Module 11

Utilisation of Water in Our Daily Life

Summary

Water is utilised for a variety of purposes in everyday life. Domestic water used for body care and household purposes is most familiar. Domestic water consumption varies among countries in the world, also within Europe. In brief, this lecture describes what purposes humans utilise water for. This module gives an overview on water consumption in Europe, which puts it in an international context. The first part of this module illustrates water consumption in Europe and the different sectors of water use. The second part focuses on 'Virtual Water' and the 'Water Footprint' by explaining their concepts and giving some examples.

Objectives

Pupils gain knowledge of the amount of water used for different purposes and especially in their immediate environment. This module is directly linked with module 12 'Water Saving'. Pupils get an idea of how their consumption of water is connected to water scarcity and water pollution, e.g. in Bulgaria or other parts of the world.

Key words and terms

Water consumption, water abstraction, virtual water, water footprint

Preparation/materials

Material	Preparation
Copies of table 4 at the end of this module	

Utilisation of water in our daily life

Introduction

In Europe 42% of total water abstraction is used for agriculture, 32% for industry, 18% for energy production and around 8% for domestic use. The water consumption between the different economic sectors varies considerably from one region to another, depending on natural conditions, and economic and demographic structures. In South-Western Europe, where the climate is drier, agriculture accounts for 50–70% of total water abstraction. In Central European countries, that have a higher presence of industry, water is dominantly used for cooling processes in the electricity production. In Northern European countries, for example Finland and Sweden, little water is used for agriculture. In contrast water is abstracted mainly for industrial purposes, such as cellulose and paper production, both very water-intensive industries (Figure 1 and Table 1).

Population distribution and density are other key factors influencing the availability of water resources. Increased urbanisation concentrates water demand and can lead to the overexploitation of local water resources. Water usage is not the only thing that puts pressure on water resources; pollution puts pressure on water usage as well. For example, the cooling process in energy production causes substantial heating of water or evaporation. The run off of power plants heats rivers and influences the ecosystem heavily. Many processes in industry and in households (toilets!) contaminate drinking water, which has to be treated adequately afterwards.

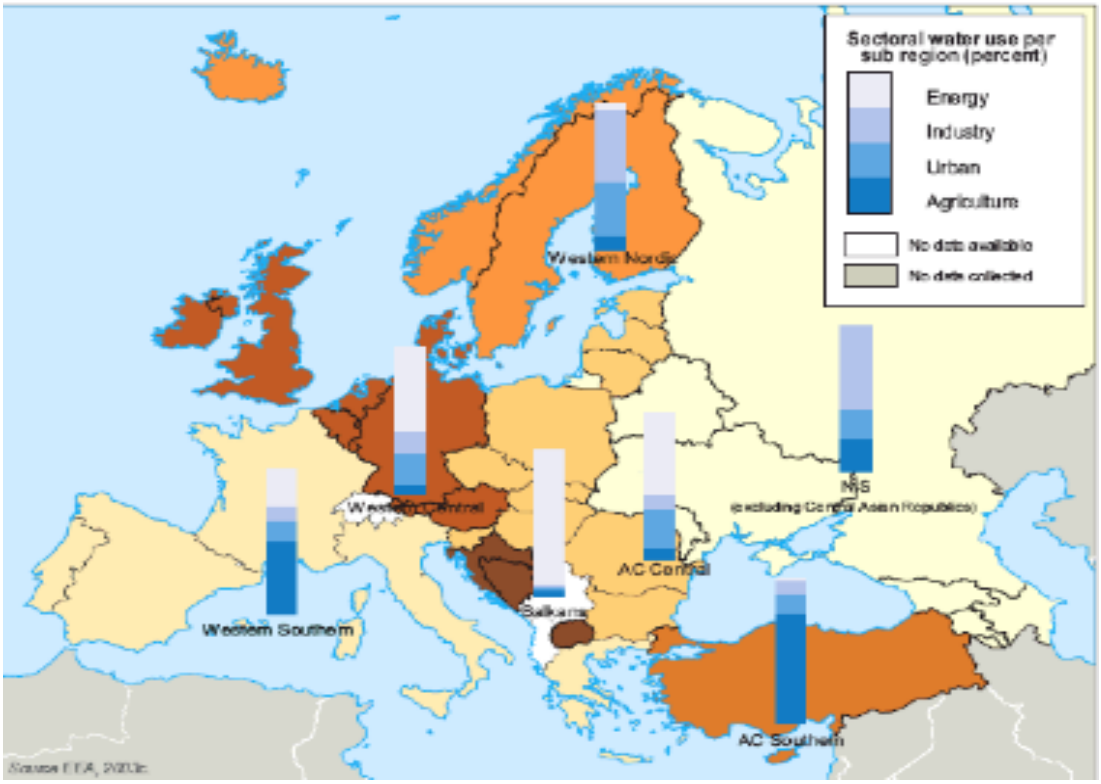

Figure 1: Water use per sector across regions in Europe
Source: http://www.grid.unep.ch/product/publication/freshwater_europe/consumption.php

1. Sectorial use of water

Regarding the total freshwater withdrawal of a country or defined groups of water users, water is used in different sectors. A distinction between different sectorial uses of water is helpful especially when a decision must be made somewhere to save water (module 12). Three sectors are distinguished: domestic, industrial and agricultural water use. Table 1 gives an overview of water use in some European countries.

		Total Fresh water With-drawal	Per Capita With-drawal	Domesti c Use	Indus-trial Use	Agri-cultural Use	Domes-tic Use	Industrial Use	Agricultu ral Use	2005 Popula-tion
Region & Country	*Year*	*km^3/yr*	*$m^3/p/yr$*	*%*	*%*	*%*	*$m^3/p/yr$*	*$m^3/p/yr$*	*$m^3/p/yr$*	*Millions*
Bulgaria	2003	6.92	895	3	78	19	27	700	168	7.73
Romania	2003	6.50	299	9	34	57	26	103	171	21.71
Spain	2001	37.70	802	9	13	78	72	104	625	47.15
Germany	2001	38.01	460	7	73	20	57	312	91	82.69
Europe	2005	350.00		8	50	42				

Table 1: Water use (Domestic / Industrial / Agricultural) per year for selected European countries
Source: Eurostat. 2005. Updated 7/2005 and Global Water Intelligence

1.1. Domestic water use

Water required for drinking and domestic purposes is the smallest proportion of the total water demand. In European countries, water consumption on household level ranges between around 80 litres/person a day in Lithuania and around 250 litres/person a day in Spain (Figure 2). On a global scale, the variation is much bigger. People in arid zones, for example in Africa, have an average water consumption of only 20 litres/person a day, an extreme contrast to the 300 litres/person a day in the USA.

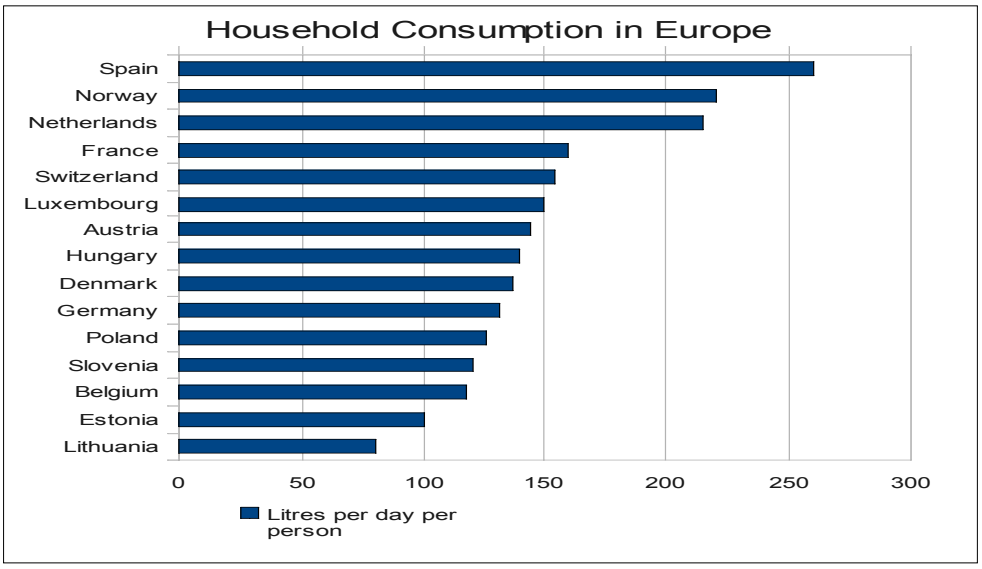

Figure 2: Household water use in selected European countries
Source: http://www.grid.unep.ch/product/publication/freshwater_europe/consumption.php

Higher standards of living are changing water demand patterns in Europe. This is reflected mainly in increased domestic water use, especially for personal hygiene. Most of the European population has indoor toilets and showers for daily use. Most of the water used in households is for toilet flushing (33%), bathing and showering (20-32%), and for washing machines and dishwashers (15%). The proportion of water for cooking and drinking (3%) is minimal compared to other utilisations. See examples of water utilisation on the household level in tables 2 and4.

Water consumption on household level	
Activity	**water use (l/day)**
Toilet	47.7
Bath/shower	31.7
Washing machine	30.2
To cook, drink, wash dishes (by hand)	24.3
Wash yourself and wash dresses (by hand)	20.7
Dishwasher	3.6
Other	3.8
Total	**162**

Table 2: Amount of water used for domestic activities (Swiss householder)
Source: http://www.grid.unep.ch/product/publication/freshwater_europe/consumption.php

1.2. Industrial water use

Industrial water demand is especially high in urban areas with high populations and where most industries are located. The amount of water used by industry and the proportion of total abstraction accounted for by industry varies greatly between countries. In Europe, the abstraction of water for industrial use has decreased over the past 20 years: 10% reduction in western (central & northern) countries, 40% reduction in southern countries and up to 82% reduction in eastern countries. In Turkey, the reduction reaches 30%. The decrease is partly due to the general decline in water-intensive industry, but also because of increase in water efficiency. The cooling processes in energy production accounts for 45% of total water abstraction in Europe. In Poland, France and Germany, more than half of the water abstraction is used for energy production (cooling).

1.3. Agricultural water use

As mentioned above water use for agricultural activities in Europe can be very high, especially in parts where intensive irrigation takes place. First, this depends largely on climate and soil conditions, not to forget the crop. Secondly, the common agricultural policy of the EU regulates type and quantity of crops and therefore has a major influence on the amount of irrigated land. So the use of water in irrigation is insignificant in countries like Ireland and Finland, but very high in the southern part of Europe, e.g. Spain, Greece, Italy and highest in Portugal (Figure 1). Around 5,000 to 7,500 m^3/ha/year of water is used for irrigation. The water demand can differ significantly depending on the technology used and maintenance of the irrigation system and grown crops. In summer, water for irrigation puts a lot of pressure on water resources and can have a great impact on the groundwater table and water quality. Vegetation, animals and the domestic use of water (wells, springs, and other aquifers) can be affected as well.

2. Virtual water and water footprint

Household water originates almost everywhere from a tap to a nearby well/borehole. Prior to use (for e.g. for baking bread or growing vegetables) it is clearly visible as water. In contrast, water which is used to manufacture commodities, goods or services, is not visible (physically touchable or perceptible) to consumers in the end product. When buying fresh vegetables or fruits from a market or grocery store, it can be difficult to imagine the amount of water that was used to grow them. This kind of water is called *'virtual water*'. Thus, virtual water plays an important role in every-day water consumption. The two paragraphs aforementioned on industrial and agricultural water use belong to this water classification (for us as consumers).
A broader, comparatively new concept is the '*water footprint'* for different kind of products, consumer groups, and geographical units etc.. Box 1 explains some important terms regarding different terms of water, the concept of 'virtual water' and the 'water footprint'.

Box 1 – Terms regarding water footprint

Virtual water. This term defines a specific *'type'* of water (like rain water, drinking water or waste water). It describes water used for the production of a good or service, which is not visible as water in the final product. Virtual water refers to freshwater "embodied" in the product; not in a real sense, but in a virtual sense. The virtual water content of a product stands for the *volume* of fresh water consumed or polluted for producing a product, measured over its full production chain.

Examples: the production of 1 kg wheat costs 1,300l water, the production of 1 kg beef costs 15,500l water, Jeans (1000g) contain 10,850 liters of embedded virtual water. (Table 3)

Water footprint. The water footprint is a multi-dimensional indicator of freshwater use that calculates both direct and indirect water use of a consumer or producer. Like the virtual water content, the water footprint refers to the embodied water in a product. In addition, the water footprint also accounts for which sort of water is being used and when and where that water is being used. The water footprint is a geographically explicit indicator, not only showing volumes of water use and pollution, but also considering the locations. Water use is measured in terms of water volumes consumed (evaporated) and/or polluted per unit of time. The water footprint of an individual, community or business is defined as the total volume of freshwater that is used to produce the goods and services consumed by the individual, community or business. A water footprint can be calculated for a particular product, for any well-defined group of consumers (e.g. an individual, family, village, city, province, state or nation) or producers (e.g. a public organization, private enterprise or economic sector).

The above terms consist of the following three components:

Blue water. Fresh surface or groundwater, i.e. the water in freshwater lakes, rivers and aquifers.

Green water. The precipitation on land that does not run off or recharge the groundwater but is stored in the soil or temporarily stays on top of the soil or vegetation. Eventually, this part of precipitation evaporates or transpires through plants. Green water can be made productive for crop growth (but not all green water can be taken up by crops, because there will always be evaporation from the soil and not all periods of the year or areas are suitable for crop growth).

Grey water. The grey water footprint measures the volume of water flow and aquifers and rivers polluted by humans.

In this way, the green, blue and grey water footprints measure different sorts of water attribution.

Example of water footprint for Bulgaria: Average water footprint of Bulgaria: 2297 m^3/yr per capita
Part of footprint falling outside of the country: 18.7 %
Global average water footprint (for comparison): 1385 m^3/yr per capita

The following table illustrates the estimated amount of virtual water used in the production of certain consumer goods:

The hidden water use (virtual water)	
Commodity	**Water consumed (l)**
1 litre of beer	7
1 litre of gasoline	10
1 cola	70
A single bath	200
1 kg of paper	320
1 kg of bread	1,000
1 kg of potatoes	1,000
Television set	1,000
1 kg of meat	4,000 to 10,000
One pair of jeans	8,000

Table 3: Hidden Water use in domestic goods
Source: http://www.grid.unep.ch/product/publication/freshwater_europe/consumption.php

2.1. An Example: The water footprint in beverage production

The food and beverages processing industry requires a huge amount of water. One of the main problems is the amount of wastewater produced in the food plants. Water is used for several purposes: as an ingredient, a cleaning agent, for boiling and cooling purposes, for transportation and conditioning of raw materials. The production of a soft drink includes the following process steps: bottle making (from PET resins to PET-bottle forms), bottle cleaning (by air), syrup preparation, mixing, filling, labelling and packing. The highest contribution to the water footprint of a soft drink comes from its supply-chain, mainly from its ingredients (95 %). A smaller fraction stems from packaging and labelling materials (4%), particularly from its bottle. In production processes, the amount of water consumed is very small compared to its supply-chain (1%), which is mainly water incorporated into the product. Sugar is one of the main water consuming ingredients in soft drinks. Three different sugar types are typically used in soft drinks: sugar beet, sugar cane and high fructose maize syrup (HFMS). Type and origin of sugar input significantly affect the total water footprint of the soft drink. For example, the total water footprint of the soft drink is 310 litres when the sugar originates from cane sugar from Cuba, 170 litres when the sugar comes from beet sugar from the Netherlands, and 180 litres with HFMS from USA (Figure 3).

2.2. A global 'virtual water balance'

The link to the Water Safety Plan: With the afore mentioned concepts of virtual water and water footprint, it is easier to compare the amount of water actually used to different approaches. This can be done for certain products, geographical locations, time scales, consumer groups, etc.. Figure 4 shows the 'global virtual water balance' per country. In combination with other figures, it is much easier to make conclusions about which country places a lot or a little amount of pressure on its water resources.

Two factors determine the magnitude of the water footprint of national consumption:
- The volume and pattern of consumption
- The water footprint per ton of consumed products.

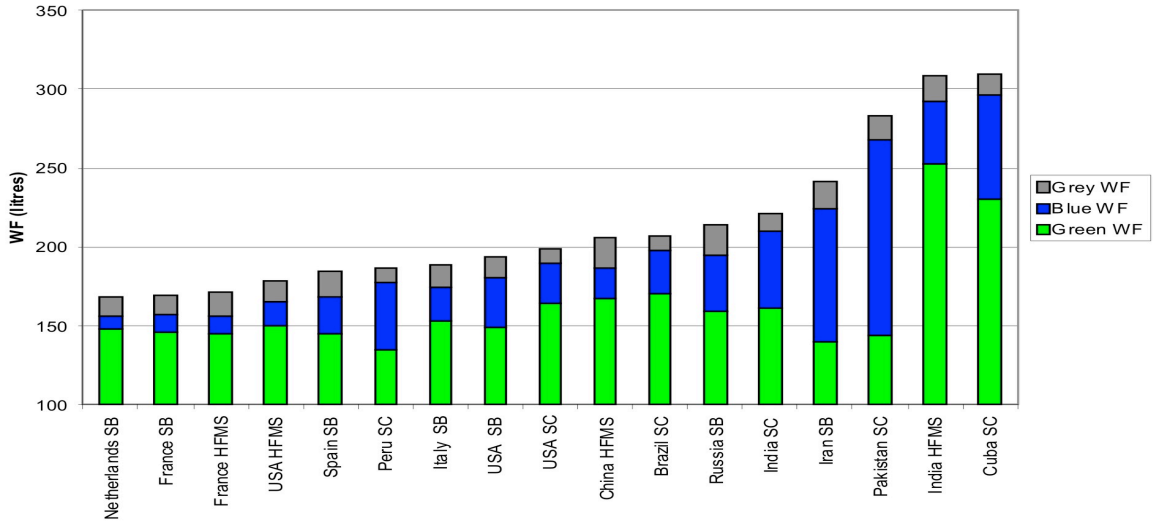

Figure 3: The total water footprint of 0.5 litre PET-bottle soft drink according to the type and origin of the sugar (SB=Sugar Beet, SC=Sugar Cane, HFMS= High Fructose Maize Syrup). Source: www.waterfoodprint.org

In the case of agricultural products, the latter factor depends on climate, irrigation and fertilisation practice and crop yield. The global average water footprint related to consumption was 1,385 m^3/yr per capita from 1996 to 2005. Industrialised countries have water footprints in the range of 1,250-2,850 m^3/yr/cap, while developing countries show a much larger range of 550-3,800 m^3/yr/cap.

The low values for developing countries relate to low consumption volumes; the large values refer to very large water footprints per unit of consumption.

Module 12 'Water Saving' gives some recommendations on how to reduce stress on local water resources and how to balance out the country's virtual water balance by choosing or letting aside certain products.

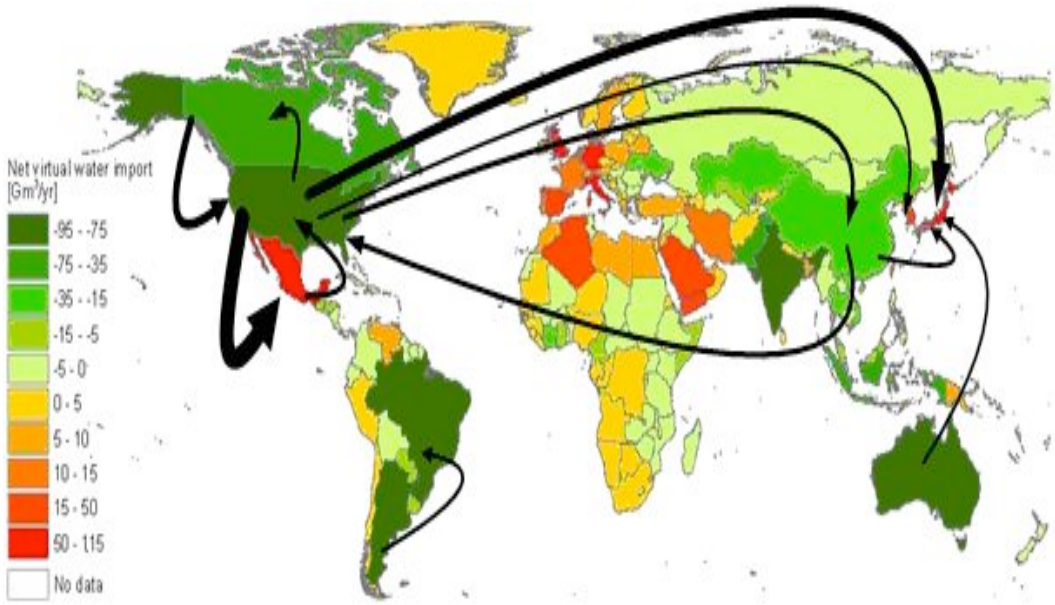

Figure 4: Virtual water balance per country related to trade in agricultural and industrial products over the period 1996-2005. Net exporters are shown in green and net importers in red. The arrows show the biggest gross international virtual water flows (> 15 Gm3/yr); the fatter the arrow, the bigger the virtual water flow. Source:National Water Footprint Accounts; Mekonnen and Hoekstra (2011).

3. Exercises and questions

- Please complete the following table 4.
- How much water do you use on a daily base? And for which purpose?
- Think about 2 or 3 goods you use: how much virtual water was used to produce them (Internet search). Which countries do they originate from (have a look at the map (Figure 4)? Are these countries net water importers or exporters?
- In which steps of the production of a PET-bottle for a soft drink is water used?
- Where do you have production sites of drinks (juices, soft drinks, etc.) in your vicinity in Bulgaria? What does that mean for the (water) environment (water abstraction, water pollution, water treatment, etc.)?
- Is "virtual"water exported in your region or village? Make a list of products.
- Make suggestions on how the consumption of virtual water could be minimized.
- Calculate your own water footprint: www.waterfootprint.org and discuss it in class.

Average water consumption per person and day in litre	**Family**	**Bulgaria**	**Germany**
Drinking			1
Cooking			3
Dish-Washer			2
Showering, Bathing			40
Body care			6
Washing machine			20
Room cleaning			4
Toilet			40
Car washing			3
Watering (flowers)			1
Watering (garden)			6
Other			
...			
...			
Total			**126**

Table 4: Average water consumption per person and day in litre
Source: Compilation of different sources

WSP related activities

- How much water do the households, the enterprises in your village consume? And for which purpose? Do a short survey (ask the water supplier).
- Make an estimate on how much water is used for irrigating crops for livestock; which source of water is used?
- Is there a water shortage in your village? If yes, how is this shortage noticeable?
- Make suggestions on how the water usage in the village could be reduced.

4. Text sources and further reading

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