Water Footprint Concept and Application

Water Footprint

- Can refer to an individual, a commodity, a business or a nation
- Is an indicator that looks at both direct and indirect water use

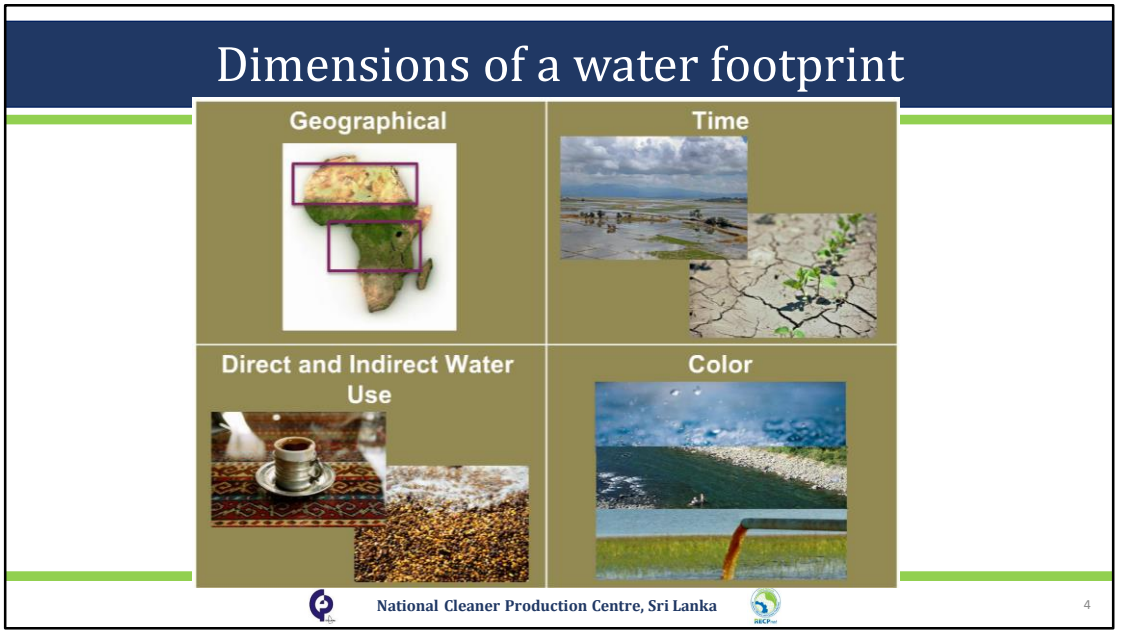
Water footprint can refer to an individual person or consumer, a commodity, a business or a nation. It is an indicator that looks both direct and

indirect water use.

- Examples:
  - **Water footprint of a commodity** = Total volume of freshwater used throughout steps in the production chain

  - **Water footprint of a consumer** = Total volume of freshwater that is used to produce the goods and services consumed

For example, the water footprint of a commodity is the total volume of freshwater used to produce the commodity throughout the various steps of the production chain.
Similarly, the water footprint of a consumer is defined as the total volume of freshwater that is used to produce the goods and services consumed by the person over a period of time.



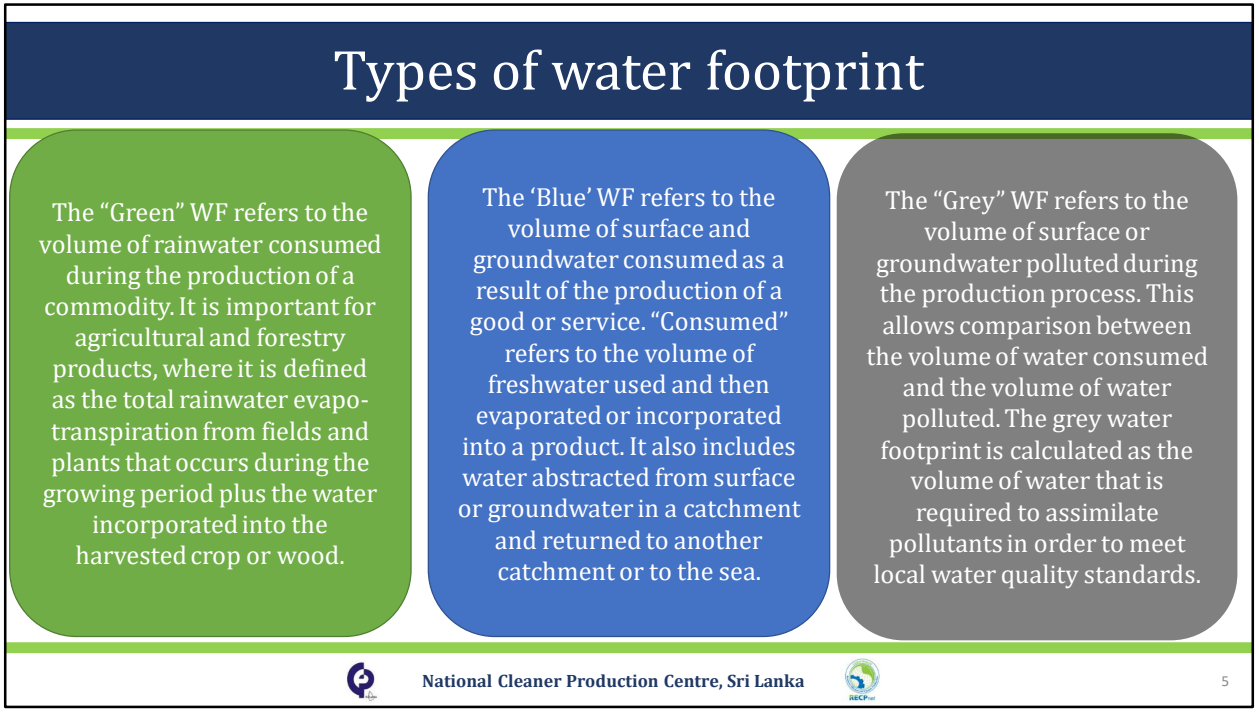
The water footprint is a multi dimensional indicator of water use:

1. First, it has a geographical dimension. It contains information on both the use of water in volume and the location of that use. Geographical information is important because consuming one cubic meter of water in a water-abundant area has a different significance than consuming the same volume in a water-scarce area.
2. Second, it has a time dimension. Consuming water from a product that is produced in a wet season has a different implication than a product that is produced in a dry season. These geographical and time dimensions of water footprints of a product are not always obvious at a first glance, as water use data is often presented in total volume or in average volume. However, if you dig deeper, you will find the data details comprising these dimensions.
3. Third, water footprint can reveal both the direct and indirect water use of producing a commodity, or by a

consumer or a producer.

4. Another dimension of water footprint is its "colour": 'Green water footprint' refers to the use of rainwater in the production of a commodity; 'Blue water footprint' refers to the use of fresh water from rivers or groundwater aquifers; and 'Grey water footprint' refers to the volume of water needed to assimilate the pollutants that enter rivers or groundwater as a result of the production of a commodity.

As you can see, water footprint differs from the traditional measure of 'water withdrawal'. First, it reflects the blue water use, and the green and grey water uses. Note that it excludes blue water when this water is returned to its source as long as this water has not been polluted. Second, it reflects direct and indirect water use. Third, it emphasizes location and season of production. Therefore, the concept of water footprint offers a more comprehensive look at how production of a commodity affects water resources than what we often measure as water use.



Green WF

You may wonder why we need to account for the volume of rainwater used in crop production. Isn't rain free? The reason is that most of the world's crop production is from rain-fed agriculture. Rainwater costs nothing but is worth a lot. Rainwater used for producing one crop is no longer available for producing other crops or for sustaining natural vegetation in the cropped area.

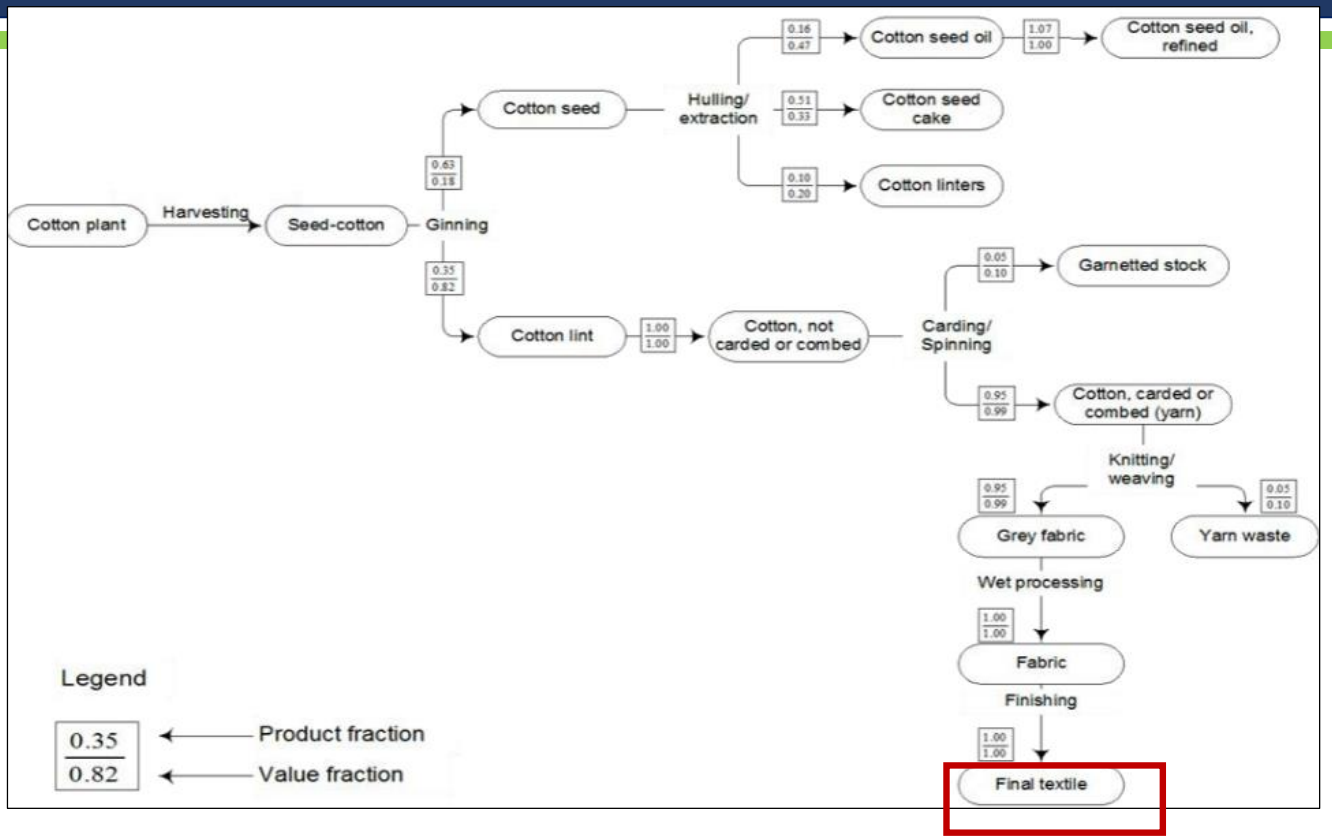
In the past, we have tended to focus on water from rivers, reservoirs and groundwater aquifers, and this has led to the undervaluation of rainwater. Making more efficient use of the rainwater or the 'green water' in rain-fed agriculture reduces the need for surface or groundwater.

Grey WF

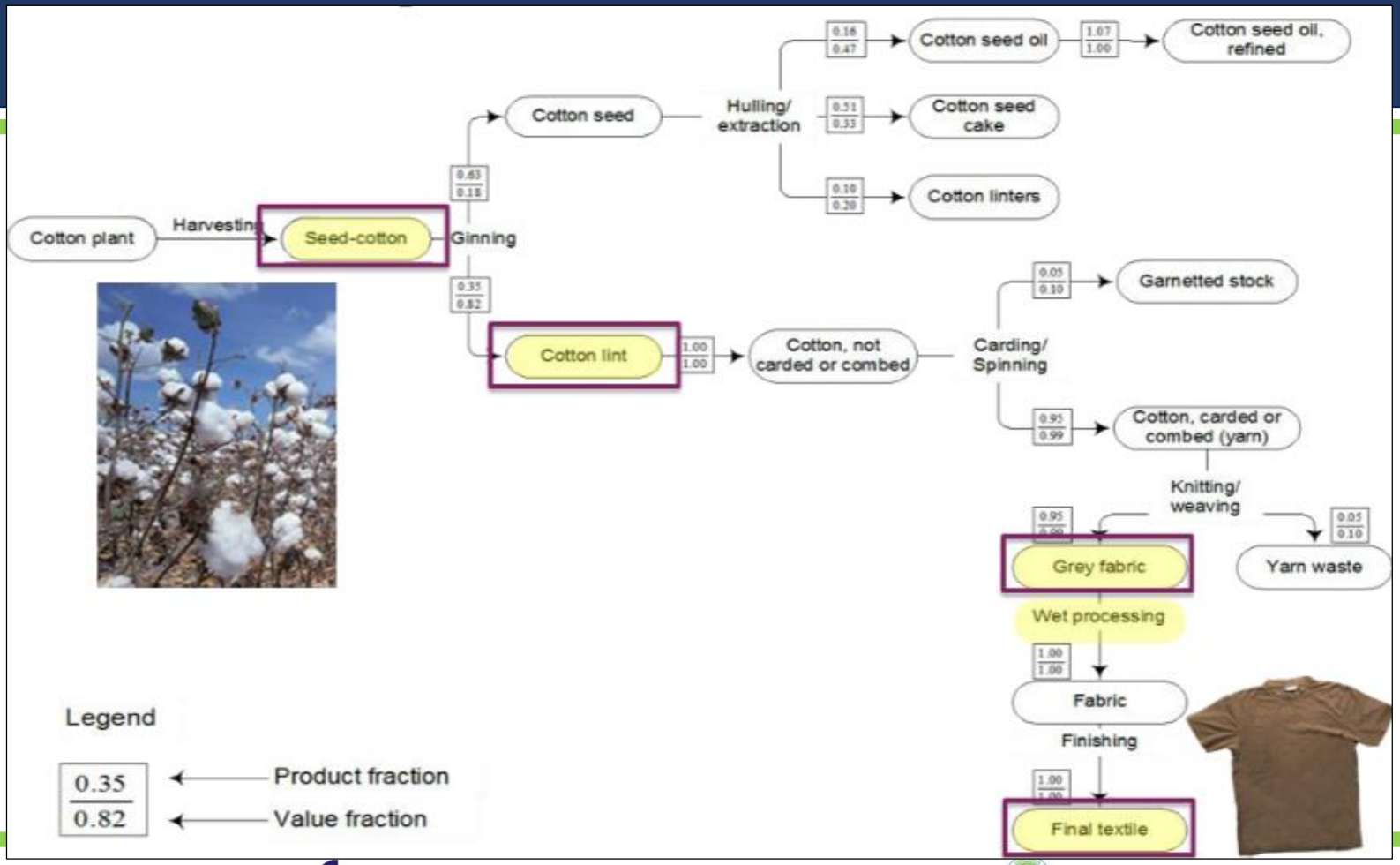
Since the grey WF is a measure of the polluted water volume, it needs to be considered in relation to the available runoff in a catchment. As long as the grey WF is smaller than the river runoff, the assimilative capacity of the river is not yet fully used. When the grey WF equals the runoff, full assimilative capacity of the river is used. Pollution exceeds the assimilative capacity as soon as the grey WF exceeds the runoff.

When the waste flow includes more than one form of pollutants, we can first estimate the grey WF for different pollutants. Then, the overall grey WF is determined by the pollutant that is most critical. If there is enough water to assimilate this pollutant, all other pollutants are assumed to have been assimilated as well.

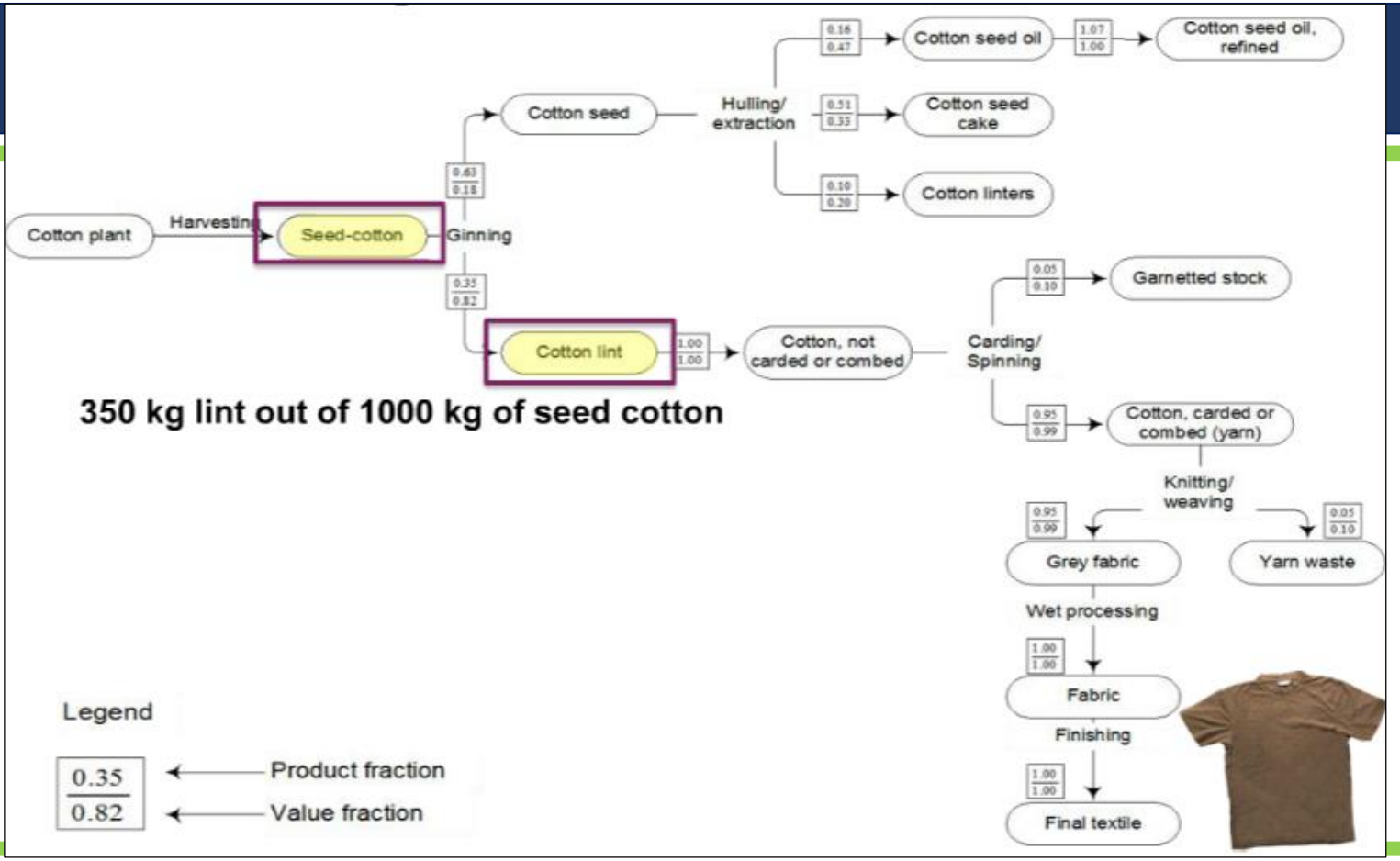
Calculating water footprint



Let's look now in more detail at how a water footprint is calculated by examining the flowchart of a production chain of cotton shirt. Here, our focus is on the bottom section, production of cotton textile. The top part of the flow chart refers to the production of cotton seed oil.



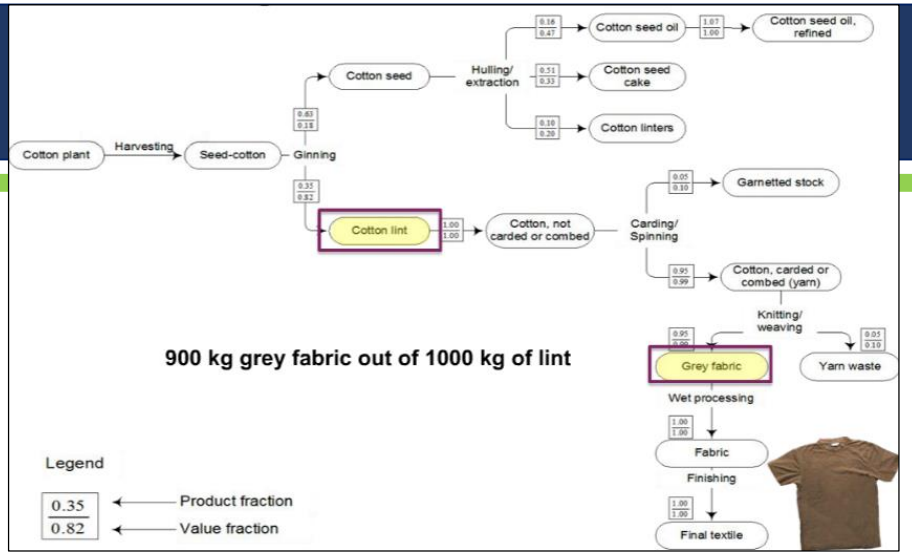
The initial material input in a cotton shirt is seed cotton, which is harvested from the cotton field. Before the final shirt product reaches the hands of a consumer, it passes through a number of intermediate processes and products. First, the seed cotton is processed into 'lint', which is then processed into 'grey fabric'. The grey fabric undergoes wet processing, which includes bleaching and dying, before it is turned into printed 'cotton textile', from which a shirt can be cut and made.

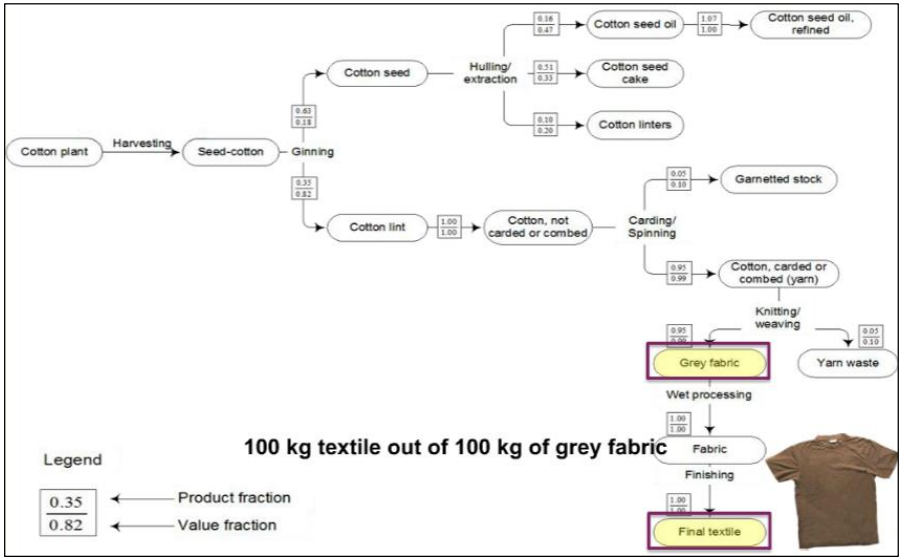


To calculate the WF we aggregate the water used in each stage of the production process. To do this calculation we need to take into account the volume of inputs used in each process and calculate how much water is used to produce these inputs.

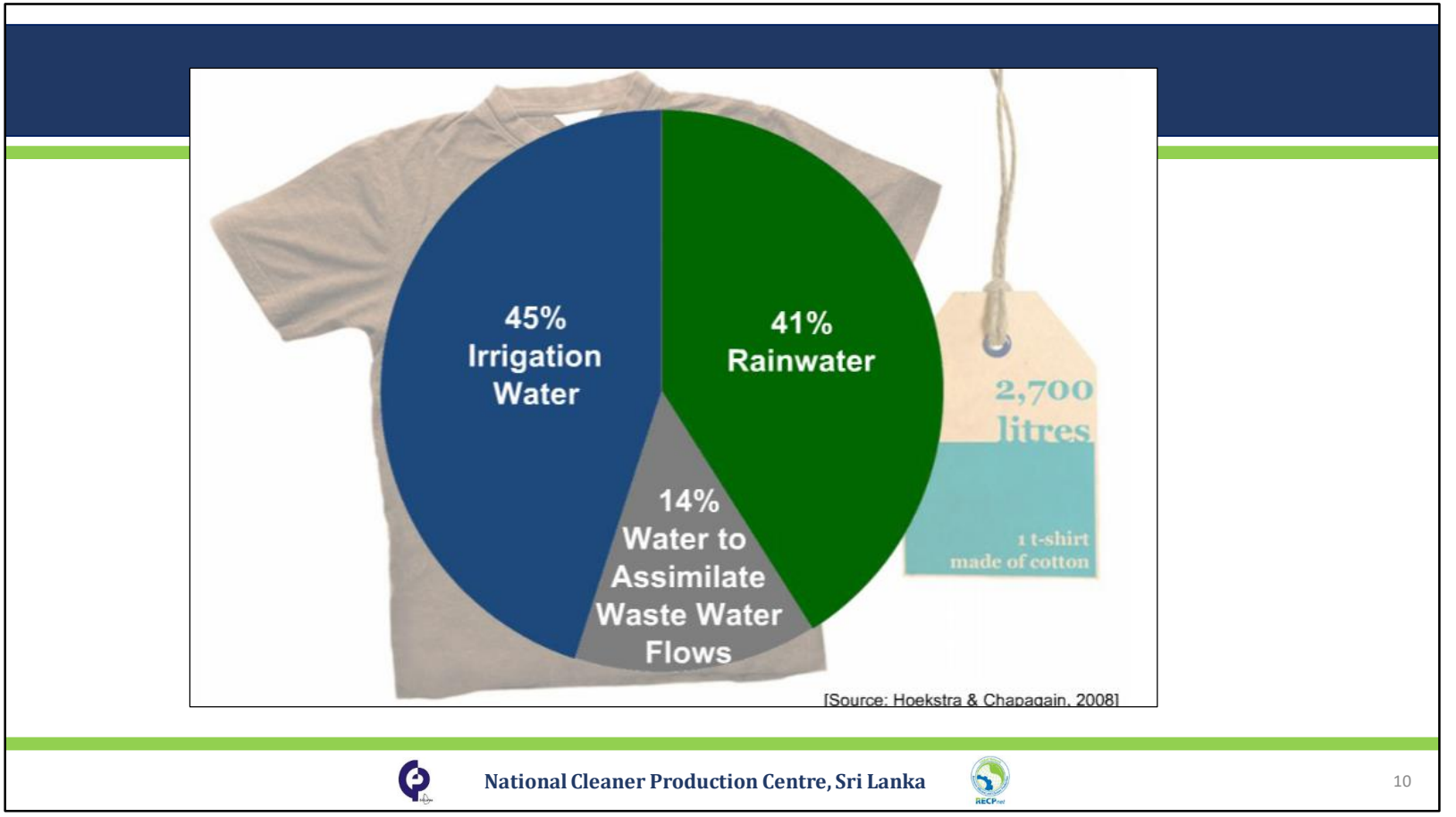
For example, to produce 350 kilograms of lint, we need 1000 kilograms of seed cotton so we first add the amount of water required to grow the

seed cotton.





To produce 900 kilograms of grey product through carding, spinning and weaving, we need 1000kilograms of lint. 100 kilograms of grey fabric is converted to almost 100 kilograms of textile.



By adding the water use in the different production stages, a cotton shirt weighing 250 grams, requires, on average 2,700 liters of water to produce.

Of this total, 45 percent is irrigation water consumed or evaporated by the cotton crop; 41 percent is rainwater evaporated from the cotton field during the growing period; and 14 percent is water required to assimilate the use of fertilizers in the crop field and the use of chemicals in the textile industry.

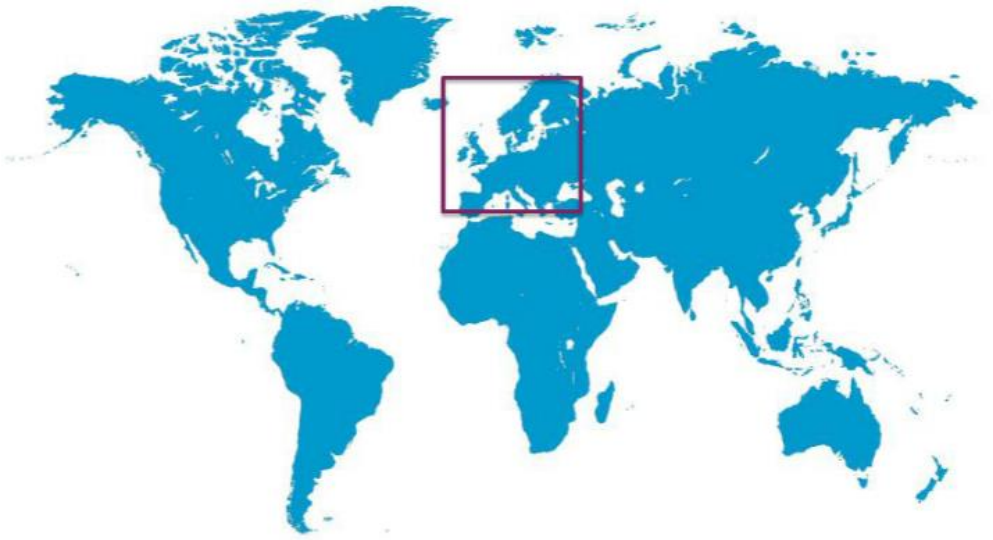
Since textile and cotton seed oil are both produced from harvested cotton, to prevent double counting of water, the water used in cotton growing is partly attributed to the cotton seed oil. The attribution is done based on the relative price value of the two products.

- The water footprint of cotton depends on;
  - Climate
  - Local irrigation practice
  - Use of fertilizers
  - Other factors

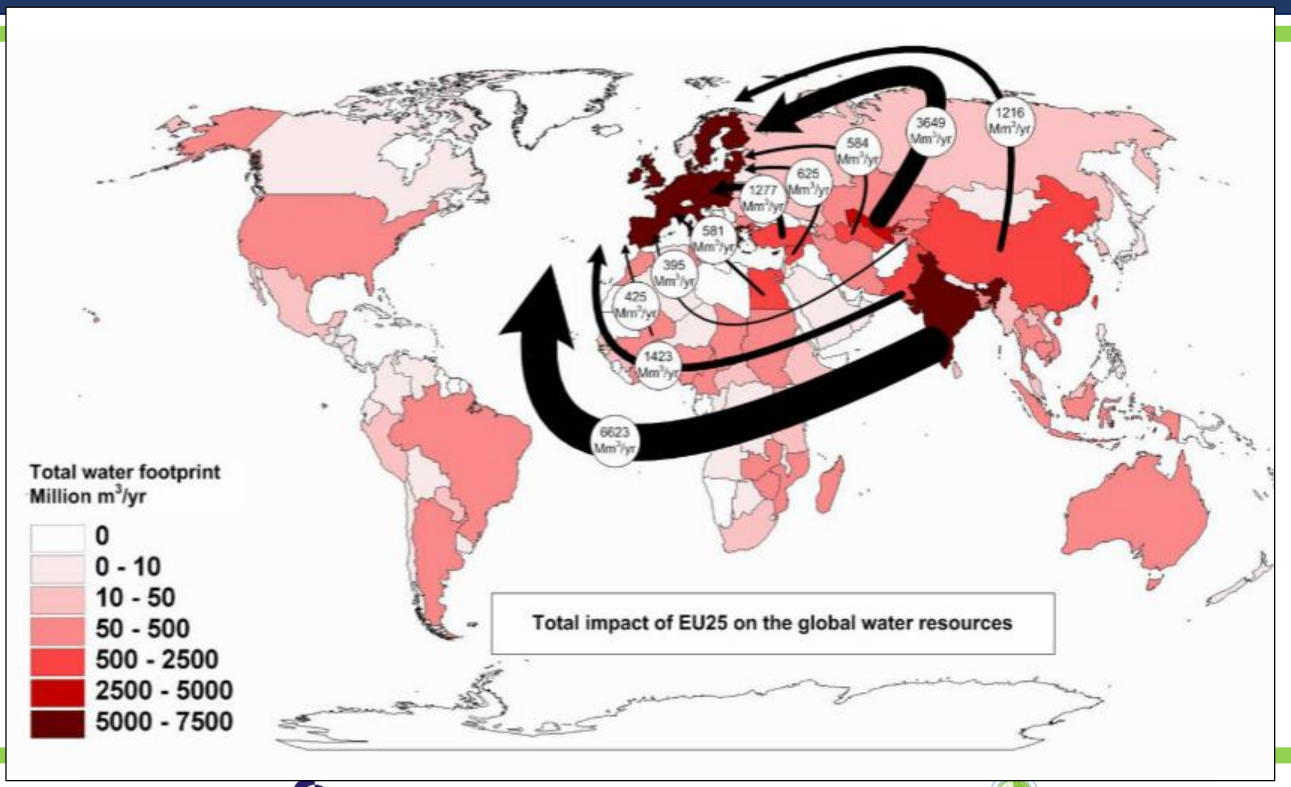
The water footprint of cotton depends on the climate under which it is grown, the local irrigation practice, the use of fertilizers and many other factors.

In theory, cloth manufacturers and consumers can compare and consciously choose cotton produced with the lowest water footprint. In reality, the market is not transparent, so this information is not readily available. It is increasingly recognized that consumers have the right to know the origin and background information of the commodities they buy.

- Cotton consumed within the European Union will be used as an example to illustrate this concept.



Water footprint of EU cotton consumption



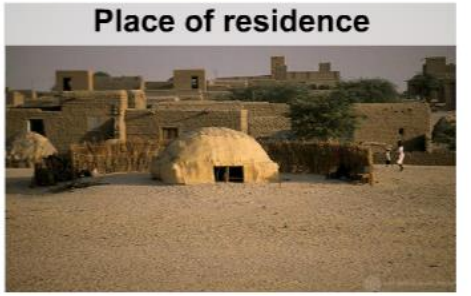
This map shows the water footprint of the cotton consumed by the citizens of the European Union. The impact of this consumption goes beyond Europe, because much of the cotton is produced elsewhere. The intensity of the red colour represent the size of the water footprint in each country. You can see the highest water footprint is in India at 6623 million cubic meters per year. We see relatively large water footprints of cotton consumed by the European Union in India, Pakistan, China and Central Asia.

- Desertification of the Aral Sea

Water use for cotton production can have major impacts on the environment. Particularly, intensive irrigation has a negative impact, as shown, for example, in the case of desertification and the salinization of the Aral Sea in Central Asia (EJF, 2012).

Water footprint of people

- Influenced by;



The water footprint of a person can be influenced by his food consumption pattern, life style and place of residence. Food consumption is the largest part of a person's water footprint. It is disproportionally larger than direct water uses such as drinking, bathing and washing, and lawn maintenance.

Food consumption and water footprint

Developed countries

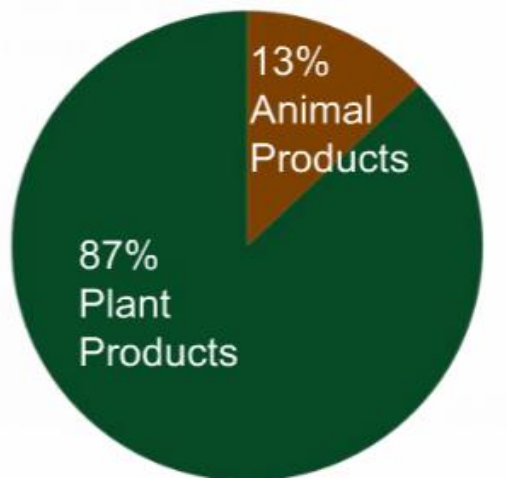
- Average calorie intake per person is around 3,400 kcal/day
- Producing food for one day for one person requires around 3,600 liters of water

In developed countries, the average calorie consumption per person is 3,400 kilo-calories per day; roughly 30 percent of that comes from animal products. Assuming that the average daily portion of animal products is a reasonable mix of beef, pork, poultry, fish, eggs and dairy products, we estimate that 1 kilo-calories of animal product requires roughly 205 liters of water. Assuming a reasonable mix of cereals, pulses, roots, fruits and vegetables, the remaining 70 percent of food consumption require roughly 0.5 liters of water per kilo-calories. Under these assumptions, producing food for

one day for one person requires 3,600 liters of water.

Developing countries

- Average calorie intake per person is around 2,700 kcal/day
- Producing food for one day for one person requires around 2, 050 liters of water



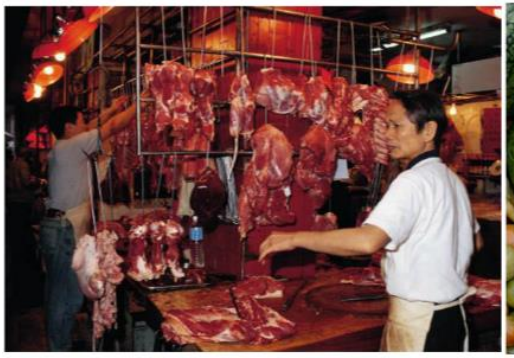
In developing countries, the average consumption per person is about 2,700 kilo-calories per day, about 13 percent of which are animal products. Such a diet requires 2,050 liters of water per day. We can see that meat based diets have a much higher, around 6 percent, water footprint than vegetarian diets.

WF of people contd…

People tend to focus on saving what they can see-reducing water waste in showers, lawns, washing, etc. while these are necessary and good actions to reduce water use and water footprint, it is almost insignificant if these uses are compared with water use in food production.

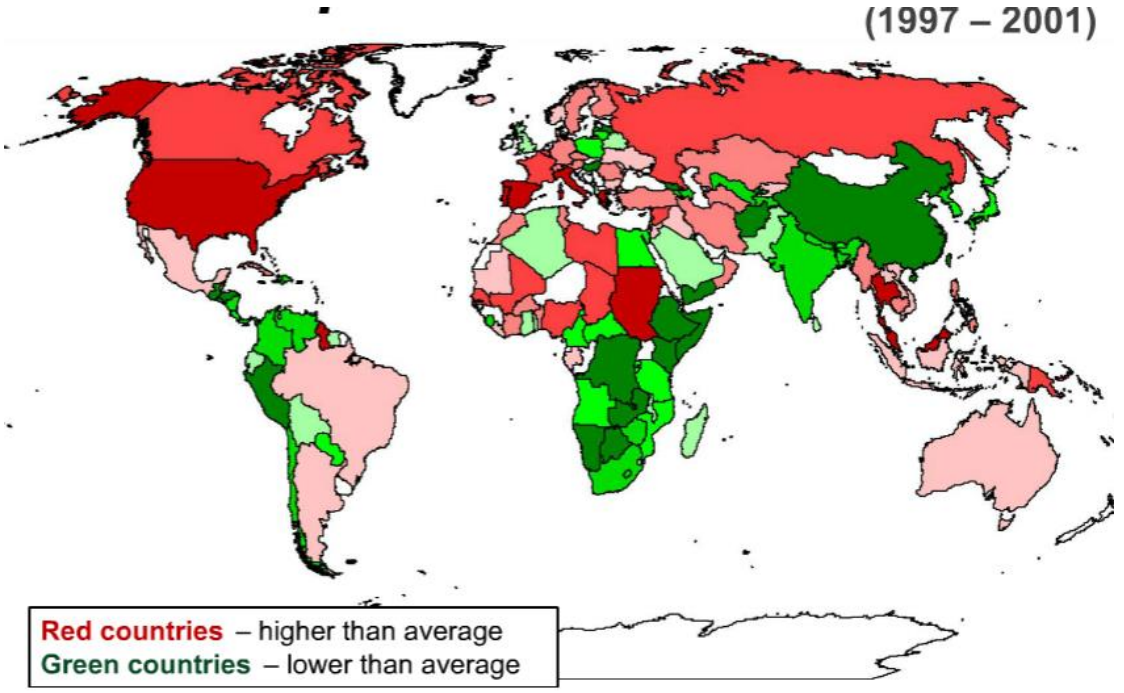
WF of people contd…

- Dietary habits influence water footprint of a person.

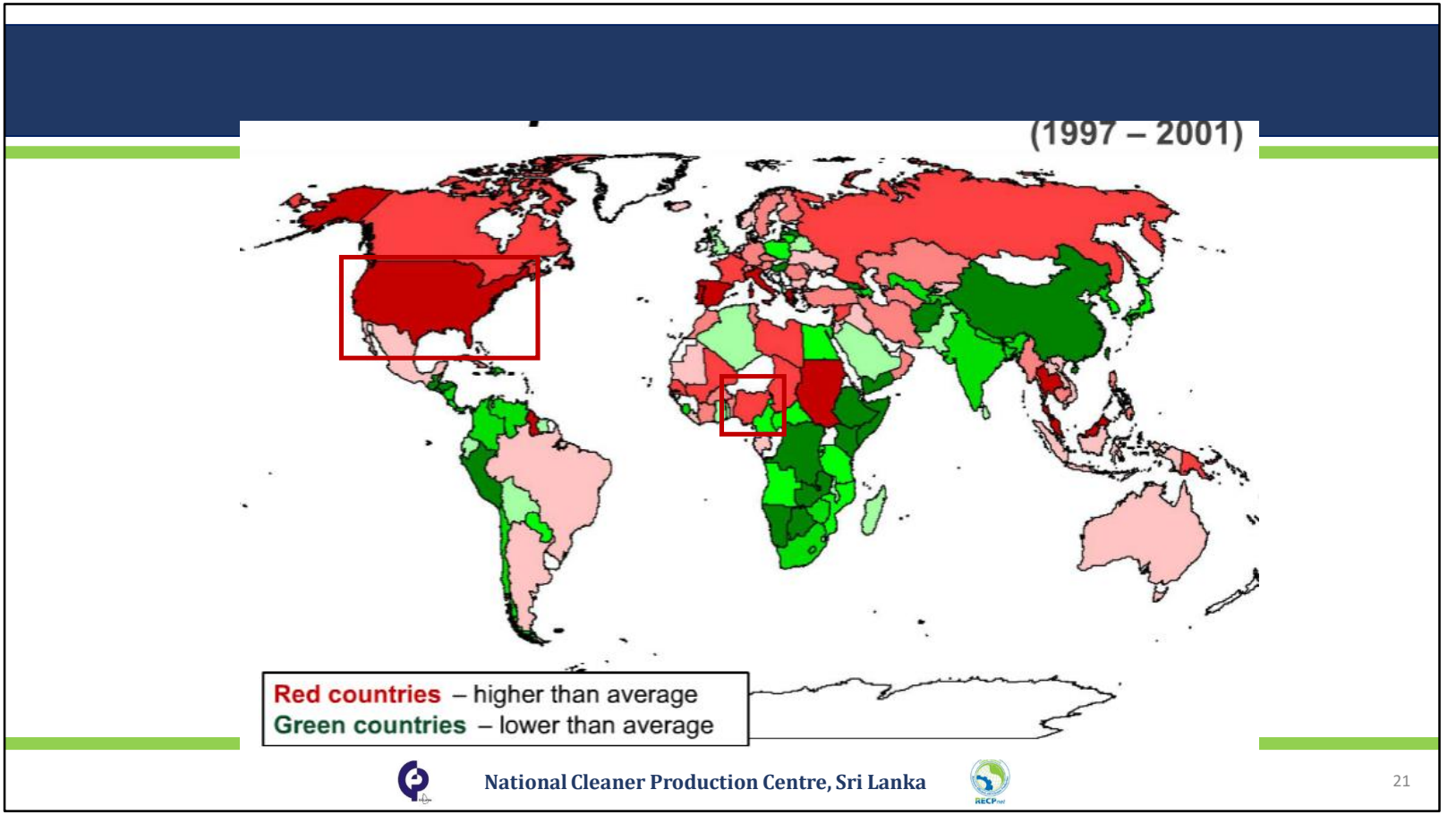


Dietary habits greatly influence a person's water footprint. Therefore, consumers can reduce their water footprint through, for example, reducing meat consumption. They can also reduce their water footprint by being more selective in their choice of meat as some animals require less water to produce meat.

Water footprint of a nation



Here, we look at the average water footprint per person in a country. The map here shows the average water footprint per capita per country for the period 1997 to 2001. green-coloured countries have a water footprint smaller than the global average; red-coloured countries are above the global average.



For countries like the US, the water footprint per person is large because of a generally high consumption lifestyle there, and also high consumption of meat. For other countries, water footprints can be large for different reasons. Take Nigeria for example. Nigeria does not have a high consumption life style and the proportion of meat in the average diet is also not high. However the grain crops grown in Nigeria have a much larger water footprint than is typical. Crops can have a large water footprint because of climate conditions, inappropriate agricultural practices and low water productivity.

Summary

- Water footprint is a multi-dimensional indicator of water use
- The water footprint of
  - A **commodity** aggregates all the volumes of water used in each step of the production process
  - A **person** is determined by lifestyle, diet and place of residence
  - A **nation** is influenced by the lifestyle and consumption habits of its residents, but also by agricultural practices that affects water productivity

References

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- Video on “ The dried up Aral Sea Eco-Disaster”
- Hoekstra, et al. (2011). The Water Footprint Assessment Manual. Pages 1-52.