The Water Footprint of Modern Consumer Society[*]

Exercise questions

Preface

What is the order of magnitude of the price of drinking water in your country?
0.01 €/litre, 0.10 €/litre, 1.00 €/litre, 0.01 €/m^3, 0.10 €/m^3 or 1.00 €/m^3

Chapter 1

What is the basic definition of a 'footprint'?

Explain why adding up the full footprints of all companies in the world would give a lot of double countings.

Explain why we can add up the full footprints of individual consumers without double counting.

How much Earths do we currently use according to the Global Footprint Network?

If we want to understand the effect of the carbon footprint of humanity on the global climate, should we consider the current annual emission of greenhouse gas emissions or the cumulative greenhouse gas emissions over time? Explain.

What do we mean by 'carbon leakage'?

Chapter 2

What have been the four basic thoughts behind the development of the science of Water Footprint Assessment?

The historical focus on blue water and neglect of green water relates to the fact that water management has traditionally been the domain of the engineer. Explain why it has been quite understandable that water engineers focused on blue water, not green water.

What is the reason to be interested in gross water withdrawals? What is the reason to be interested in net water withdrawals?

Sketch the relations between the national water footprints of consumption and production and national virtual water import and export.

Chapter 3

How can freshwater be a renewable resource but finite though?

Water forms a cycle, it never disappears. So how is it possible to say that freshwater is scarce?

Why is desalination not the ultimate solution to the world's problems of freshwater scarcity?

Is freshwater a reproducible or a non-reproducible resource?

What are the two basic characteristics of a common pool resource?

What is free-rider behaviour?

Give five examples of free-rider behaviour outside the field of freshwater use.

Why is the mechanism of demand and supply of freshwater very different from other economic commodities?

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[*] Hoekstra, A.Y. (2020) The water footprint of modern consumer society: Second edition, Routledge, London, UK.

How can it be that it is economically attractive for farmers in semi-arid areas to overdraft groundwater?

List five reasons why freshwater is easily overexploited

What makes freshwater a global resource?

What is the basic building block for all water footprint accounts?

What is the difference between 'water abstraction' and 'water consumption'?

What is more important in global food production: green or blue water?

Measuring water footprints is innovative compared to measuring water withdrawals in three ways. What are these three innovations?

Chapter 4

How is it possible that the water footprint of one bottle of cola is much bigger than another, even when both bottles are from the same brand and have the same composition?

Why it is very limited if a beverage company uses "water withdrawal in their bottling plants" as a "key performance indicator"?

What is larger: the water footprint of a bottle of water or the water footprint of a bottle of orange juice?

Chapter 5

Crop yields (ton/ha) in irrigated agriculture are often higher than yields in rain-fed agriculture. Why aren't water productivities (ton/m^3) then generally higher as well?

How can international trade result in a "global water saving"?

What is the difference between "national water saving through trade" and "global water saving through trade"?

Give two reasons why bread wheat production in Italy gives less water problems than durum wheat production in the same country.

Chapter 6

Which fraction of the water footprint of humanity is related to the consumption of animal products?

Which stage in the supply chain of beef contributes most to the total water footprint of beef?

What are the two most important factors determining the water footprint of animal products?

Is the feed conversion efficiency of chicken smaller or larger than for beef cattle?

What are the two most important components in the water footprint of fish from freshwater ponds on land?

What sort of feed has a larger water footprint per kilogram: roughages or feed concentrates?

Explain why, in general, the water footprint of animal products is larger than the water footprint of crop products.

How would water allocation over different types of uses potentially change when one would look at getting most 'kcal per drop' instead of most 'crop per drop'.

Chapter 7

What is the most important crop contributing to the disappearance of the Aral Sea? What are the two most important rivers in the Aral Sea basin?

List two policy instruments that can be used to reduce the water footprint of agriculture in the Aral Sea basin.

Chapter 8

Give three examples of why the water sector is becoming more energy intensive.

Give two examples of why the energy sector is becoming more water intensive.

How do we define the 'energy return on investment' (EROI)? What does have a higher EROI: fossil fuels or biofuels?

From the perspective of its water footprint, is it more attractive to grow sugar beet or rapeseed for producing first-generation biofuel?

What generally has a larger water footprint: bio-ethanol or biodiesel?

Biofuel from miscanthus is a so-called second-generation biofuel. An advantage is that – unlike as in the case of first-generation biofuels – the cellulosic fraction of the plant can be turned into biofuel. What do you think about this sort of second-generation biofuel versus first-generation biofuel?

Miscanthus and jatropha are two non-edible crops and are therefore embraced as suitable energy crops, since competition with food is avoided. What do you think?

What is the most water-efficient mode of transport?

How do hydrogen cars perform compared to electric cars if in both cases the original energy source is solar or wind energy?

Why does hydroelectric generation often have a substantial blue water footprint?

How can mining shale gas form a threat to drinking water?

Mention two forms of energy that can contribute to energy supply at a relatively small carbon footprint and small water footprint at the same time.

Chapter 9

What is the country of origin of most import roses in the Netherlands? What is the name of the lake affected by the rose production in that country?

What is better: stop importing cut flowers in Europe from other continents or invest in improving the production circumstances in the source regions? Give the pros and cons of both options.

Explain why implementing a scheme for full-cost water pricing in agriculture is generally very difficult.

What are the pros and cons of raising a water-sustainability premium at the consumer end of the supply chain versus local measures to promote sustainable water use?

Chapter 10

What is the biggest water problem associated with paper mills?

Trees grown for timber and paper production mostly depend on rainwater. So why care about the water footprint in the forestry stage of producing timber and paper?

What are the two most obvious measures to reduce the water footprint of paper?

Chapter 11

Why is it impossible to say that one specific product or activity is sustainable or unsustainable? Or formulated more precisely: why do we always need to consider the full context?

If we would already have set water footprint caps for total blue water consumption in an area, why would it be good to have additional specific water footprint caps for groundwater consumption?

Which fraction of the land in the world needs to be reserved for nature according to the Convention on Biological Diversity? What is a more reasonable fraction according to ecologists?

The solution to unsustainable water consumption in water-scarce river basins lies partly in increasing the water productivity in water-abundant river basins. Explain how this can work.

Chapter 12

We can probably achieve zero water footprint in most manufacturing processes. However, this may come at a certain energy cost, why?

How can we define ‘blue water productivity’ in crop production?

How would water allocation over different types of uses potentially change when one would look at getting most ‘dollar per drop’ instead of most ‘crop per drop’.

Why water-efficiency improvements will not be sufficient to solve problems of water scarcity?

What is meant by water-use efficiency at local, river basin and global level, respectively? Give examples of what can be done at the different levels to increase efficiency.

Describe what precisely is meant with ‘zero water footprint’ in industry. How can this be achieved?

What is the difference between full, deficit and supplemental irrigation? Which of the three has highest water use per hectare? Which of the three has the highest water productivity (crop per drop)?

What do farmers try to minimize in case of ‘deficit irrigation’? And what do they try to maximize in case of ‘full irrigation?

What is the difference between irrigation efficiency and water-use efficiency? Give definitions of both concepts.

What precisely shows a ‘marginal cost curve’ (in general)? In the case of a marginal cost curve for water footprint reduction in irrigated agriculture, what measure will likely come first?

A water loss from the perspective of an irrigation engineer is not necessarily a water loss from the catchment manager. Please explain.

Mention two ways of setting water footprint benchmarks.

Setting water footprint benchmark for products can be useful for governments, businesses, investors and consumers. What is the usefulness to each of those actors?

Current international trade in agricultural commodities results in a global water saving of about x per cent. What is x?

International trade can result in global water losses or savings because of regional differences in water productivities. One can promote certain trade flows to increase global water savings, or one can

promote the increase in water productivities in those places where it is relatively low. What has your preference? Please explain why.

What is the ‘rebound effect’?

Give an example of the rebound effect in case of efficiency improvements in irrigation.

Chapter 13

What is the daily water footprint of the average global citizen? About 500, 1000, 2000 or 4000 litres?

What does the human right to water as formally acknowledged by the UN refer to? About how much water per person per day do we talk in the case of this right to water?

How can we translate the UN-ratified human right to *food* into a certain water requirement? About how much water per person per day do we talk in the case of this ‘right to water for food’?

Mention four reasons why the water footprint of humanity will probably increase in the coming few decades.

What do we mean by the ‘need for contraction and convergence’ of national water footprints?

How could a ‘Kyoto protocol’ or ‘Paris agreement’ for water look like?

In international negotiations, one can position countries in a power-interest grid. Explain the position of pushers, draggers, intermediates and bystanders.

In the hypothetical case of international negotiations on water footprint reduction, mention two countries that may likely be pushers. The same question for draggers, intermediates and bystanders.

Give examples of how we can achieve more equitable water use across people in the world (a) through addressing consumption patterns; (b) by improved production; and (c) by changing global production and trade patterns.

Chapter 14

Mention four major development principles to be taken into account in water allocation.

What policy instruments governments could employ to achieve (a) more sustainable and efficient *production* patterns; (b) more sustainable and equitable *consumption* patterns; and (c) more sustainable, equitable and robust *trade* patterns?

Give an example of an inevitable trade-off between sustainability and efficiency in the case of irrigation.

Give an example of an inevitable trade-off between equity and efficiency in the case of agriculture.

Give some pros and cons of both extensive and intensive farming.

Explain what we mean by ‘internal integration’ and external integration’ in water resources management.

Mention two major omissions in SDG6 on water.

Chapter 15

List four countries with very large domestic water savings as a result of trade.

Explain the concept of opportunity cost in the context of water allocation.

What is the difference between absolute and comparative advantage in trade?

The international trade theory on comparative advantage says that countries can have mutually beneficial trade because of differences in productivities. Suppose that country A has higher water productivities for two crops than country B. Explain with a numerical example why country A may still profit from trade with country B. [Assume the simplified case in which water is the only production factor.]

Since freshwater is hardly priced, regional differences in freshwater scarcity cannot influence international trade patterns. Nevertheless, international trade is influenced by water scarcity to some extent. If not through price, how can that happen?

Explain a possible 'logic' behind the water scarcity – export paradox.

Which important principle underlying 'free trade' is at odds with the possible wish of countries to set trade barriers against unsustainable products?

Why would we need an international agreement on sustainable water use that includes a clause allowing countries to raise trade barriers for non-sustainable products?

Chapter 16

Why product transparency is important? And for which different actors is it important?

How can we measure 'good water stewardship'?

Chapter 17

What is meant by 'the race to the bottom'?

What can ordinary citizens do to promote sustainable water use?

What are four different possible incentives for companies to work on sustainable water use in their operations and supply chain?

Do companies bear responsibility for the production circumstances in their supply chain? If no, who does have this responsibility instead? If yes, what can companies do to take this responsibility? Give your personal opinion.

What can a government do in its agricultural and energy policies to promote sustainable water use?

What can a government do in its tax policy to promote sustainable water use?

Do the people in a country bear responsibility for the circumstances under which their consumer products are produced when production occurs in another country? If no, who does have this responsibility instead? If yes, what can people do to take this responsibility? Give your personal opinion.