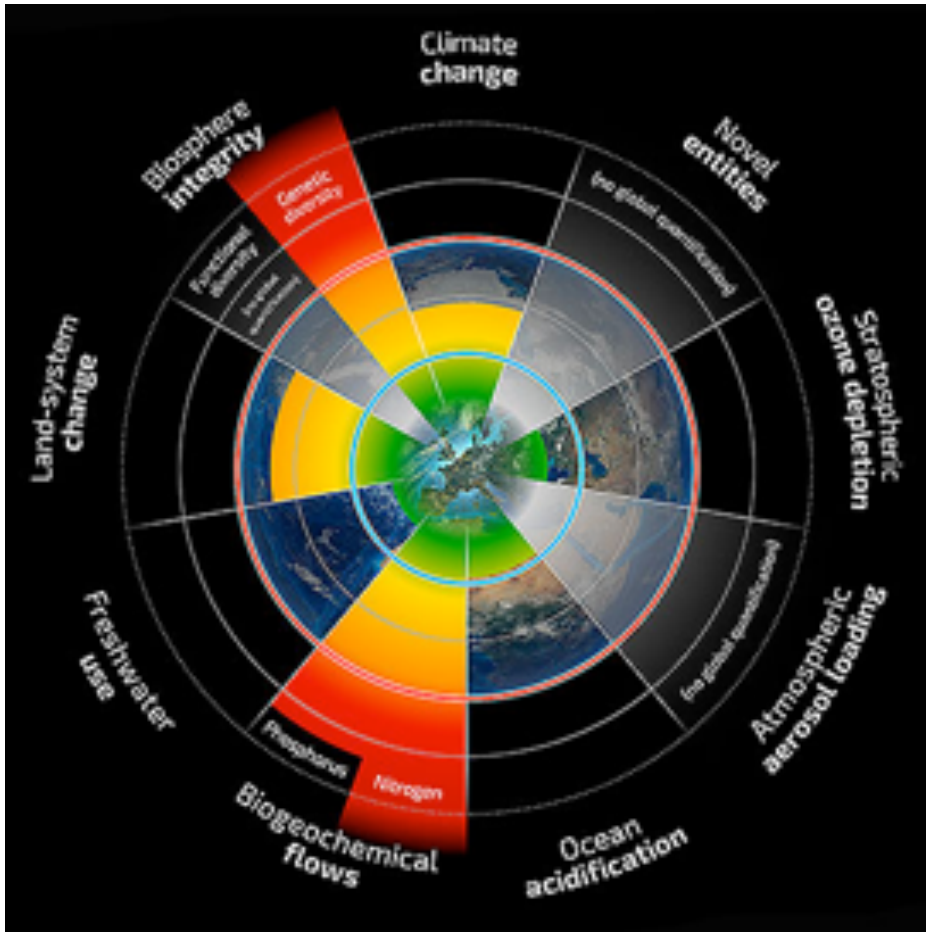
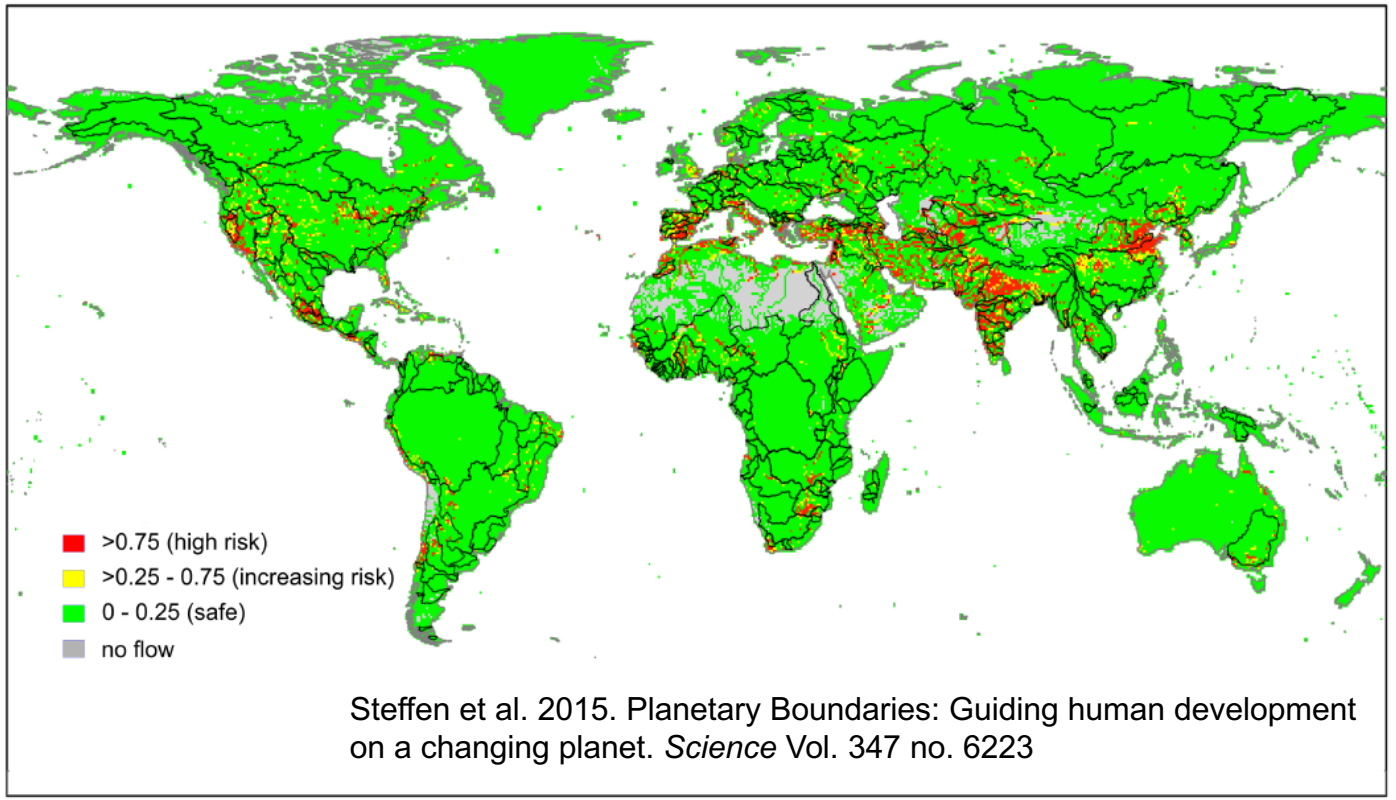
How much of water can we use?



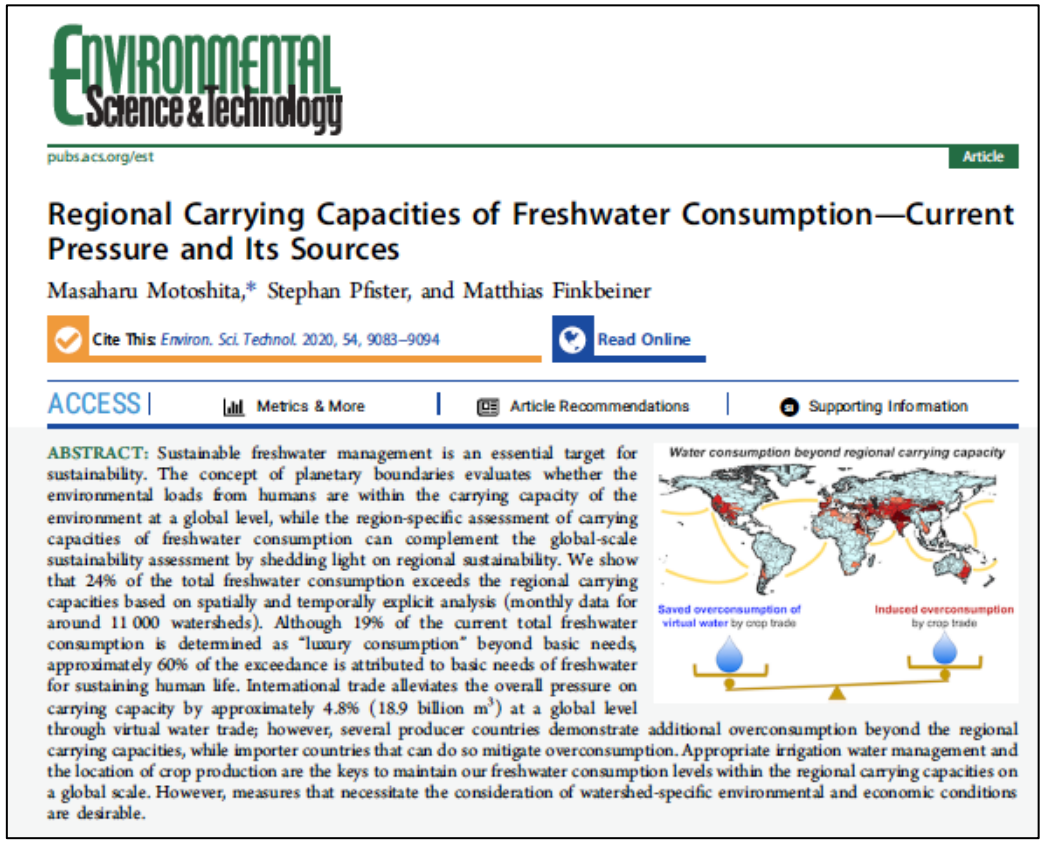
Rockström et al. 2009. A safe operating space for humanity. *Nature*, 461, 472-475.



Steffen et al. 2015. Planetary Boundaries: Guiding human development on a changing planet. *Science* Vol. 347 no. 6223

Adopted hydrological model (LPJmL) usually overestimates water flow compared with measured water flow.

Overconsumption beyond regional carrying capacity



Environmental Science & Technology

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Regional Carrying Capacities of Freshwater Consumption—Current Pressure and Its Sources

Masaharu Motoshita,* Stephan Pfister, and Matthias Finkbeiner

Cite This: *Environ. Sci. Technol.* 2020, 54, 9083−9094 | Read Online

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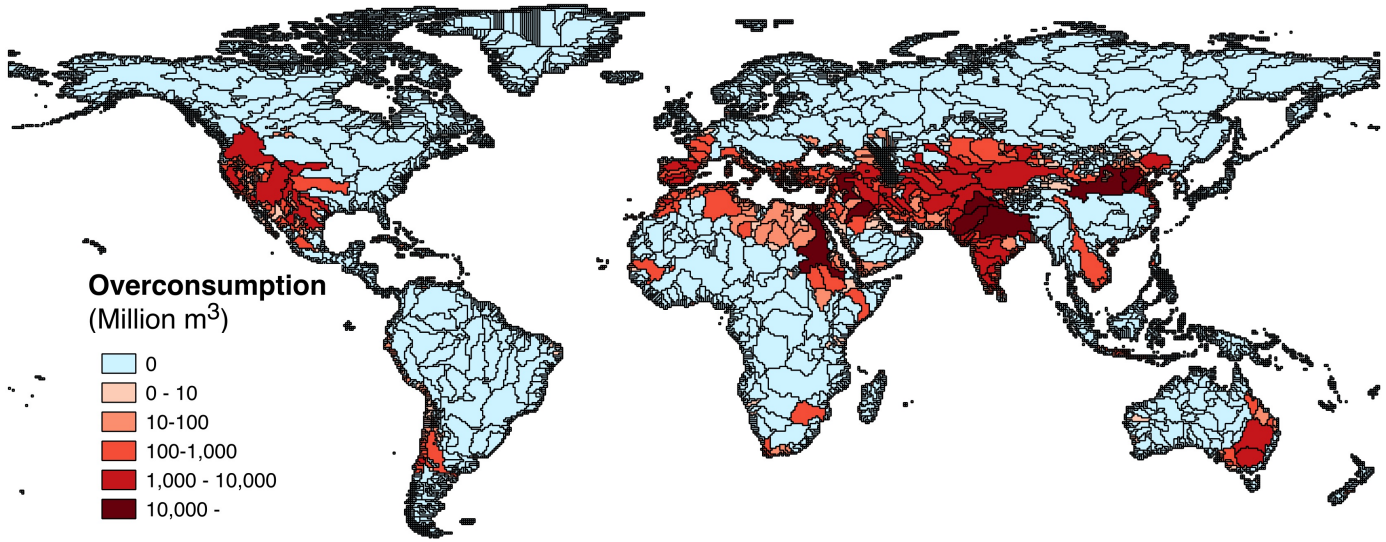
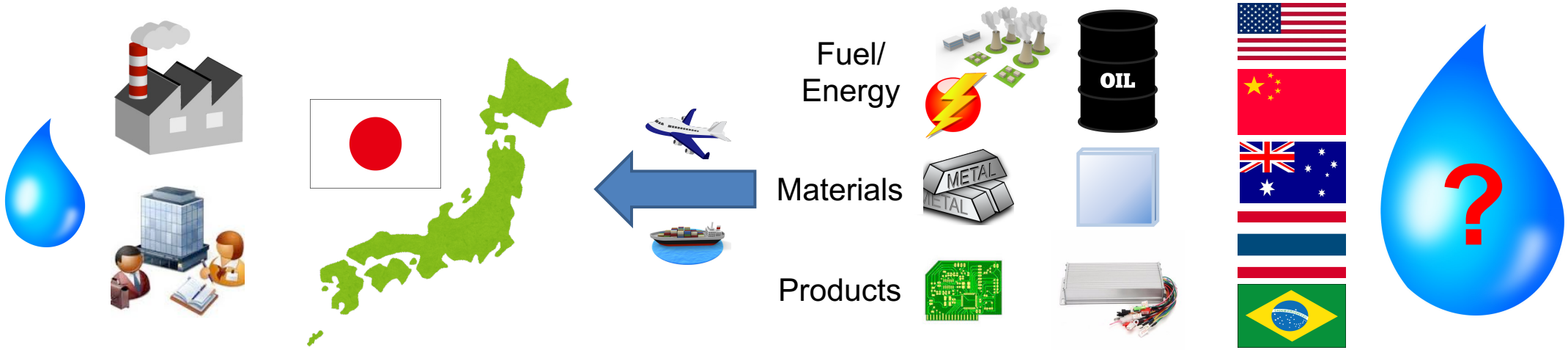
ABSTRACT: Sustainable freshwater management is an essential target for sustainability. The concept of planetary boundaries evaluates whether the environmental loads from humans are within the carrying capacity of the environment at a global level, while the region-specific assessment of carrying capacities of freshwater consumption can complement the global-scale sustainability assessment by shedding light on regional sustainability. We show that 24% of the total freshwater consumption exceeds the regional carrying capacities based on spatially and temporally explicit analysis (monthly data for around 11 000 watersheds). Although 19% of the current total freshwater consumption is determined as "luxury consumption" beyond basic needs, approximately 60% of the exceedance is attributed to basic needs of freshwater for sustaining human life. International trade alleviates the overall pressure on carrying capacity by approximately 4.8% (18.9 billion m^3) at a global level through virtual water trade; however, several producer countries demonstrate additional overconsumption beyond the regional carrying capacities, while importer countries that can do so mitigate overconsumption. Appropriate irrigation water management and the location of crop production are the keys to maintain our freshwater consumption levels within the regional carrying capacities on a global scale. However, measures that necessitate the consideration of watershed-specific environmental and economic conditions are desirable.

Masaharu Motoshita, Stephan Pfister, and Matthias Finkbeiner, Environmental Science & Technology ***2020*** *54 (14), 9083-9094 DOI: 10.1021/acs.est.0c01544*



- ***1/5 of total consumption*** (396 Billion m^3) exceeds regional carrying capacities.
- ***60%*** of overconsumption attributes to ***fundamental needs*** (food, drinks, sanitary use etc.).
- ***Virtual water trade alleviates*** the exceedance, but ***around 5%*** of the total overconsumption.

Responsibility as a consumer

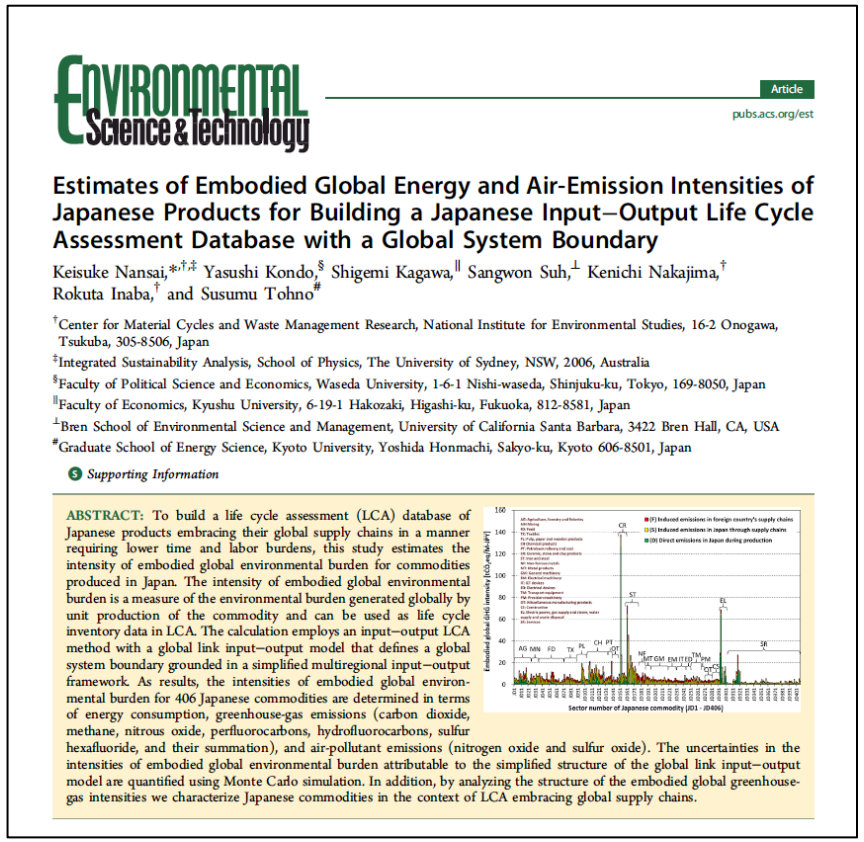


Rank	GDP (2019)*1	Imports (2019)*2
1	United Stats	United Stats
2	China	China
3	**Japan**	Germany
4	Germany	**Japan**
5	India	United Kingdom

How much do we induce water consumption and associated overconsumption in other countries?

*1 World Bank: World Development Indicators, *2 International Trade Centre: International Trade Statistics

Embodied water consumption in supply chains



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Estimates of Embodied Global Energy and Air-Emission Intensities of Japanese Products for Building a Japanese Input–Output Life Cycle Assessment Database with a Global System Boundary

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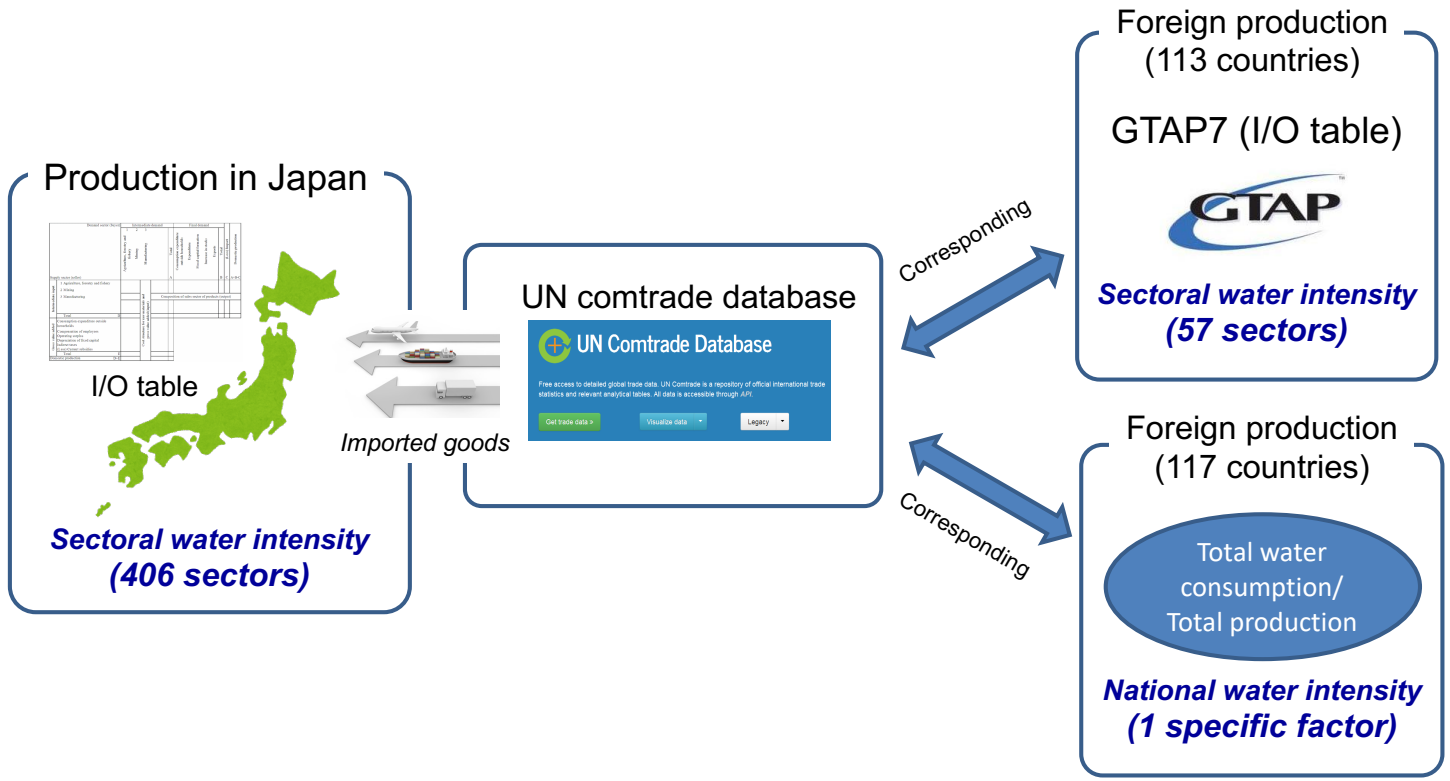
Supporting Information

ABSTRACT: To build a life cycle assessment (LCA) database of Japanese products embracing their global supply chains in a manner requiring lower time and labor burdens, this study estimates the intensity of embodied global environmental burden for commodities produced in Japan. The intensity of embodied global environmental burden is a measure of the environmental burden generated globally by unit production of the commodity and can be used as life cycle inventory data in LCA. The calculation employs an input–output LCA method with a global link input–output model that defines a global system boundary grounded in a simplified multiregional input–output framework. As results, the intensities of embodied global environmental burden for 406 Japanese commodities are determined in terms of energy consumption, greenhouse-gas emissions (carbon dioxide, methane, nitrous oxide, perfluorocarbons, hydrofluorocarbons, sulfur hexafluoride, and their summation), and air-pollutant emissions (nitrogen oxide and sulfur oxide). The uncertainties in the intensities of embodied global environmental burden attributable to the simplified structure of the global link input–output model are quantified using Monte Carlo simulation. In addition, by analyzing the structure of the embodied global greenhouse-gas intensities we characterize Japanese commodities in the context of LCA embracing global supply chains.

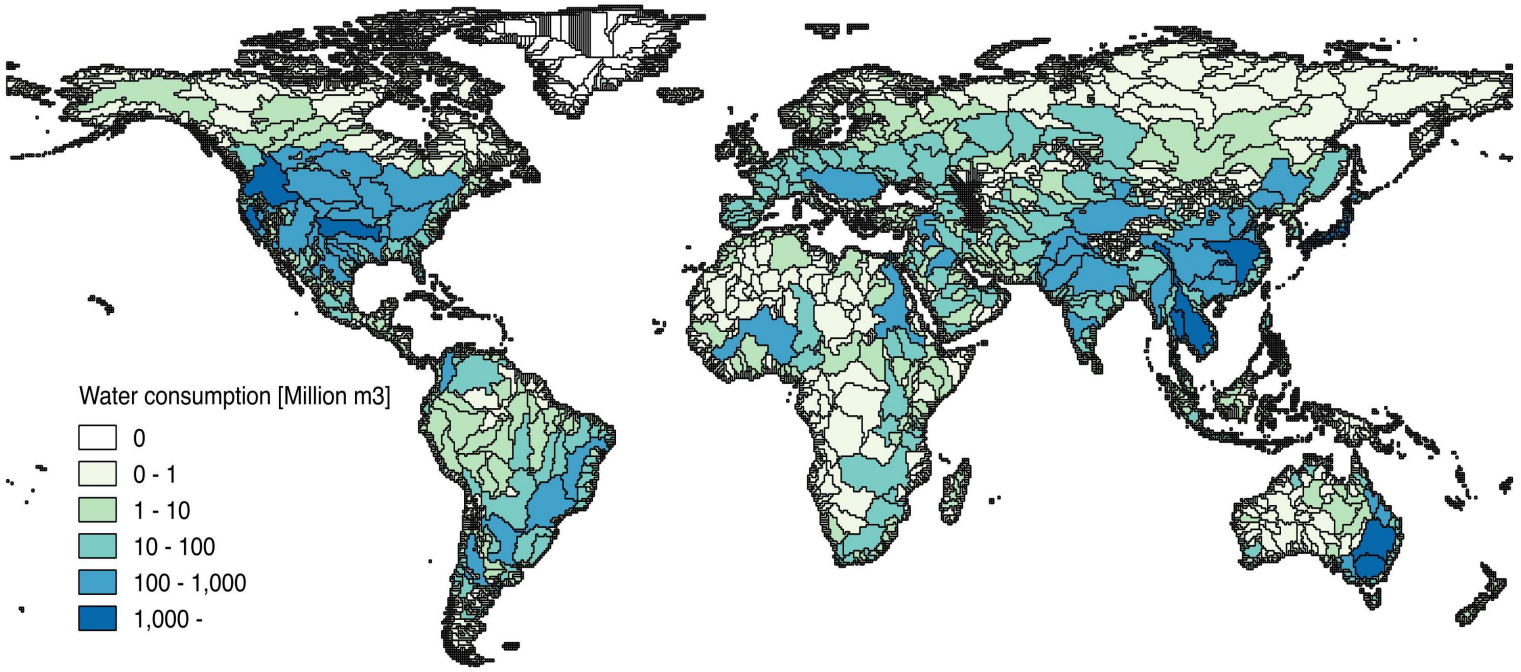
Nansai K., et al. *Environmental Science & Technology* **2012** *46* (16), 9146-9154
DOI: 10.1021/es2043257

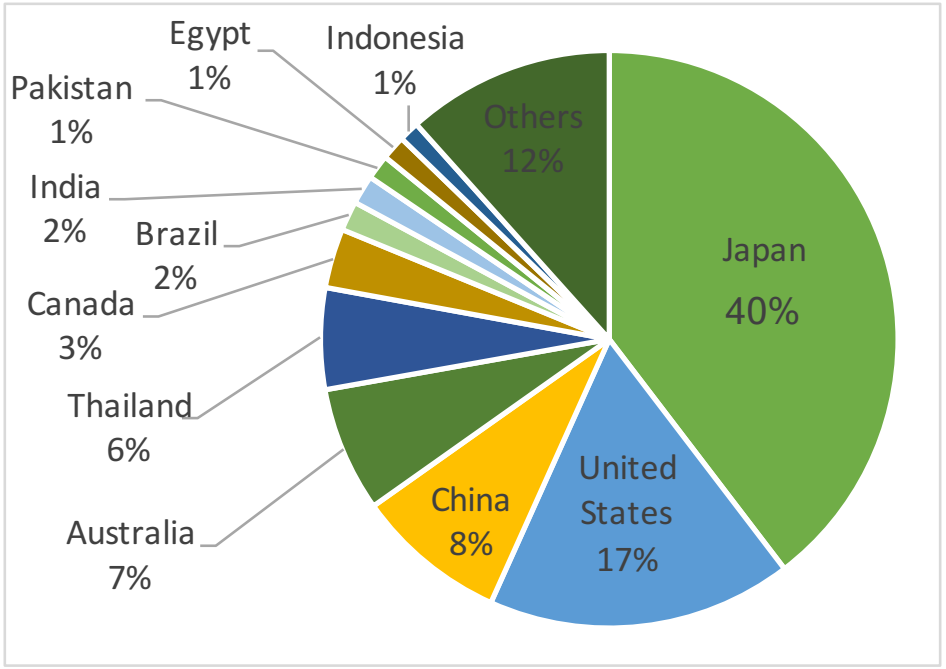


- Specificity to Japanese economy
- Country coverage (230 countries in the world)

Dependency on trade: water volume

Water footprint inventory of Japanese final demand



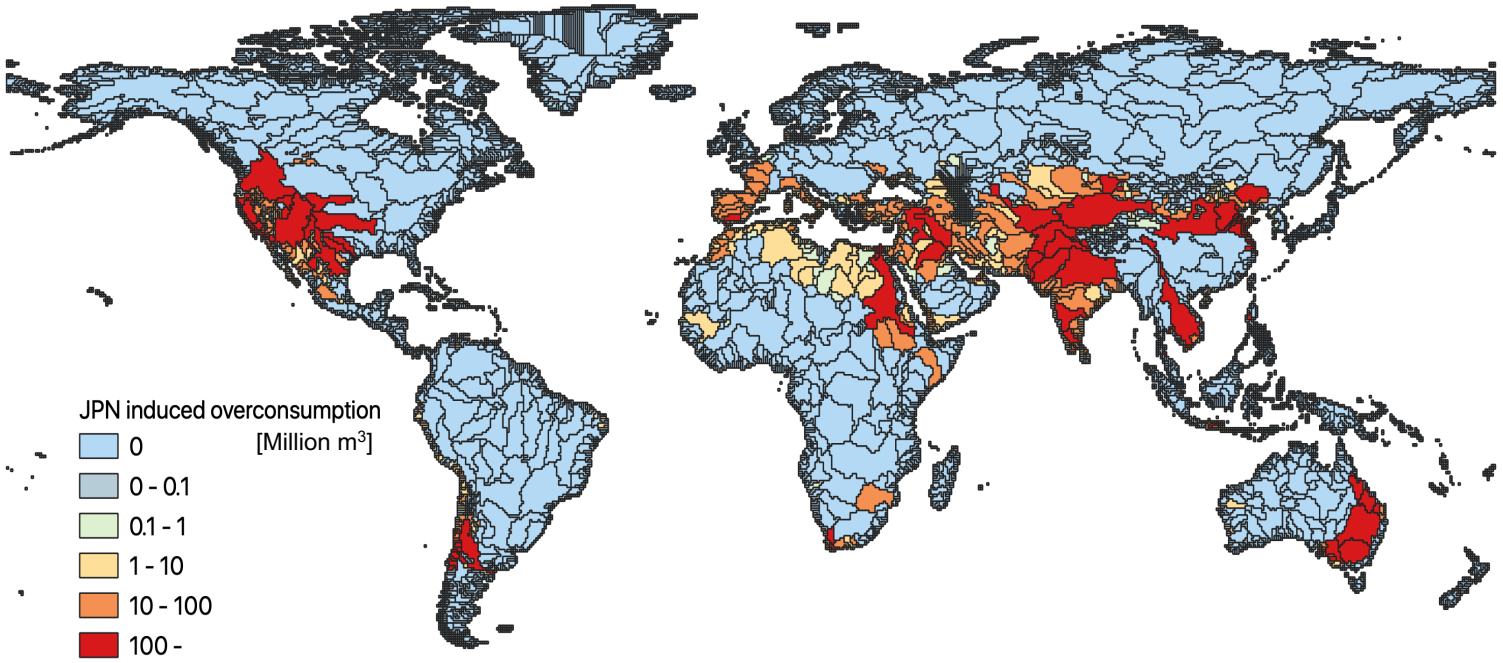


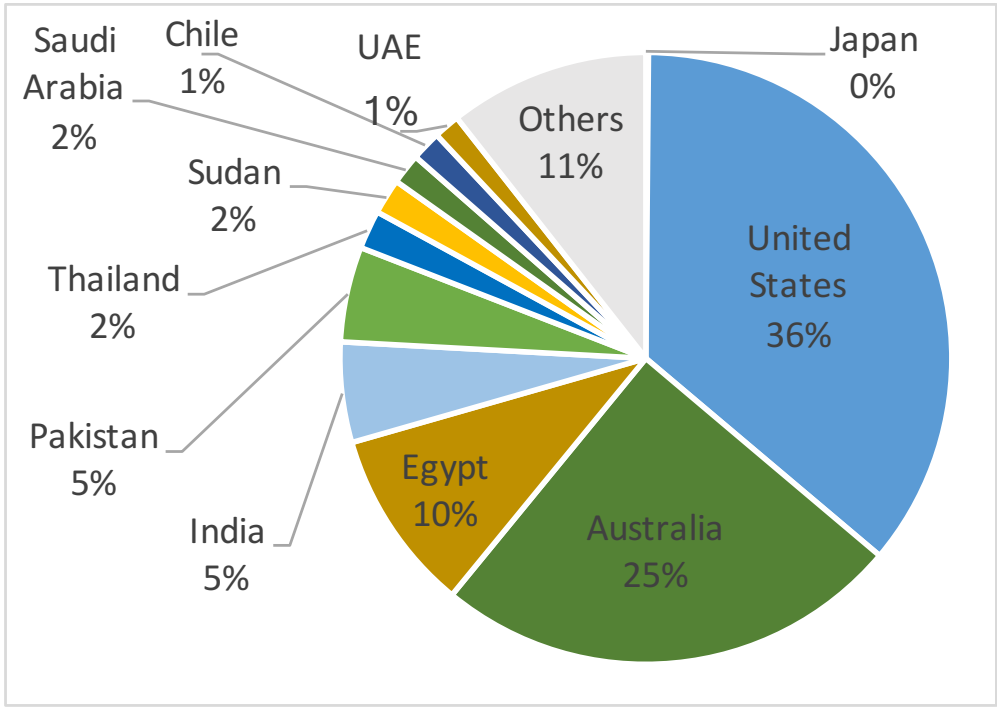
68.0 [Billion m³/year] ⇒ 566 [m³/capita/year]
⇒ 1,550 [L/capita/day]

60% of consumption in other countries

Dependency on trade: capacity exceedance

Overconsumption associated with Japanese final demand

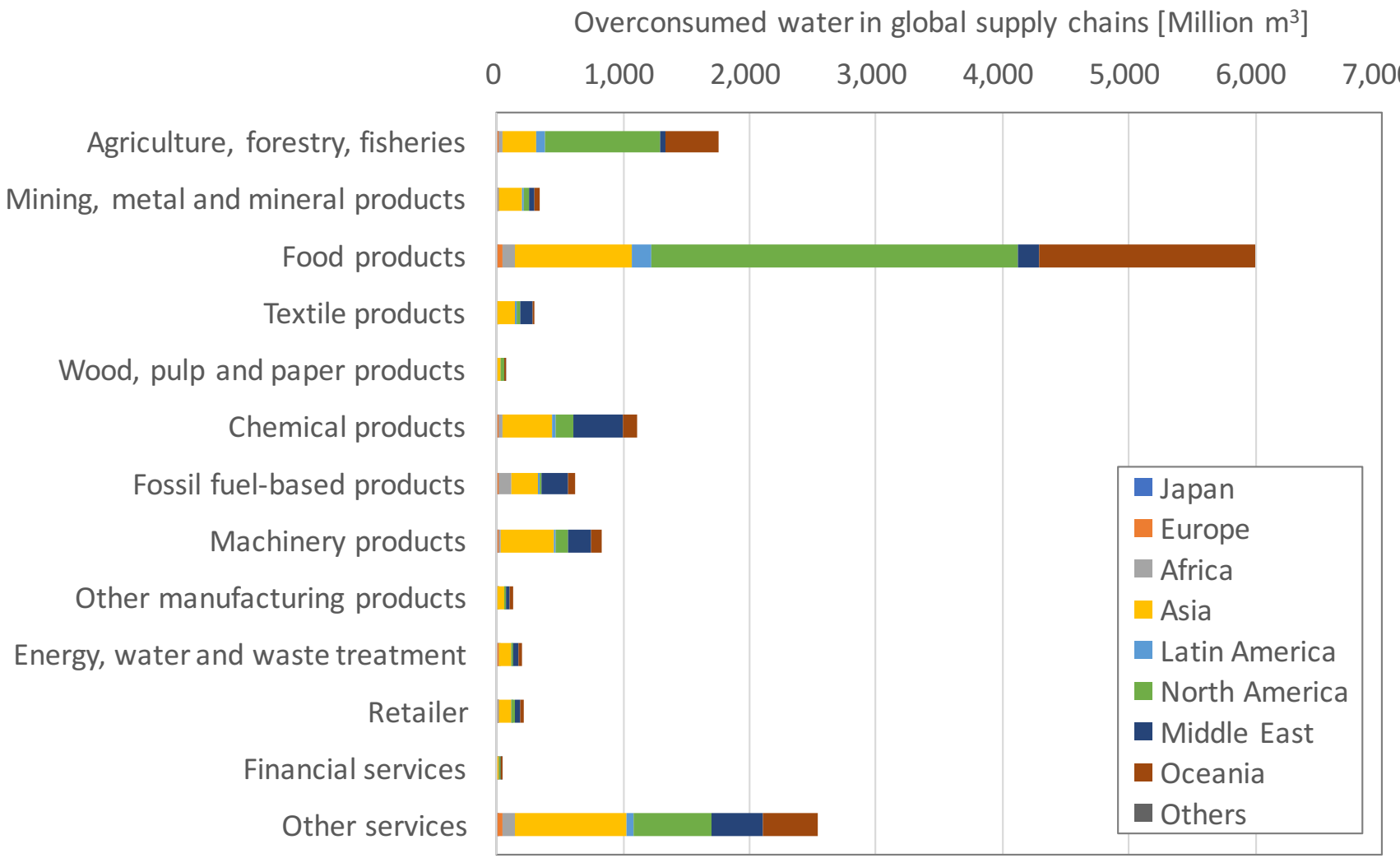




6.2 [Billion m³/year] ⇒ 52 [m³/capita/year]
(10% of total consumption)

All overconsumption occurs in other countries

What is the responsible demand?



Not only agri. related sectors but some industrial sectors show high significance to overconsumption in supply chains.

Quantity or responsibility?

Rank	Induced overconsumption		Responsibility to country's	
	Country	value	Country	value
1	United States	1,894	Thailand	15.5
2	Australia	1,303	United Arab Emirate	10.9
3	China	970	Australia	9.6
4	Egypt	507	Papua New Guinea	8.5
5	India	279	Saudi Arabia	8.2
6	Pakistan	265	Oman	6.8
7	Thailand	107	Canada	6.7
8	Sudan	99	Chile	6.2
9	Saudi Arabia	85	Namibia	6.0
10	Chile	83	Qatar	5.9

Even if the absolute amount is relatively small to the total, it matters for some supplier countries.

Summary

- ***High responsibility for regional sustainability of water use***

  Japanese economy depends on others for 60% of the total demand of freshwater, while all of overconsumption occurs in other countries.

- ***Food is not the only thing that matters***

  Irrigation water demand is critical in overconsumption, but other indusrial activities also matter.

- ***Quantity and responsibility***

  Small amount of overconsumption in some watersheds can not be disregarded in the context of local sustainability of freshwater.

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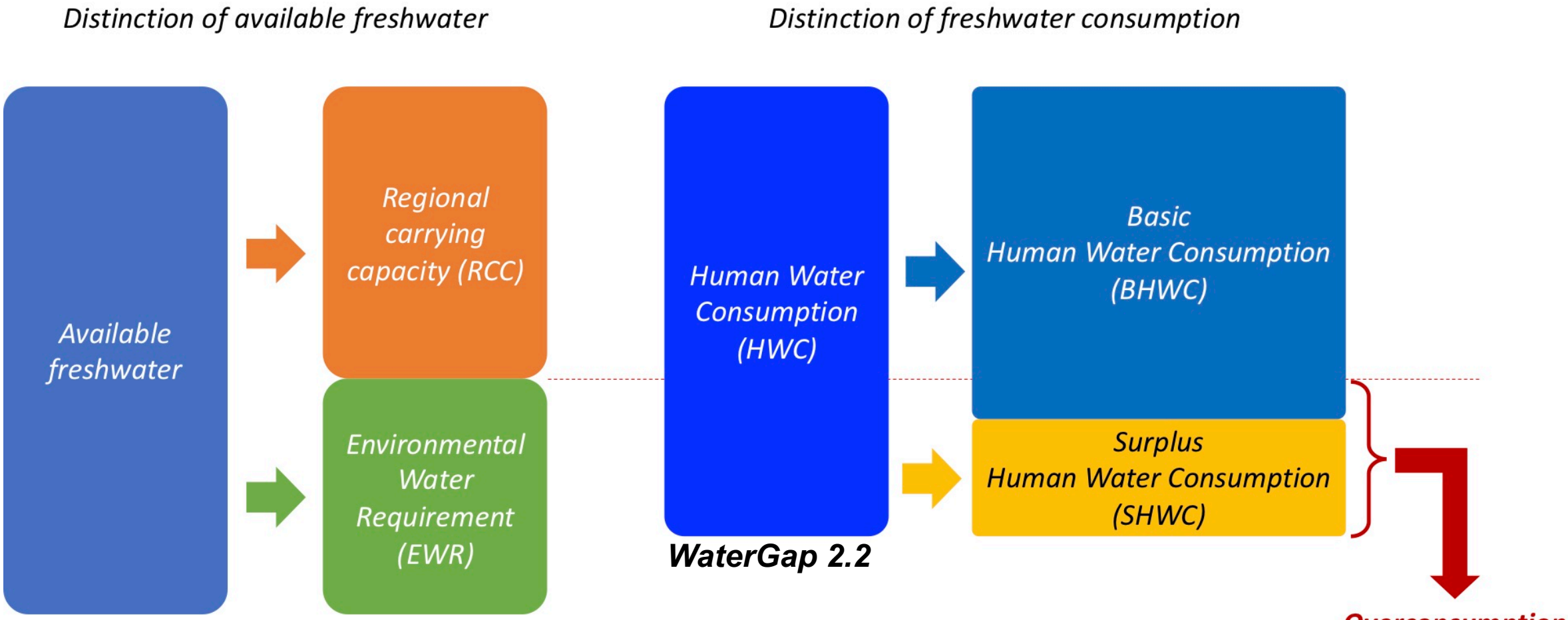
技術を社会へ– Integration for Innovation

Appendix 1: Determination of overconsumption



Pastor et al. (2014) Hyrdrol. Earth Syst. Sci., 18, 5041-5059

Appendix 2: Scarcity- & overconsumption-WF

- Water scarcity-based WF generally assess…

  how much of the marginal impacts could occur due to the target product system.

  ⇒ Potential of additional pressure on the environment.

- Overconsumption-based assesses…

  the contribution of the target product system to the current overconsumption.

  ⇒ Responsibility for the current state of overconsumption.