

Role Play on Globalization of Water Management¹

Interactive Learning about Water Footprint and Virtual Water Trade

Hand-Out to Participants

About 85% of fresh water use in the world is applied in agriculture to grow crops for food, animal feed, cotton, and bio-fuel. These goods are increasingly being traded across national borders. As water is required to produce commodities for export, consumers have a 'water footprint' outside their national borders. Trade can enhance global water-use efficiency when crops are grown at other locations with the use of less water. It can also shift the environmental burden to distant locations. The link between national consumption of food, natural fibres and bio-energy from agriculture on the one hand and the use of water resources across the globe on the other can be assessed with the water footprint and virtual water trade assessment framework as developed by Hoekstra and Chapagain (2008).

This role play is developed to illustrate the above concepts through active participation and interaction by participants, as an introduction to analyzing the impact of globalization on water management.

Learning Objectives

This role play aims to illustrate:

1. the global dimension of water management, through trading of water-intensive products, including trans-border externalities (i.e. the import of water-intensive commodities contributes to water scarcity and reduced environmental water flows in other countries);
2. the concept of comparative advantage applied to water (i.e. a country can profit from exporting water-intensive commodities for which it has *relatively* high water productivity and importing commodities for which it requires relatively a lot of water per unit);
3. national water self-sufficiency versus water-dependency.

In addition, you will also come across issues relating to water conflicts among different sectors and water for nature; the water-intensity of animal products compared to that of crop products (in terms of m³/calorie); and the difference between green and blue water use (e.g. in rain-fed agriculture, both productivities and negative externalities are relatively small if compared to irrigated agriculture).

Develop Your Country by Wise Water Use and Trade

In this role play you will represent the government of a country that tries to increase the national development level, which is reflected by six development indicators. (Other indicators also exist, but for the purpose of the role play and to simplify, six major factors are used as indicators).

Food supply. This indicator shows the supply of three food categories: (1) grains, (2) vegetables & fruits, and (3) meat & dairy products. Per food category, the actual supply will be compared with a

¹ Designed by A.Y. Hoekstra, M.M. Mekonnen and P.W. Gerbens-Leenes, University of Twente, the Netherlands (e-mail: a.y.hoekstra@utwente.nl; website www.waterfootprint.org). The development of the role play is funded by the World Bank Institute (WBI), in collaboration with University of Twente (Feb. 2009), as part of a WBI core learning program on water management, led by Mei Xie, WBI Water Team. mxie@worldbank.org.

reference food supply level, which indicates the level beyond which additional quantities are no longer beneficial.

Economic development. Welfare is assumed to depend on three factors: (1) food supply, (2) cotton supply and (3) bio-energy supply. There are of course various relevant production factors (land, soil, water, labour, etc.), but this role play focuses on fresh water as the limiting production factor – the development of a country is hampered by water shortage and/or low water productivity, not by other factors. Your country can produce the various commodities domestically through either rain-fed agriculture or irrigated agriculture. In the case of meat and dairy products, you need water for sustaining pastures and producing feed crops. A question that you have to solve as a government is: how should water be allocated over the different sectors of economy? You can decide on water allocation and thus domestic production per sector, but you can also decide on trade. Produced commodities can be internationally traded against other commodities.

Environment. This indicator reflects how well your country meets the environmental flow requirements in your rivers and water bodies. As a guideline, 40% of the available blue water resources (surface and groundwater flows) is needed to maintain healthy aquatic ecosystems, and 50% of the available green water resources (evaporation flows from land) is needed to maintain natural vegetation.

Water footprint. Try to reduce the global water footprint related to the consumption within your country. The water footprint of a country is defined as the total amount of water that is used to produce the goods and services consumed by the inhabitants of the country. It includes two components: the part of the footprint that falls inside the country (internal water footprint) and the part of the footprint that presses on other countries in the world (external water footprint).

Water saving. Your country can save domestic water resources by importing commodities that require a lot of water and exporting commodities that require less water.

Dependency on foreign resources. You need to decide to what extent your country may depend on foreign resources or to what extent it needs to be self-sufficient.

The setting

Four countries. For simplicity we have a world with four countries. The countries fundamentally differ in terms of climate, development, water availability and water productivity. To simplify, each country has 50 million inhabitants (but this number needs not to be used because all data on water availability and commodity demand are provided on a per-capita basis). The ideal number of participants is *twelve persons – three persons per country* for four countries. When there are more than twelve people, one can play in parallel worlds.

	Country A	Country B	Country C	Country D
Climate	Temperate	Mediterranean	(Sub)tropical wet	(Sub)tropical dry
Development status	Developed	Developed	Developing	Developing
Water endowment	Humid	Semi-arid	Humid	Semi-arid
Water productivity	High	Very High	Very low	Low

Three roles per country. For each country, you will first assign the following roles among yourself (it is best to have one role per person to endure full participation):

- Head of State, coordinating decisions but mostly interested in the national economy.
- Minister of Environment, responsible for allocating water in a sustainable manner.
- Minister of Trade & Foreign Affairs, responsible for negotiating with other countries and relation with other countries.

Six rounds. The role play consists of several rounds, depending on the time available. Each round corresponds to *one year*. Playing one round will take about 30 minutes: 20 minutes for making decisions on water allocation, production, trade and consumption in that round and 10 minutes for feedback from the facilitator. The first round is likely to take more time.

Decisions You Will Make in Each Round

In each round, your country needs to make the following decisions:

- Allocate the available green water resources (broadly speaking “rain water”, technically “evaporation flows”) and blue water resources (ground/surface water flows) over the five sectors of economy and the environment.
- Decide, per sector, how the produced commodities are distributed over consumption and export.
- Exchange the exports for other commodities. Imported commodities are used for consumption.

Commodities can be traded through barter. The price of commodities in terms of another commodity is to be negotiated between the trading countries. You may decide to meet and negotiate with other countries to trade, because your country can import a particular commodity only when other countries export that commodity.

Development Indicators

Development indicators are calculated per country at the end of each year (round). The table below shows the various indicators and how they are calculated. Welfare increases linearly with the increase of food, cotton and bio-energy supply. However, in the case of food, welfare does not increase beyond the reference values as given in the second table below.

Category	Indicator	Unit	Calculation
Food supply	Grain supply	kg/yr/cap	C_1
	Vegetable & fruit supply	kg/yr/cap	C_2
	Meat & dairy products supply	kg/yr/cap	C_3
Economic development	Welfare	-	$1/3 \times [F + C + B]$
	• Food supply indicator (F)	-	$1/3 \times [\text{MIN}(1, C_1 / C_{1,\text{ref}}) + \text{MIN}(1, C_2 / C_{2,\text{ref}}) + \text{MIN}(1, C_3 / C_{3,\text{ref}})]$
	• Cotton supply indicator (C)	-	$C_4 / C_{4,\text{ref}}$
	• Bio-energy supply indicator (B)	-	$C_5 / C_{5,\text{ref}}$
Environment	Meeting environmental flow requirements	%	$\text{MIN}(100, 100 \times (\text{Water availability} - \text{Water use}) / \text{Environmental flow requirement})$
Water footprint	Green water footprint	$\text{m}^3/\text{yr}/\text{cap}$	Water use behind consumed commodities that were made with green water
	Blue water footprint	$\text{m}^3/\text{yr}/\text{cap}$	Water use behind consumed commodities that were made with blue water
	% above your equal global water share	%	$100 \times \text{Total water footprint} / \text{Global water availability}$
Water saving	National green water saving	$\text{m}^3/\text{yr}/\text{cap}$	Net import of commodities produced with green water / green water productivities
	National blue water saving	$\text{m}^3/\text{yr}/\text{cap}$	Net import of commodities produced with blue water / blue water productivities
Dependency	Dependency on foreign resources	%	$100 \times \text{External water footprint} / \text{Total water footprint}$

C_x = consumption of commodity x; $C_{x,\text{ref}}$ = reference consumption as given in the table below.

Commodities: 1 = food grains, 2 = vegetables/fruits, 3 = meat/dairy products, 4 = cotton, 5 = bio-energy.

Commodity	Reference figure for the commodity demand (kg/yr/cap)
Food grains	160
Vegetables & fruits	150
Meat and dairy products	80
Cotton	25
Energy crops	100

The Game Board

To make your decisions more visible, you can use a game board, a smaller version of which is attached as an illustration. Each country has its own game board.

1. Each round you put the amount of available green and blue water resources on the proper fields in the upper part of the board.
2. You allocate the available water by moving the water units down to the various sectors of economy and the environment.
3. Per economic sector, the water allocated will produce a certain amount of commodity (the amount depending on your country's green and blue water productivity). [To save time, you can report your water allocation to the facilitator, who can calculate for you the corresponding amount of commodity production]
4. Per economic sector, the commodity units can be used for consumption or export to other countries (global market).
5. Exports can be exchanged for import of other commodities from other countries. Imports are used for consumption.
6. At the end of a round, you remove all commodities from the consumption field and start all over with step 1.

Recording Your Decisions

Attached, you will find a "country record sheet". In each round (year), you will need to fill in a row for that year (round) for all the tables. [To save time, you can report your water allocation to the facilitator, who can calculate for you the corresponding amount of commodity production.]

You will hand over the filled record sheet to the facilitator, who will feed your record into a computer model that calculates the development indicators for you. At the end of each round, the facilitator gives feedback to you on your country's food supply, welfare, environment, global water footprint, national water saving and resource dependency. You will start the next round only after the facilitator announces it.

Reference

Hoekstra, A.Y. and Chapagain, A.K. (2008) Globalization of water: Sharing the planet's freshwater resources, Blackwell Publishing, Oxford, UK.

Country record sheet

Name of world:

Your country:

Water allocation (m³/yr/cap)

	Food grains		Vegetables & fruits		Meat & dairy products		Cotton		Energy crops		Environmental flows	
	Green	Blue	Green	Blue	Green	Blue	Green	Blue	Green	Blue	Green	Blue
year 1												
year 2												
year 3												
year 4												
year 5												
year 6												

Commodity production (kg/yr)

	Food grains	Vegetables & fruits	Meat & dairy products	Cotton	Energy crops
year 1					
year 2					
year 3					
year 4					
year 5					
year 6					

Export (kg/yr)

	Food grains	Vegetables & fruits	Meat & dairy products	Cotton	Energy crops
year 1					
year 2					
year 3					
year 4					
year 5					
year 6					

Import (kg/yr)

	Food grains	Vegetables & fruits	Meat & dairy products	Cotton	Energy crops
year 1					
year 2					
year 3					
year 4					
year 5					
year 6					

Consumption (kg/yr)

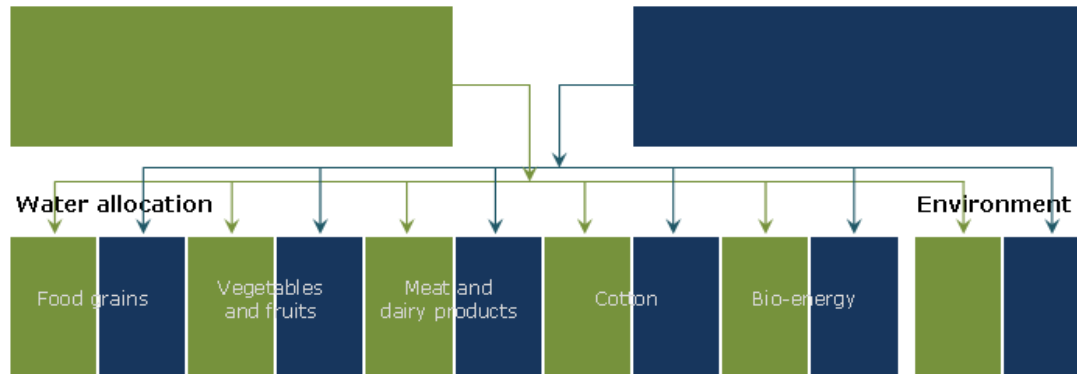
	Food grains	Vegetables & fruits	Meat & dairy products	Cotton	Energy crops
year 1					
year 2					
year 3					
year 4					
year 5					
year 6					

Game board

At water at the start of a round

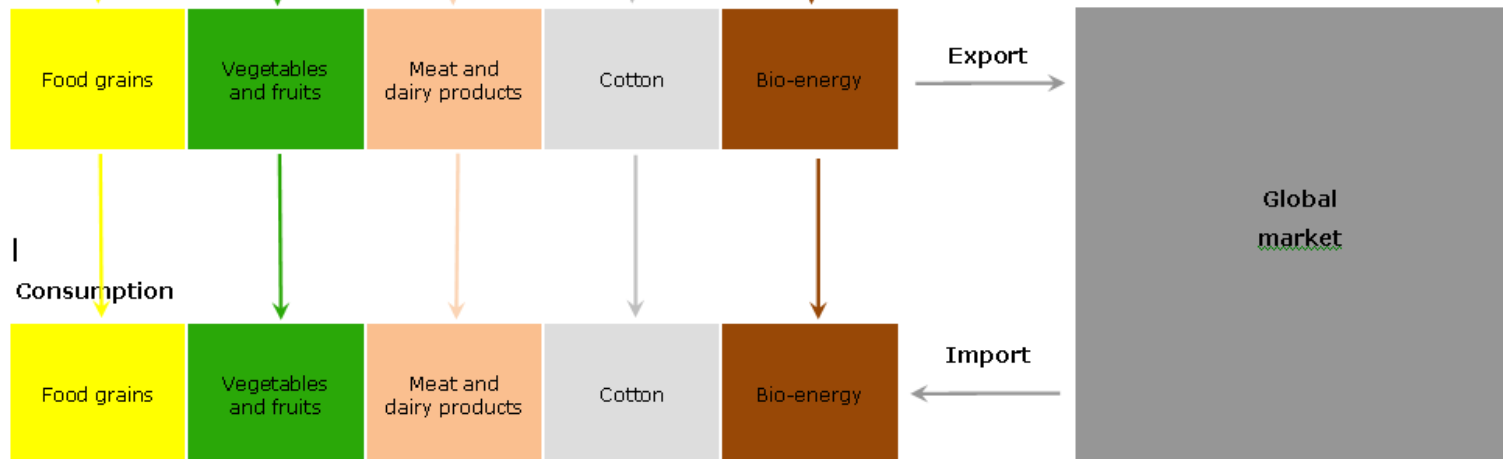
Available green water

Available blue water



Substitute water units into commodity units based on water productivities in your country

Production



Remove the consumed commodities from the board at the end of a round