UK Water Footprint: the impact of the UK's food and fibre consumption on global water resources

Volume one

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* Available in separate volume, downloadable from wwf.org.uk/waterfootprint

SUMMARY: WE ALL LIVE AT THE WATER'S EDGE

This report tells the important but largely unknown story of the water we use and where it comes from. More importantly, it highlights the impact of the UK's consumption patterns on water resources across the world. WWF's intention in publishing this report is to start a debate about how UK-based organisations can help to ensure that critical, and often scarce, water resources are managed wisely.

WWF has used state-of-the-art analysis to estimate the UK's total national water footprint (WF). This report presents both the results of this analysis and several case studies that illustrate the impacts of the UK's WF in the countries where our food and cotton are grown.

For readers who don't have time to digest the technical detail, the key messages from this WWF report are as follows:

There is a mounting crisis over the world's water: Our food and clothing cannot be made without a great deal of water. That water is sourced from ecosystems. As well supporting agriculture to produce food, cotton and bio-fuel, freshwater ecosystems provide other services to society: they regulate water flows; purify waste water and detoxify wastes; regulate climate; provide protection from storms; mitigate erosion; and offer cultural benefits, including significant aesthetic, educational, and spiritual benefits. The withdrawal of freshwater from ecosystems in quantities and at rates greater than nature's ability to 'renew' is widely documented in many parts of the Middle East, India, Mexico, China, the USA, Africa, Spain and central Asia. The latter of course includes the Aral Sea, which, more than any other water body in the world, has come to epitomise the devastating economic and ecological effects of water mismanagement. Much of that particular disaster has been caused by withdrawal of water to irrigate cotton crops.

You probably use far more water than you thought, and from further afield than you knew: While average household water use in the UK is around 150 litres per person per day, our consumption of produce from other countries means that each of us effectively soaks up a staggering 4,645 litres of the world's water every day. Most of this is in the form of 'virtual water', i.e. water that has been used to grow the crops that make the food we eat, the beverages we drink and the clothes we wear.

Location, location, location: While this massive amount seems important in itself, the critical issue is where this virtual water comes from. Much of the food we eat is grown here in the UK so a proportion of our total WF affects our own rivers and wetlands. WWF's analysis shows that this proportion amounts to only 38%. So the UK is nowhere near self-sufficient in water. Conversely 62% of the total UK WF is accounted for by water from other nations. In other words, our consumption of food and clothing is inextricably linked to the continuing security and good management of water resources in other parts of the world.

Good water management is the key: So, our consumption has an impact on rivers and aquifers both in the UK and globally. It also has an impact on local communities who rely on the water and other services that are provided by such ecosystems. How can we address this from the UK, given that we all need to eat, drink and wear clothes, and, inevitably, we will continue to rely on products from other countries? Firstly, it's important to realise that, while reducing our total WF might help, the best solutions will involve promoting good management of water in river basins. This includes more efficient farming practices and improved allocation of water between different water users. In short, the priorities for water managers should be to:

1) provide enough water for the basic needs of local people;
2) ensure that sufficient water is left in rivers, lakes and aquifers so that they continue to support essential ecosystem functions and services – i.e. so that the ecosystem doesn't "die"; and
3) share the remaining water fairly and transparently between different water users and encourage those people to use water as efficiently as possible.

Government holds the key, but businesses and consumers/citizens here in the UK can play a positive role: The primary responsibility for good water management lies with governments across the world. But people and organisations in the UK can help. As a society we can address our WF and help to promote good water management across the world. In summary, this means:

1) understanding that water use is an issue;
2) measuring our WF and identifying where it has the most harmful impact;
3) reducing our harmful footprint where it matters most;
4) encouraging those who have influence to promote good water management; and
5) sharing experience and lessons with others.

If you are a UK government official, minister or politician: Water security is fundamentally about effective collective action by all of those who use and depend on the water supply. Government has a central role to play in ensuring that this collective action works, both by supporting or influencing overseas governments and by implementing legislation and policy in this country. If you are involved in policy debates in other countries, you can support other governments to ensure good management of water resources. You should also encourage other governments to enlist the support of a broad range of stakeholders, including those nations or businesses whose WF is exerting the greatest impact on their country's or region's water resources. Domestically, you may need to review policy for water management here in the UK to ensure greater water efficiency, make better use of legislative and policy instruments, and empower regulatory agencies to enforce such instruments. Finally, you may need to undertake a WF assessment of your government's procurement policies.

If you are a business leader: Think about the extent to which your business is dependent on water or how your business shapes the management of water. If water security is a risk to your supply chain or your investments, measure the WF of your company. Focusing on where the impacts are most harmful, ask your suppliers to be more water-efficient wherever possible, and invest in their efforts. As well as achieving efficiencies in your company's WF, you may be able to liaise with water managers and encourage and support them to manage water well, so that the poor and the environment get enough and that the water supply on which your business depends is more secure. As a last resort, if all avenues for influence and management have been exhausted and your WF is still having a harmful impact, you may need to think about shifting the source of your raw materials to regions where water resources are better managed.

If you are a consumer and/or citizen: As a consumer you can ask businesses, including your local supermarkets, to tell you what they are doing to ensure good water management along their supply chains. Everyone can help by reducing food waste. As a citizen you can urge your government to make good water management a priority both in this country and overseas.

1 INTRODUCTION

Recent studies of the impacts of the food and cotton trades to the UK have focused almost exclusively on the finite nature of fossil fuels and the way in which transport emissions contribute to climate change (Jones, 2001; DEFRA, 2005; J. Pretty *et al.*, 2005). A recent exception notes that this focus on transport has in many ways diverted attention away from production site impacts, notably on water resources (Cabinet Office, 2008). These include significant changes in regional water systems through the impact of irrigation and chemical use in farming, resulting in reduced river flows, depleted groundwater aquifers, and deteriorating water quality. Today, a multitude of acute pressures on global water resources and the resulting strain on humans and ecosystems worldwide mean it is more crucial than ever to assess the effects of the food and cotton trades.

This study examines the UK's effect on global water resources, building on earlier studies (Chapagain and Hoekstra, 2004; Zygmunt, 2007; Hoekstra and Chapagain, 2008) to assess the water required for UK consumption through a WF. A WF is estimated through the virtual water content of products (for definitions please refer to section 2). The WF is conceptually similar to the ecological footprint (EF) which measures how much land a human population requires to produce the resources it consumes and to absorb its wastes (Wackernagel and Rees, 1996; Wackernagel and Jonathan, 2001). However, the EF model does not include freshwater in any meaningful way. A nation's or individual's water impacts under an EF equates the energy required to process freshwater for human consumption as well as the land area required to support those water-processing industries. These measures tell only a small part of the story concerning threats to the world's freshwater ecosystems, where the key issues are water abstraction, water pollution, over-exploitation of aquatic species, the physical modification of water bodies (e.g. dams, draining of wetlands), and the effects of rainfall patterns that result from climate change. The WF gives information about a region's dependence on global water resources and highlights the reliance and impact we have on often distant locations.

This report argues that the best contribution we can make to solving our numerous water problems is first to understand and then to reduce our impacts. We must then improve our WF in areas of poor water quality or water stress, and in places where water use is unsustainable given poorly managed water systems.

1.1 OBJECTIVES

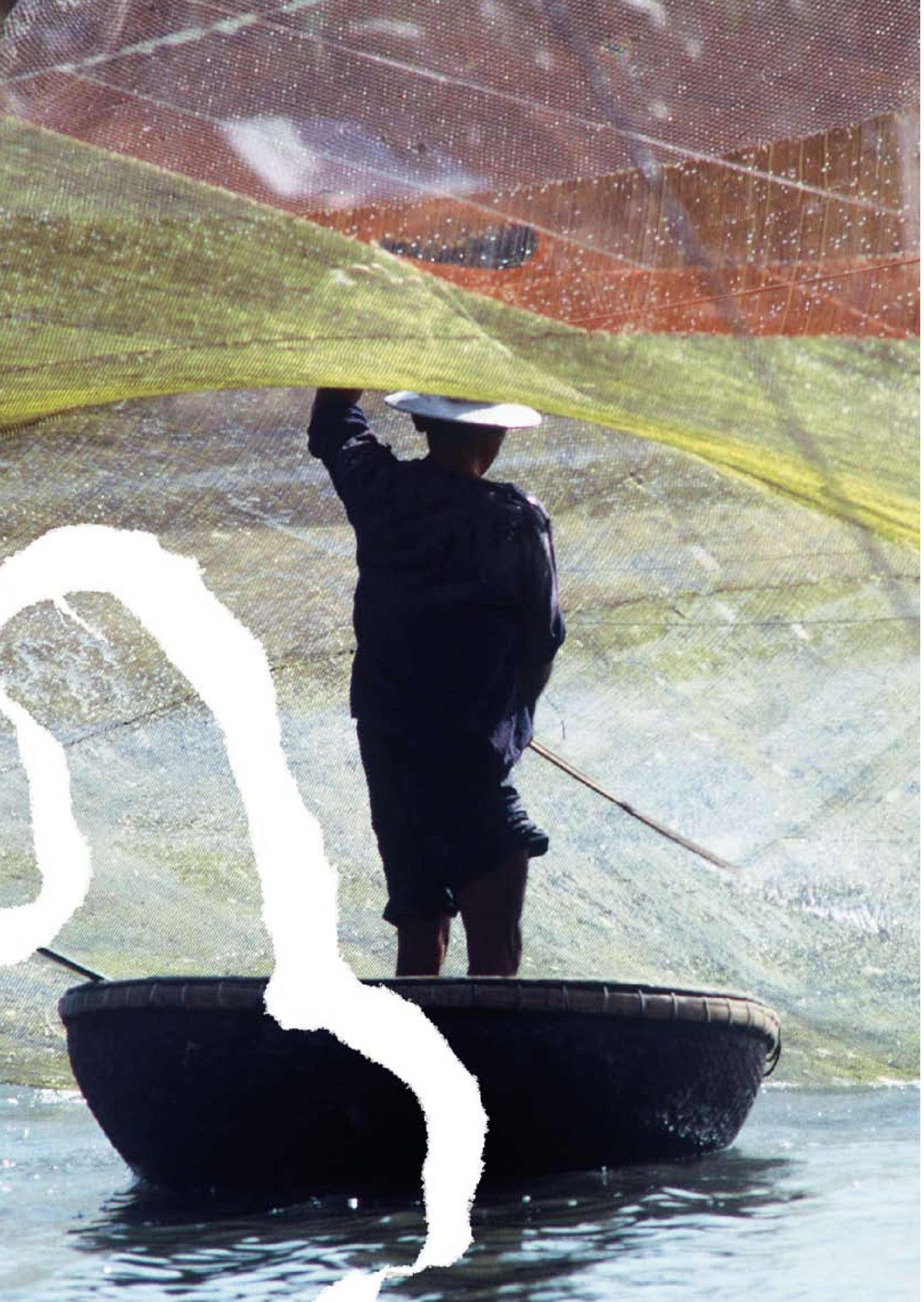
WWF aims to highlight the often forgotten role that water plays as an input to the commodities we consume. Fundamental to this is an assessment of the way that food, bio-fuel and cotton production can drive the over-abstraction and pollution of freshwater ecosystems. UK lifestyles are dependent on water from many nations, making our lives inextricably linked with what happens elsewhere. As such, we all have a stake in and responsibility towards the social and environmental consequences of how water is managed. Through awareness of water issues inside and beyond our borders, the roles and responsibilities of citizens, business managers and government policy makers may increasingly be highlighted in terms of deficiencies and possibilities.

This report suggests that, given the increasing stress on global water resources, the decisions regarding the management of water and the procurement of agricultural products are increasingly moral and ethical choices, as well as economic ones. Sustainable resource use and water's role in trade are therefore major topics for discussion and re-evaluation. Understanding how much water we require as a nation is but the first step in this important chain. We then need to assess the relative size of our WF in relation to available water resources in parts of the world where the crops we consume are grown and processed. Simply put, it is not necessarily how much water we use, but more often when and where it comes from that matters.

In this report we:

- Present a method to estimate the WF of a nation (section 4);
- Estimate and analyse the different components of the UK WF (section 5);
- Discuss the UK WF in the context of water stress at sites of production (section 6);
- Highlight key features of the UK WF with selected case studies (sections 5 and 6); and
- Suggest actions for key stakeholders (section 7).

In the appendices (produced separately) you will find the detailed method and data behind the report.



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2 DEFINITIONS

Total water demand
The water demand of a country is usually expressed as the total water withdrawn from rivers, lakes and aquifers in that country for different sectors of its economy. However, this does not equate to the total water demand of a country, since it does not take into account the impact on those global water resources which are required to produce imported products. Given that many goods consumed within a country are produced elsewhere, the total or actual water demand of a country is often much higher than traditional assessments suggest. Water demand can therefore be better expressed through a WF which includes the concept of virtual water.

Virtual water
The concept of virtual water was first developed by Allan (1998; 1999; 2001). Virtual water is the volume of water required to produce a product. For example, a can of cola contains 0.35 litres of water, yet it requires an average of 200 litres to grow and process the sugar contained in that can. Similarly it takes 2,900 litres to 'grow' a cotton shirt and 8,000 litres to produce a pair of leather shoes, i.e. the amount of water required to grow feed, support a cow, and process its skin into leather (Hoekstra and Chapagain, 2008).

Water footprint
A water footprint (WF) is the total virtual water content of products consumed by an individual, business, town, city or country. A WF consists of two parts, the use of local water resources and the use of global water resources. Both parts include the use of blue water (water withdrawn from ground or surface water sources), green water (water evaporated from soil moisture supplemented by rainfall) and grey water (the polluted volume of blue water returned after production). These three components of a WF affect water systems in different ways.

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3 WATER IN CONTEXT

Our food and clothing cannot be made without a great deal of water. Freshwater ecosystems support agriculture to produce food, cotton and bio-fuel; regulate water flows; purify waste water and detoxify wastes; regulate climate; provide protection from storms; mitigate erosion; and offer cultural benefits, including significant aesthetic, educational, and spiritual benefits (IWMI, 2007). The withdrawal of freshwater in quantities and at rates greater than nature's ability to 'renew' is widely documented in many parts of the Middle East, India, Mexico, China, the United States, Spain and the former Soviet Union (Falkenmark and Lannerstad, 2004; UNESCO-WWAP, 2006). The latter of course includes the Aral Sea, which, more than any other water body in the world, has come to epitomise the devastating economic and ecological effects of water mismanagement.

Water use in agriculture

70% of existing global freshwater is withdrawn for irrigation in agriculture (UNESCO-WWAP, 2003). This, however, refers only to water from lakes, rivers and aquifers (blue water), and does not take into account the water stored in the soil from rainfall (green water) that is used in agriculture production. Part of the irrigation water returns to local water systems as a result of irrigation inefficiencies, while all evaporated water returns to the hydrological system somewhere, and at some other time.

Rising demand for water

The strain on global water resources will become more acute through increases in population and economic growth. It is estimated that by 2050 food demand will roughly double (IWMI, 2007). Demand on water allocations for agriculture will rise and stronger purchasing power, shifts to increased consumption per person of meat and livestock products, increased urbanisation, and the effects of climate change will increase demands on water. This demand will manifest at a number of levels. The inadequate allocation and availability of clean water will continue to hamper development progress and cause conflict. Significant problems of over-abstraction and pollution of ecosystems will increase, leading to continued decline in aquatic biodiversity. Restrictions on water availability and use will affect the cost and supply of water-sensitive commodities and other inputs.

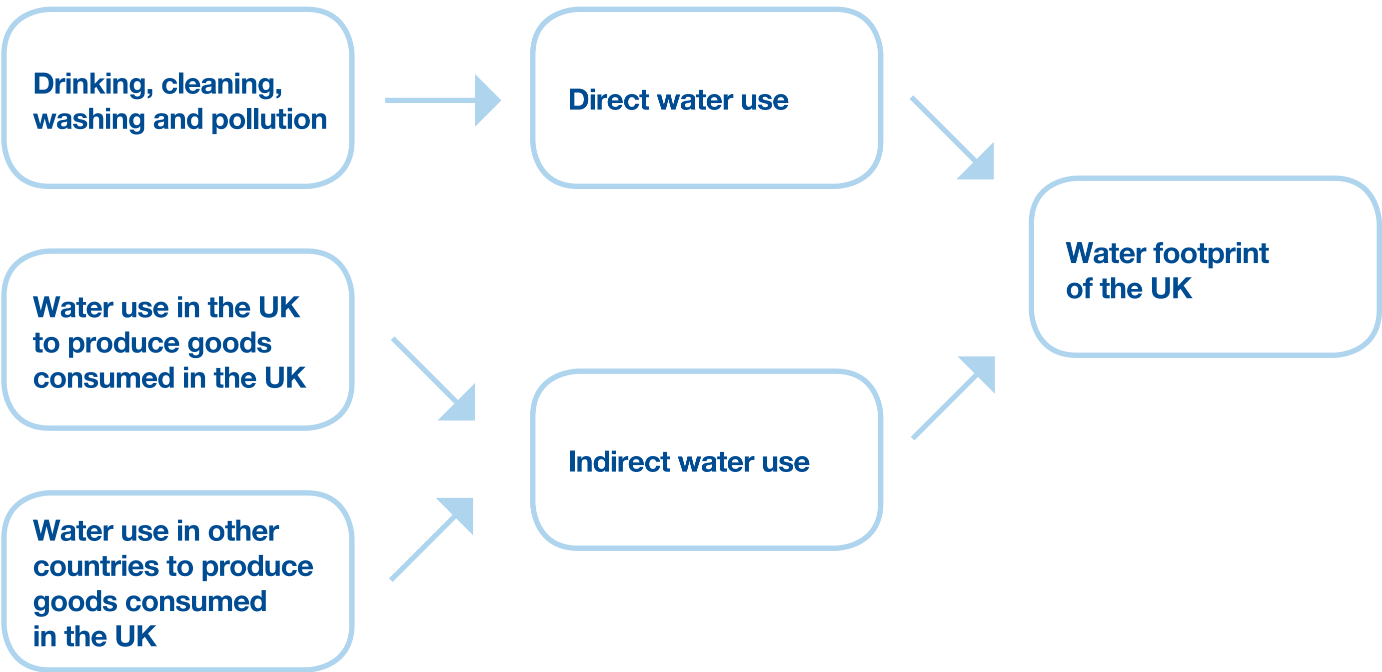
4 METHODS: CALCULATING THE UK'S WATER FOOTPRINT

The UK, a relatively affluent nation, consumes many diverse products. These include large quantities of livestock products, cereals, tea, cotton, and sugar originating from all over the world. To calculate the UK's WF, we have analysed the water requirements of all agricultural products consumed, based on trade data from PC-TAS (ITC, 2006). This includes 503 crop (e.g. cotton, food, flowers) and 141 livestock products as categorised in the trade database (appendix D). Estimating the WF of industrial products is complex but we have made a crude assessment of the industrial WF of the UK using the best available methods (Chapagain and Hoekstra, 2004). This includes products such as chemicals, machinery and other manufactured goods, whose WF is based on the industrial value added per product per unit of water used. The methods used for calculating the industrial component need improvement, but are beyond the scope of this report, which focuses more on the agricultural and household elements of the UK's WF.

What goes into the UK's water footprint?
The WF of a person, business or nation is the sum of water use (direct or indirect) to produce goods and services consumed (figure 4.1). Direct water use (i.e. water from the tap) is easy to estimate, whereas indirect water use (i.e. water used to produce goods and services), is more difficult to quantify. The quantity of indirect water in a product is expressed in terms of the virtual water content of a product (e.g. cubic meters of water per tonne of product).

A detailed version of the methodology followed is presented in Appendix B.

Figure 4.1 Schematic to establish a WF



5 RESULTS

5.1 TOTAL WATER FOOTPRINT OF THE UK

- **102 Gm^3 (billion cubic metres) per year**
- **4,645 litres per person per day**

The total WF of the UK is 102 Gm^3 per year, equal to 49 times the annual flow of the River Thames. This is made up of agricultural products (74.8 Gm^3/yr or 36 times the annual flow); industrial products (24.0 Gm^3/yr or 11.5 times the annual flow); and household water use (3.3 Gm^3/yr or 1.5 times the annual flow). Based on the UK's population of 60,441,000, this equates to, on average, 4,645 litres per person per day, equivalent to 50 normal bath tubs or 75 cycles of a standard washing machine. This figure breaks down as: agricultural products, 3,400 litres per person per day, with cotton alone representing 211 litres per person per day; industrial products, 1,095 litres per person per day; and household water, 150 litres per person per day. These figures include both internal (the water used from inside the UK to grow the food consumed in the UK) and external (imports) WF (see table 5.1).

Table 5.1 Total WF of the UK

	WF (Gm^3/yr)			
	Internal	**External**	**Total**	**% of total WF**
WF of agricultural products	28.4	46.4	74.8	73
WF of industrial products	6.9	17.2	24.0	24
WF of household water use	3.3	–	3.3	3
Total WF (Gm^3/yr)	38.6	63.6	102.1	100%
% of total WF	**38%**	**62%**	**100%**	

Dependence on global water sources
These results show that the UK is just 38% self-sufficient in water (the ratio of internal to total WF), and is therefore 62% dependent on water from elsewhere. The UK is the sixth largest net importer of virtual water (table 5.2a) based on the WF of agricultural products. Table 5.2b presents the top six net virtual water exporters of agricultural products.

A complete list of the virtual water imports and exports of the UK related to the international trade of agricultural products is presented in Appendix D.

Table 5.2a List of top six net agricultural virtual water importers (Gm³/yr)

Country	Export	Import	Net import
Brazil	91	199	107
Mexico	19	103	84
Japan	4	86	83
China	55	133	78
Italy	38	88	50
UK	15	55	40

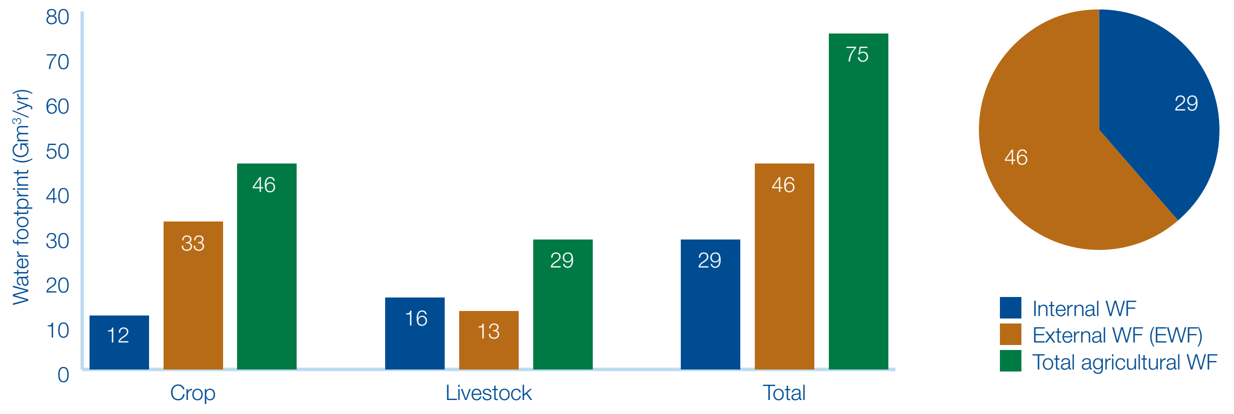
Table 5.2b List of top six net agricultural virtual water exporters (Gm³/yr)

Country	Export	Import	Net import
USA	298	137	161
Australia	71	10	62
Argentina	58	4	54
Canada	70	27	44
Thailand	52	9	43
India	66	24	42

5.2 WATER FOOTPRINT OF AGRICULTURAL PRODUCTS

The agricultural WF of the UK is 74.8 Gm³/yr (figure 5.1) or 73% of the total WF. This is considerably higher than reported in an earlier study (see Chapagain and Hoekstra, 2004 which estimated the total at only 47.5 Gm³/yr). The internal WF of UK agriculture is 28.4 Gm³/ yr while the external component is 46.4 Gm³/yr.

Figure 5.1 Total agricultural WF of the UK

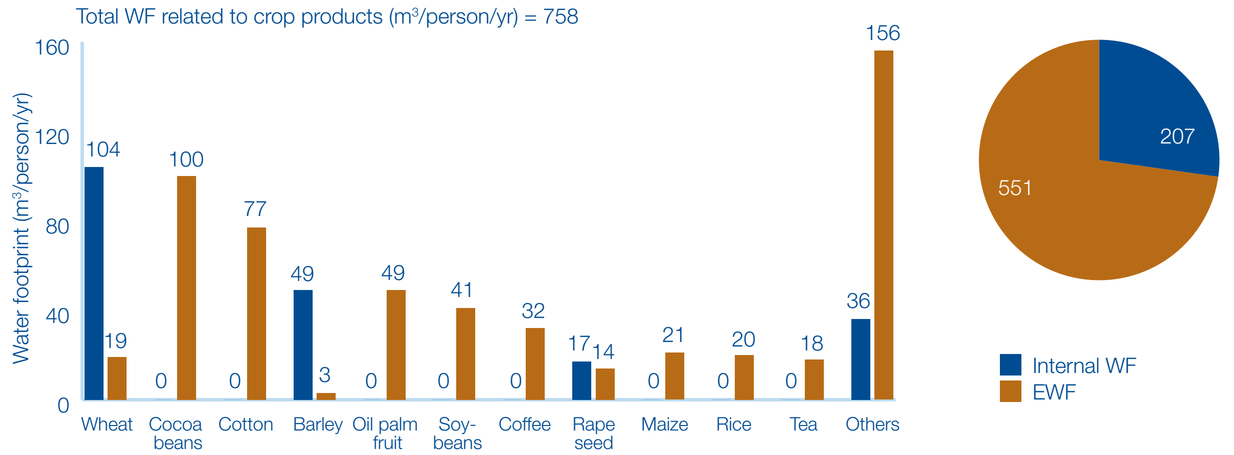


Water footprint by product type
A larger share of the internal WF is related to livestock production and cereal products (wheat and barley), whereas the larger share of the external WF (EWF) is related to products originating from oil crops, cotton products, livestock products and stimulants (coffee, tea and cocoa). Most of the products responsible for the EWF are not grown in the UK mainly because of unsuitable agro-climatic conditions.

The WF of livestock products is about 40% of the total agricultural WF of the UK. The total volume of water needed to support livestock production in the UK is 27.4 Gm³/yr. Of this, the volume of water in imported crops to feed UK livestock is only 2.0 Gm³/yr.

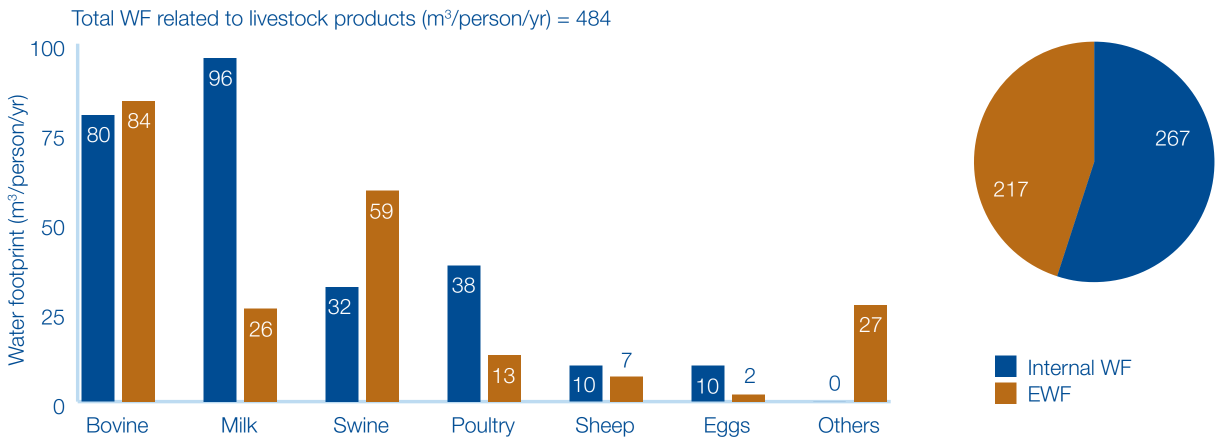
The various crop categories and their internal and external components are presented in figure 5.2.

Figure 5.2 Contribution of crop products to the UK's internal and EWF



The livestock footprint (figure 5.3) shows that beef (bovine) is the largest category followed by milk, swine (pig meat comprising bacon and pork) and poultry meat. The various livestock products and their internal and external components are presented in figure 5.3. The share of the internal WF related to livestock products (55%) is slightly larger than the external component. The main products produced internally are milk, beef and poultry, and externally, beef and swine. The complete list of products and their related internal and EWF is presented in Appendix E.

Figure 5.3 Contribution of livestock products to the UK's internal and EWF



Water footprint by region

The EWF of the UK is presented in figure 5.4. The arrow points in the figure show the major sources of the UK's external agricultural WF. A full list of these countries and the most significant products associated with the EWF of the UK can be found in table 5.3.

Most of the products that make up the UK's EWF originate from Brazil, France, Ireland, Ghana and India. Ghana provides cocoa, which is mainly rainfed. Brazil provides soybeans, coffee, and livestock products, while France provides mainly seasonal produce. Ireland provides mainly meat products, and India, cotton, rice and tea.

Figure 5.4 The UK's external agricultural WF

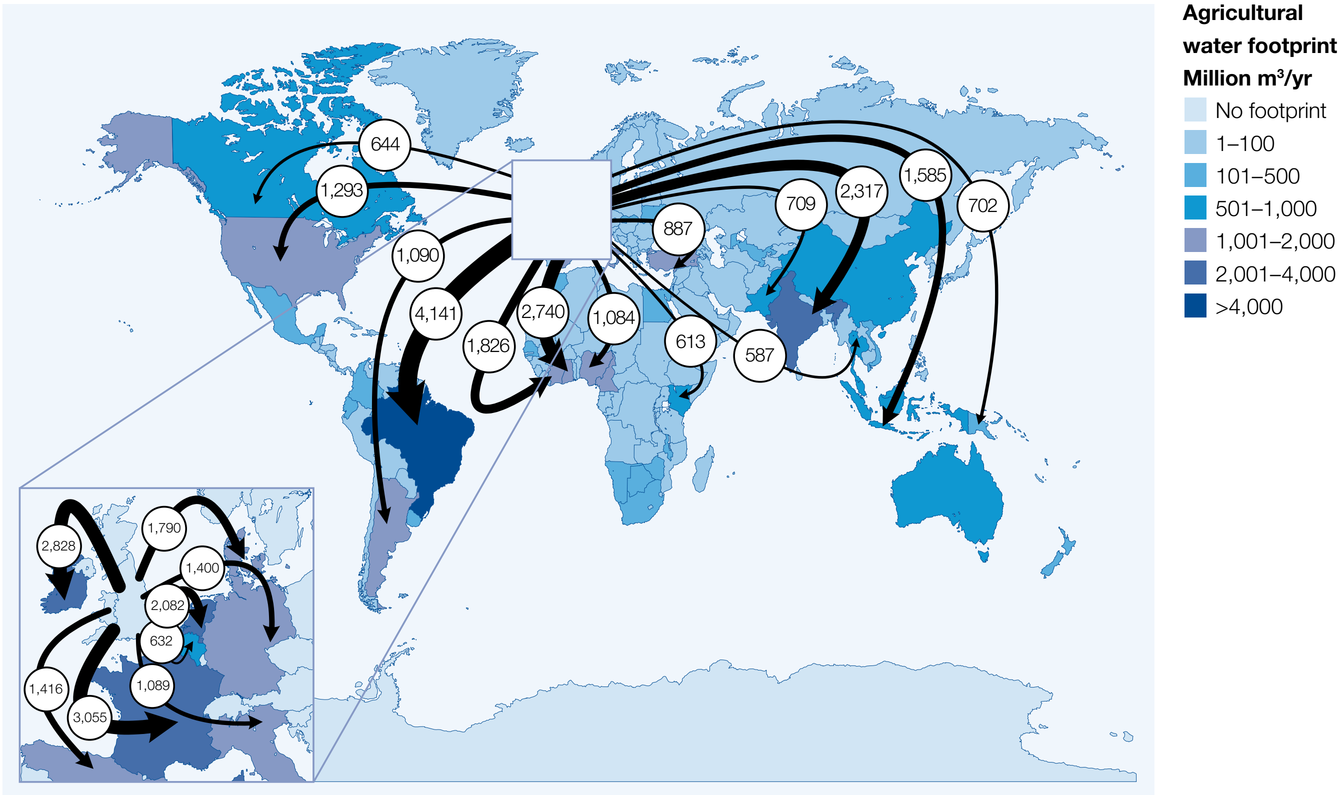


Table 5.3 shows the top 12 countries of origin of the products that make up the UK's external agricultural WF.

Table 5.3 Top 12 countries supporting the UK's external agricultural WF

Country	EWF (Mm³/yr)	% of EWF	Major product categories (Mm³/yr)
Brazil	4,141	9	Beef (1,545), soybeans (1,431), coffee (418), poultry (104), livestock (309)
France	3,055	7	Maize (1,045), rapeseed (325), wheat (280), swine (266), milk (209), sunflower (173)
Ireland	2,828	6	Beef (1,850), milk (423), swine (275), livestock (9,110), poultry (60), barley (42)
Ghana	2,740	6	Cocoa (2,676), groundnuts (22), oil palm fruit (6)
India	2,317	5	Cotton (1,206), rice (353), castor beans (262), tea (140), cashew nuts (86), groundnuts (61)
Netherlands	2,083	4	Swine (961), livestock (217), poultry (161), beef (157)
Ivory Coast	1,826	4	Cocoa (1,676), coffee (62), banana (44), oil palm fruit (13), cotton (11), cashew nuts (9)
Denmark	1,790	4	Swine (1,370), milk (221), livestock (81), beef (36), poultry (22), wheat (19)
Indonesia	1,585	3	Oil palm fruit (989), coffee (206), cotton (115), tea (114), cocoa (79), coconuts (38)
Spain	1,417	3	Olives (344), grapes (189), oranges (91), rice (90), swine (85), beef (85)
Germany	1,400	3	Rapeseed (266), swine (235), milk (214), wheat (161), beef (149), livestock (145)
USA	1,293	3	Soybeans (633), rice (148), wheat (92), cotton (77), grapes (53), sunflower (942)
Others	19,947	43%	
Total	**46,422**	**100%**	

Table 5.4 shows the top 12 agricultural products consumed in the UK (accounting for 72% of the total UK WF relating to agricultural products), their associated EWF and their countries of origin. A complete list of products and related internal and EWF can be found in Appendix E.

Table 5.4 Major locations of the EWF for the UK's top 12 agricultural products

Products	EWF (Mm³/yr)	% of EWF	Location of EWF (Mm³/yr)
Cocoa beans	6,067	13	Ghana (2,676), Ivory Coast (1,676), Nigeria (865), Cameroon (412), Indonesia (79), Singapore (57)
Bovine	5,086	11	Ireland (1,850), Brazil (1,545), Italy (197), Uruguay (162), Netherlands (157), Germany (149)
Cotton	4,661	10	India (1,206), Turkey (549), China (472), Pakistan (439), Bangladesh (266), Egypt (138), Uzbekistan (100),
Swine	3,552	8	Denmark (1,370), Netherlands (961), Ireland (275), France (266), Germany (235), Belgium (224)
Oil palm	2,946	6	Indonesia (989), Malaysia (560), Papua New Guinea (548), Nigeria (199), Colombia (177)
Soybeans	2,454	5	Brazil (1,431), USA (633), Argentina (226), Paraguay (58), Canada (46), Uruguay (13)
Coffee	1,952	4	Brazil (418), Colombia (238), Indonesia (206), Vietnam (170), Kenya (133), Mexico (86)
Livestock	1,610	3	Brazil (309), Netherlands (217), Germany (145), Thailand (126), France (112), Italy (111)
Milk	1,575	3	Ireland (423), Denmark (221), Germany (214), France (209), New Zealand (105), Netherlands (87)
Maize	1,282	3	France (1,045), Argentina (98), Belgium (28), Hungary (22), Brazil (19), Germany (18)
Rice	1,225	3	India (353), Thailand (176), Pakistan (167), USA (148), Italy (135), Spain (90)
Wheat	1,178	3	Canada (470), France (280), Germany (161), USA (92), Italy (29), Ireland (22)
Others	12,832	28%	
Total	**46,422**	**100%**	

5.3 CASE STUDIES

The following case studies have been chosen because they are important products in terms of volumes consumed within the UK, and because their cultivation and trade illustrate some of the issues raised in this report. Sugar cane, tomatoes and cotton are crops grown in areas where water use and scarcity are significant issues.

5.3.1 CASE STUDY A: WATER FOOTPRINT OF SUGAR CROPS

Sugar is one of the most common ingredients in our diet. More than 200 countries produce sugar, 78% of which is made from sugar cane grown primarily in the tropical and sub-tropical zones of the southern hemisphere. The balance comes from sugar beet which is grown mainly in the temperate zones of the northern hemisphere (Northwest and Eastern Europe, northern Japan and some areas in the USA).

During the period 2000-04, the global production of sugar crops was over 1.5 billion tonnes per year. Brazil is the largest producer (24%) followed by India (18%), China (6%), Thailand (4%), the USA (4%) and Pakistan (4%). Currently 69% of the world's sugar is consumed in the country of origin whilst the balance is traded on world markets. Brazil is a major grower of sugar cane to produce sugar and provide the ethanol used in making gasoline-ethanol blends (gasohol) for transportation fuel. The production of sugar results in residues which differ substantially depending on the raw materials used and on the place of production. Cane molasses is normally used in food preparation, as an animal feed additive and to brew into alcohol, while residues from sugar beet are mostly used as industrial fermentation feedstock, or as animal feed. Bagasse, the solid waste from sugar cane, is used to generate electricity.

Being mainly a tropical crop where sunshine is not a limiting factor of production, irrigation is often required in sugar cane production. Sugar beet is mostly grown in rainfed areas with little or no supplementary irrigation except in the Mediterranean region. Both cane and beet need about 3–10 m³ of water per ton of raw material, with the water used in the plant growth stage being considerably higher than the water used in processing. The global average virtual water content of sugar beet is 114 m³/ton, and of sugar cane, 174 m³/ton.

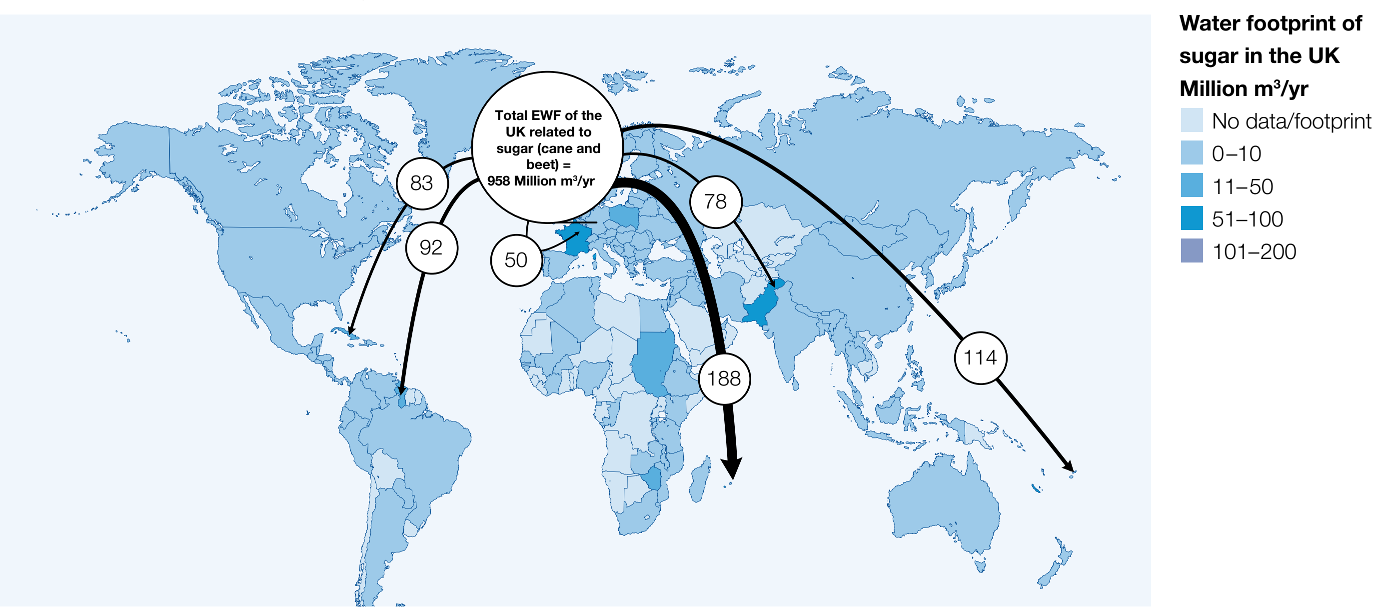
UK sugar consumption

The total WF of sugar consumption in the UK is 1,450 Mm³/yr (million m³), with 958 of that being external (table 5.5). Mauritius accounts for around 18% of the EWF, Fiji 11%, Guyana 9%, Jamaica 8%, and Pakistan 8%. The EWF of UK related to sugar consumption is presented in figure 5.5.

Table 5.5 WF of sugar consumption in the UK (Mm³/yr)

			Virtual water export					
	Domestic water use	**Gross import**	**Domestic products**	**Imported products**	**Total export**	**Internal WF**	**EWF**	**Total WF**
Sugar cane		2,500		1,544	1544		955	955
Sugar beet	506	2	14	0.01	14	493	2	495
Total	**506**	**2,502**	**14**	**1,544**	**1558**	**493**	**958**	**1,450**

Figure 5.5 Contribution of sugar (cane and beet) to the UK's EWF



5.3.2 CASE STUDY B: WATER FOOTPRINT OF TOMATOES

The tomato is the single most important horticultural crop in terms of world production and trade. World production of tomatoes is around 115 million tonnes per year. The largest water users in tomato cultivation are China (4,464 Mm³/yr), Egypt (1,121 Mm³/yr), India (2,284 Mm³/yr), and Turkey (1,565 Mm³/yr). Total water use for tomato production in the UK is only 0.8 Mm³/yr however as an importer of tomatoes, the UK's WF in relation to tomato consumption is 13.9 Mm³/yr.

UK tomato consumption

Most tomatoes grown in the UK are produced in green houses. Domestic production is constrained by climatic conditions which guarantee an acceptable crop for supermarket standards. Total water use for tomato production in the UK is only 0.8 Mm³/yr, however imports use 13.9 Mm³/yr (table 5.6).

Table 5.6 WF of tomato consumption in the UK (Mm³/yr)

			Virtual water export					
	Domestic water use	**Gross import**	**Domestic products**	**Imported products**	**Total export**	**Internal WF**	**EWF**	**Total WF**
Total	**0.78**	**13.14**	**0**	**0.02**	**0.02**	**0.78**	**13.12**	**13.90**

Imports to the UK remain high and this is not expected to change in the future. Currently the UK imports mainly from Spain followed by Italy, the Netherlands, Morocco, Turkey and Portugal (table 5.7). The EWF of tomatoes consumed in the UK is presented in figure 5.6 overleaf.

Table 5.7 EWF of tomato consumption in the UK (Mm³/yr)

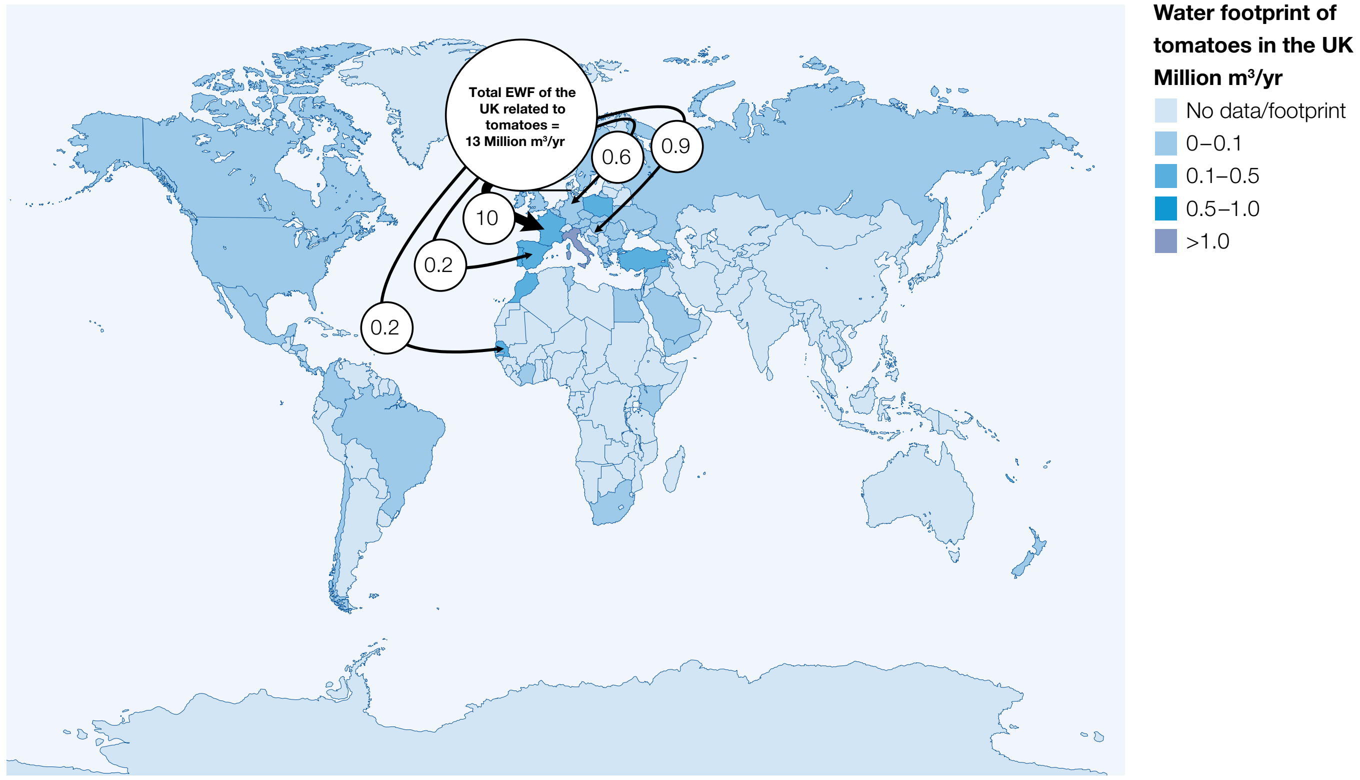
	EWF	**Contribution to total imports in the UK %**
Spain	10.02	76.3
Italy	0.98	7.5
Netherlands	0.61	4.6
Morocco	0.28	2.1
Turkey	0.25	1.9
Portugal	0.20	1.5
Poland	0.18	1.4
Israel	0.14	1.1
France	0.13	1.0
Senegal	0.12	0.9
Others	0.21	1.8
Total	**13.12**	

Spanish tomatoes

As the largest provider of tomatoes to the UK, Spain represents 76% of the WF for this product. Tomato cultivation covers over 60,000 ha. The main regions for tomatoes used in processed food are the Ebro valley (Navarra, Rioja, and Zaragoza) and Guadiana valley (Extremadura), while the south-east catchments of the Júcar, Segura and Sur (Valencia, Alicante, Murcia, Almería) and Canary Islands are the main producers of fresh tomatoes. According to Beaufoy (2005) these sites are among the most significant in Spain in terms of conflicts between agriculture and the conservation of rivers and water resources.

In Spain, tomato production alone evaporates 297 Mm³/yr and pollutes 29 Mm³/yr of fresh water resources (Chapagain and Orr, 2008). On average, producing one tomato (assuming it to be equal to 100g) evaporates about 1.4 litres of green water and 6.1 litres of blue water, and pollutes nearly 0.7 litres of freshwater, totalling 8.2 litres per tomato (ibid).

Figure 5.6 Contribution of tomatoes to the UK's EWF



5.3.3 CASE STUDY C: WATER FOOTPRINT OF COTTON PRODUCTS

About 73% of global cotton production is irrigated (Soth *et al*., 1999) and mainly grown in warm climatic regions where freshwater is already a scarce commodity. Nearly 70% of the world's cotton production occurs in China, the USA, India, Pakistan and Uzbekistan (USDA, 2004). From field to end product, there are numerous stages in cotton production, often carried out at different locations, making it one of the most complex commodity supply chains. The global volume of water use for cotton crop production is estimated at 198 Gm³/yr (nearly twice the size of the total UK WF).

The impacts of cotton production on the environment are multifaceted and relate to both the quantity and the quality of water resources. From a quantity perspective, the Aral Sea is the most notorious example of water's over-abstraction for irrigated cotton fields. During the last 40 years (1960-2000), the Aral Sea lost almost 60% of its area and 80% of its volume (Glantz, 1998; Hall *et al*., 2001; Pereira *et al*., 2002; UNEP, 2002; WWF, 2004) as a result of the water abstraction for irrigation from its two tributaries, the Amu Darya and the Syr Darya. The Aral Sea lost 20 out of 24 fish species due to decreased water, and the local fishing industry collapsed when catches fell from 44,000 tons annually in the 1950s to zero, concluding with a loss of 60,000 jobs (IWMI, 2007).

This study includes a wide range of cotton products that are imported into the UK (Appendix D); but tracing these products to areas where they are grown is often difficult. We covered 205 cotton products (such as cotton garments) compared to only 79 products in an earlier study (Chapagain *et al*., 2006).

UK cotton consumption

Since cotton is not grown in the UK, the WF of UK cotton consumption is calculated by subtracting the re-export of cotton products from gross imports to the UK. The total WF of UK cotton consumption is 4.66 Gm³/yr, or 77 m³ per person/yr. The average daily equivalent WF of the UK is 211 litres per person/day.

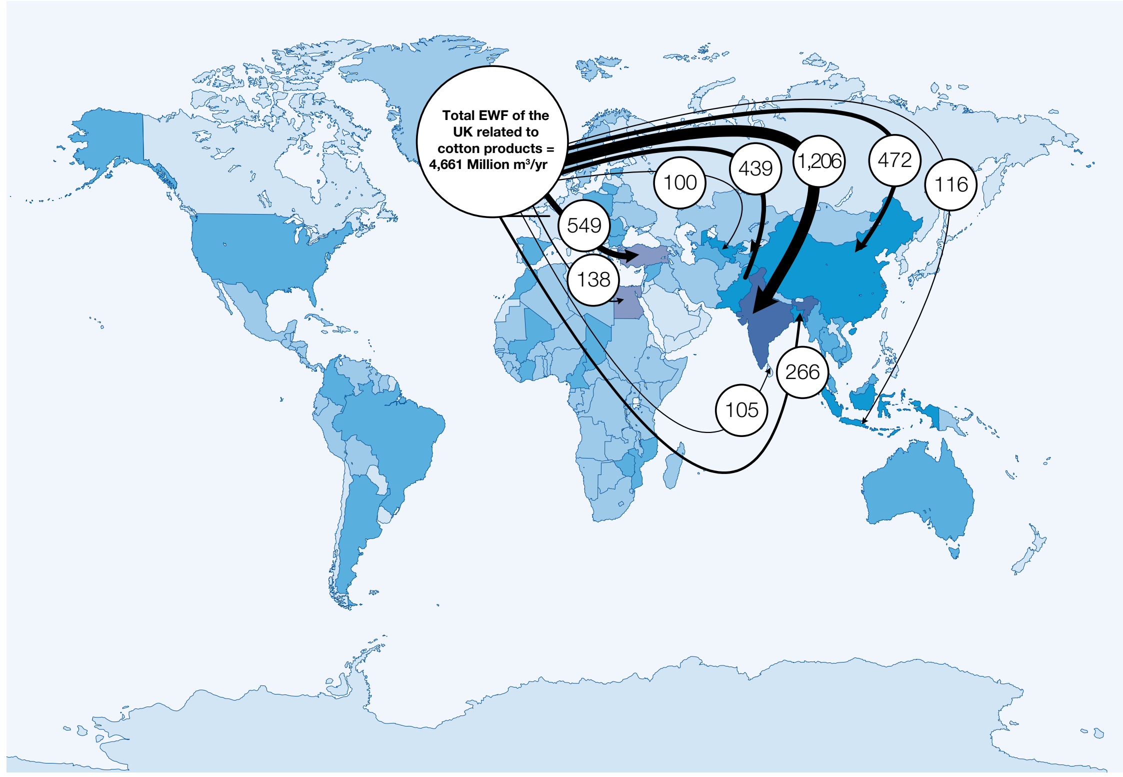
Table 5.8 below shows the main export countries which support the UK consumption of cotton products and their contribution in percentage to the total. The EWF of the UK's cotton consumption is presented in figure 5.7 overleaf.

The total UK WF for cotton is presented in terms of green, blue and grey components in table 5.9 overleaf. Such separation is necessary in order to delineate between where the water came from in the hydrological cycle and the pollution effects of this crop. The type of water used is useful information for policy intervention. While green water is essentially a 'gift', its use has different impacts from water pumped out of a river or an aquifer. Blue water has higher opportunity costs because it has a number of alternative uses such as household or industrial supply. Grey water is essentially the volume of blue water polluted in the production process. The amount produced depends on the efficiency of use of fertilisers and pesticides in field and the quality of waste water from cotton industries.

Table 5.8 WF of UK cotton consumption from major locations (Mm³/yr)

	Gross import	UK export of imported virtual water	WF of the UK	Contribution to total WF of the UK related to cotton %
India	1,620	414	1,206	26
Turkey	738	189	549	12
China	634	162	473	10
Pakistan	590	151	439	9
Bangladesh	358	92	266	6
Egypt	186	48	138	3
Indonesia	154	39	115	2
Sri Lanka	142	35	105	2
Uzbekistan	136	35	101	2
USA	103	26	77	2
Others	1,600	407	1,193	26%
Total	**6,262**	**1,601**	**4,661**	**100%**

Figure 5.7 Contribution of cotton to the UK's EWF



Water footprint of cotton products in the UK Million m³/yr

- No data/footprint
- 1–10
- 10–100
- 100–500
- 500–1,000
- >1,000

Table 5.9 WF components (Mm³/yr) related to trade in cotton products

	Gross import Mm³/yr	Gross export Mm³/yr	Net import Mm³/yr	WF of cotton consumption (litres/ person/day)
Green water	2,465	658	1,807	82
Blue water	2,750	678	2,072	94
Grey water	1,048	265	783	36
Total	**6,262**	**1,601**	**4,661**	**211**

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6 ASSESSMENT OF THE EXTERNAL IMPACT OF THE UK'S WATER FOOTPRINT

6.1 WATER FOOTPRINT IMPACT LOCATIONS

The impact of a WF depends on both the volume of water required to produce a product and the nature of the source of that water. To assess the external impact of the UK's WF, we have therefore looked to those countries where our impact on the water source is greatest. Impacts on water sources are defined as 'water stress', and can be calculated through a water stress indicator (WSI) (Smakhtin *et al.*, 2004), which reflects the scarcity of water for human use by taking into account the environmental requirements of systems. A full description of the impact methods can be found in Appendix B.

Figure 6.1 shows where the UK has the highest impact, based on the volume of product consumed and the level of stress on the water system in question. Group D is therefore where we must focus to address the impact of our WF. Figure 6.2 shows the countries that fall into Group D, based on the EWF of the UK and water stress in these locations.

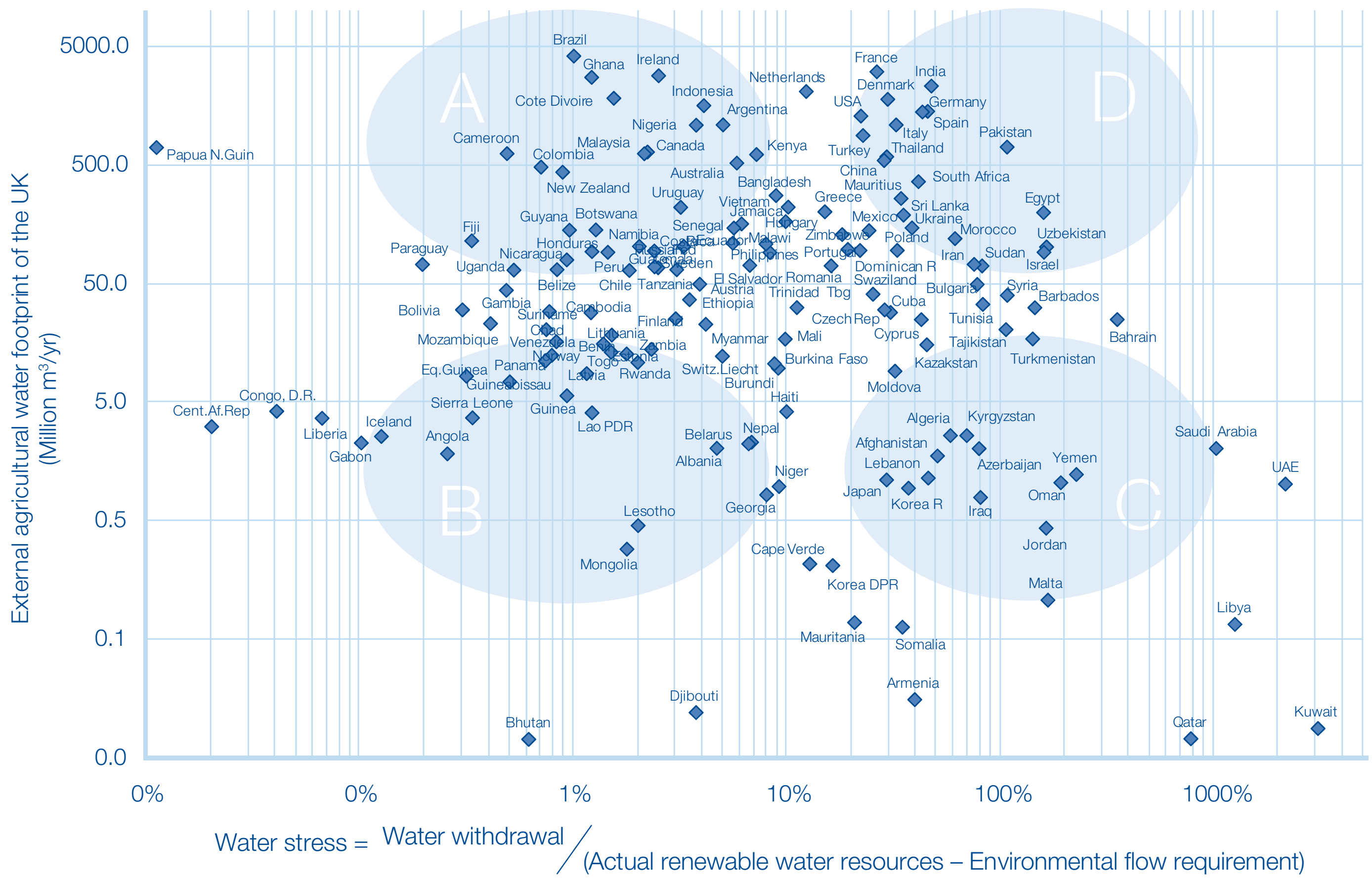
Figure 6.1 Schematic to categorise impact groups based on water stress and EWF

External water footprint of the UK

Group A Countries where — High external water footprint of the UK — Low water withdrawal per unit available	**Group D** Countries where — High external water footprint of the UK — High water withdrawal per unit available
Group B Countries where — Low external water footprint of the UK — Low water withdrawal per unit available	**Group C** Countries where — Low external water footprint of the UK — High water withdrawal per unit available

Water stress = Water withdrawal / (Renewable water resources – Environmental flow requirement)

Figure 6.2 The UK agricultural WF and water stressed production sites



The following case studies, of Group D countries, illustrate why addressing the impacts of the UK WF is so important for the long-term sustainability of water sources.

6.2 CASE STUDY D: SPAIN

Spain uses more than 70% of its water for irrigated agriculture. In Spain, the main environmental issues associated with agricultural production other than water consumption, are water pollution, soil pollution and erosion, as well as habitat loss from expanding cultivation in some areas. The over-exploitation of aquifers from exports has affected water quantity and quality, including water salinity and declining water tables, with additional loss of biodiversity and landscape amenity across the Mediterranean area (Martínez-Fernández and Selma, 2004).

The following regions of Spain have some of the most pressing issues in the country in terms of their use and management of water.

Almeria and Murcia

In the Almeria region, 24% of the local economy is based on agriculture, the highest percentage in the EU and comparable to a Spanish average of 3.7% (Downward and Taylor, 2007). Rising water demands in Almeria have resulted in over-abstraction of many of the province's aquifers (in some cases withdrawals exceeding recharge by 250%) leading to significant water deficits and increasing salinisation (ibid). Current water use is around four to five times more than the region's annual rainfall, and is mainly obtained from deep wells with high salinity, limiting the possibilities for water re-use.

The situation in neighbouring Murcia is just as precarious. Murcia, which was traditionally a poor farming region, has undergone a resort-building boom, even as many of its farmers have switched to more thirsty crops. This combination has put new pressures on the land and on Murcia's dwindling supply of water (Rosenthal, 2008).

Barcelona

Between agriculture, tourism and profligate public use, the demands on the Spanish water supply has led to a considerable shortage of household water in Barcelona, prompting a national debate about poor planning and failed governance. In May 2008, a shipping tanker arrived from France with 36 million litres of drinking water for Barcelona's citizens, which supplied enough water for 330,000 homes for only a few minutes. This part of a contract to bring water from the Rhone every few days for months is illustrative of why sustainability where water supplies are concerned can legitimately be viewed as crucial (Nash, 2008).

The government's response to over-abstraction

The Spanish Government has responded to excessive water abstraction from aquifers with a national water plan, 'Programa Agua', which calls for, among other things, an increase in desalination plants (Downward and Taylor, 2007). Desalination, while it may solve the immediate water problem, contributes to many other significant environmental impacts (e.g. high GHG emissions, marine impacts, waste flows). It is an increasingly popular response to water scarcity, especially in southern Europe where irrigation, urbanisation and increasing demands from tourism have combined with poor management to create water scarcity. Desalination should not however be seen as the miracle cure; curtailing demand and better governance should first be implemented.

Spain as an exporter to the UK

The UK relies on Spain for 3% of its agricultural WF (figure 6.3).

The highest water-intensive products exported from Spain to the UK are olives, grapes, oranges, rice, and swine and bovine products. While imports from Spain represent a small proportion of the UK's total WF, their impacts on Spanish water resources are severe, causing huge competition for water resources, particularly where agricultural and holiday areas overlap.

Figure 6.3 The agricultural WF of the UK from Spain

Agricultural WF of the UK from Spain	
Olives	344 Mm³/yr
Grapes	189 Mm³/yr
Oranges	91 Mm³/yr
Rice	90 Mm³/yr
Bovine products	85 Mm³/yr
Swine products	85 Mm³/yr
Cotton products	58 Mm³/yr
Other Citrus	49 Mm³/yr
Plums	41 Mm³/yr
Peaches/nectarines	27 Mm³/yr
Eggs	24 Mm³/yr

Agricultural water footprint
Million m³/yr

- No footprint
- 1–100
- 101–500
- 501–1,000
- 1,001–2,000
- 2,001–4,000
- >4,000

6.3 CASE STUDY E: MOROCCO

Morocco is quickly becoming the Southern Mediterranean's newest production site for exports to the EU and is particularly keen to enter the UK market. The Souss-Massa basin is the main agricultural area in Morocco for exports and has an irrigated area of 108,500 ha. Apart from 17,700 ha of agricultural crops, other significant crops in the area include cereals, citrus fruits and bananas. Cash crops such as citrus and vegetables cover 35% of the irrigated valley area and contribute to almost two thirds of Moroccan agricultural exports. The major products responsible for our WF on Morocco are presented in figure 6.4.

Groundwater is the major water source for the region and is obtained primarily from two main aquifers, the Souss-Massa and Chtouka aquifers. The over-pumping of these aquifers, through more than 13,000 wells (some of them illegal), has resulted in water level declines ranging from 0.5 to 2.5 metres per year during the past three decades. The water table level dropped from 15 metres in 1969 to more than 35 metres in 2005. Groundwater level declines in some areas have already prompted major actions, such as the construction of an 80 km canal to transfer water to a key citrus growing area that is at high risk of drought. This canal diverts water that was previously used to refill groundwater aquifers in other parts of the basin (Tayaa, 2007).

The alarming trend in water scarcity reflects the lack of a strategy for regional water use to ensure sustainability. The agricultural sector is protected through trade restrictions, tax exemptions, price support and subsidies, including a subsidy for water. These measures have resulted in an inefficient allocation of scarce water resources: irrigated agriculture currently uses 95% of all blue water in the Souss-Massa Basin, with the remainder left for household and industrial use.

The demand for water in the Souss-Massa basin exceeds the sustainable supply. The deficit is made up by mining groundwater, i.e. pumping more water from the aquifer than is replenished by natural or artificial recharge. Besides considerably increasing the pumping costs, lowering the water table means that the system will get to a point at which the availability of water will not satisfy demand.

In 2000, Moroccan water resources authorities prepared reports predicting water consumption for the next 20 years. These reports indicate that even under the most optimistic forecasts (which assume maximum collection of surface water, maximum conversion to modern drip irrigation systems and reuse of treated sewage effluent), water supply in the basin is expected to reach a deficit of 50 Mm^3 per year by 2020.

In the Souss-Massa Basin, even under the best planning conditions, the current rate of water usage is not sustainable. If water-saving measures are not taken rapidly, the groundwater deficit will reach a catastrophic level for the economy of the basin. In addition, beyond 2020, even if the irrigation water demand is kept constant, the groundwater deficit would be irreversible. Groundwater levels will be so low in some locations that it may be uneconomical to pump the water out. Some land now under cultivation may have to be abandoned with a consequent loss of agricultural employment and production, a situation that would have major economical and social impacts in the region (Kent, 2002).

Figure 6.4 The agricultural WF of the UK from Morocco

Agricultural WF of the UK from Morocco	
Cotton	67 Mm^3/yr
Oranges	28 Mm^3/yr
Sugar cane	4 Mm^3/yr
Grapes	2 Mm^3/yr
Strawberries	1 Mm^3/yr
Other citrus	8 Mm^3/yr
Nutmeg	1 Mm^3/yr
Potatoes	1 Mm^3/yr
Beans	1 Mm^3/yr

Agricultural water footprint
Million m^3/yr

- No footprint
- 1–100
- 101–500
- 501–1,000
- 1,001–2,000
- 2,001–4,000
- >4,000

6.4 CASE STUDY F: PAKISTAN

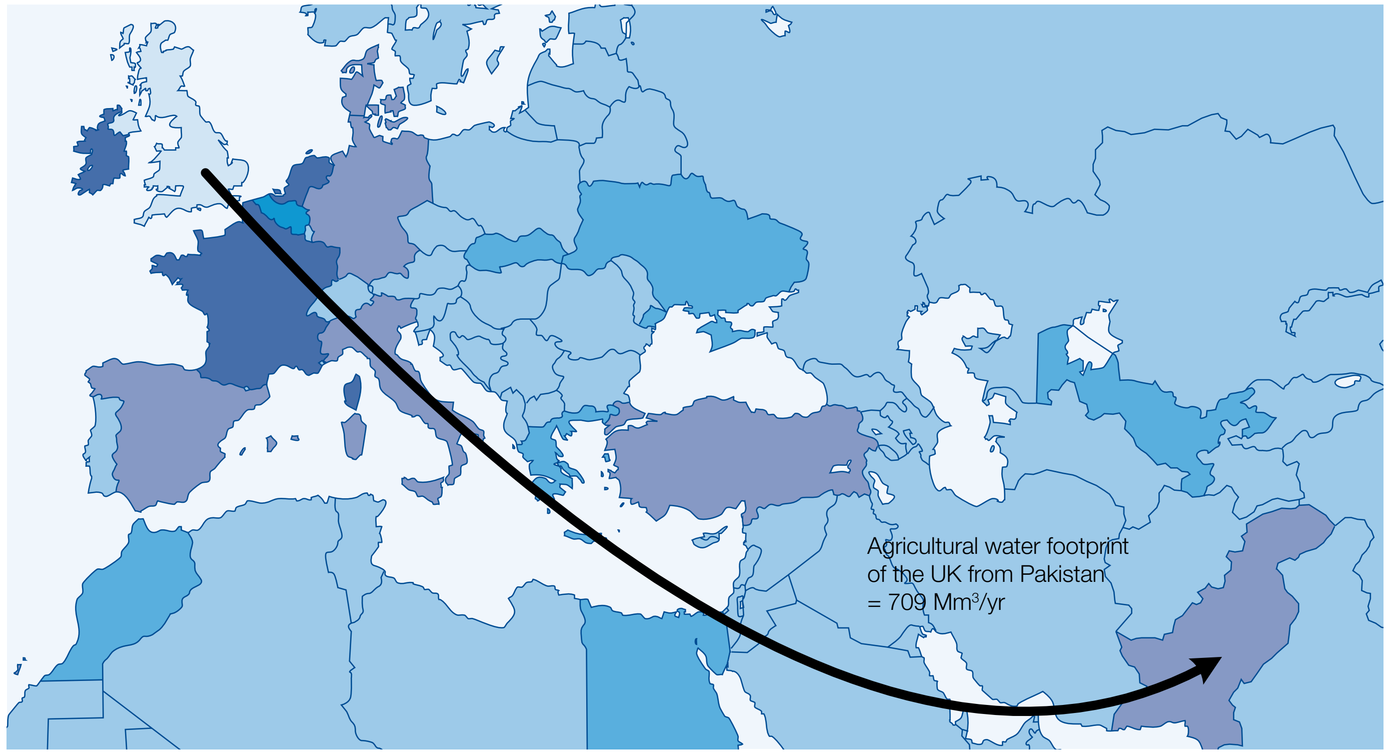
In Pakistan, with its population of 164 million people, water plays an extremely important role in the economy. Agriculture alone accounts for 24% of national GDP, 48% of employment and 70% of the country's exports. Irrigation in Pakistan mainly depends upon the Indus River (Pildat, 2003). Although about 88% of water is used for agriculture, the industrial, commercial and public health sectors are also greatly affected by the quantity and quality of available water. The UK imports numerous products from Pakistan (figure 6.5) the most important of which are cotton and rice from the Indus valley.

From 1999 to 2003, Pakistan experienced its lowest water availability on record due to a combination of low rainfall and unusually low snowfall in the Himalayas. Most blue water is sourced from spring and summer snowmelt. With its decrease, groundwater took on an even more important role. Unfortunately, the rapid increase in use of groundwater over the last two decades, combined with lower than average recharge, has resulted in declining groundwater levels.

Per person, the availability of blue water has been gradually dwindling in Pakistan from 5,300 m^3 in 1951 to 1,300 m^3 in 2002. It is projected that, by 2005, the availability of blue water may hit 1,000 m^3 per person, the threshold for defining a country as water stressed.

The Indus River basin contains approximately 16 million of Pakistan's 22 million hectares of cultivated land and the vast majority of the country's irrigated area (IWMI, 2006). Population growth, rapid urbanisation and industrialisation, and over-reliance on exports are putting great pressure on water. The rising imbalance between supply and demand has resulted in shortages and unhealthy competition leading to inter-provincial tension, environmental degradation in the form of persistent water-logging in certain areas, and the rapid decline of groundwater levels in other areas. Intrusion of saline water into fresh groundwater aquifers is another problem caused by excessive and imbalanced pumping (Pildat, 2003), and will become an increasing difficulty for Pakistan.

Figure 6.5 The agricultural WF of the UK from Pakistan



Agricultural WF of the UK from Pakistan	
Cotton	439 Mm^3/yr
Rice	167 Mm^3/yr
Sugar cane	78 Mm^3/yr
Mangoes	9 Mm^3/yr
Chick peas	2 Mm^3/yr
Castor beans	1 Mm^3/yr

Agricultural water footprint
Million m^3/yr
- No footprint
- 1–100
- 101–500
- 501–1,000
- 1,001–2,000
- 2,001–4,000
- >4,000

6.5 LESSONS FROM THESE CASE STUDIES

The case studies illustrate many issues which exist for water exporting countries. Reducing our impacts will involve co-ordinated action at point of productions while being pragmatic about the level of influence we possess.

However, it must be the role of UK business interests and UK government policies to ensure that sourcing and promoting water use is done within sustainable limits. If you import, your imports need water, and if water is poorly managed or scarce where you source, your imports will be at risk in terms of quantity, quality or price. The key question is, of course, what can you do about it?

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7 SOLUTIONS AND IMPLICATIONS FOR KEY STAKEHOLDERS

The UK WF is, in global terms, very high per person. The intention of this report is to challenge government to support laws that address water use in the UK and the EU, and to fully consider water in crucial development strategies overseas where our WF has the greatest impact. At the same time we need to challenge the business community to consider and address its WF and impacts. It is also designed to encourage the general public to engage with the issues surrounding our use of water. How can we reduce our WF and thus reduce our impact on the water environment where it matters most? How can retailers, growers and processors support more sustainable water use beyond their own efficiency?

Increasing demands for water
The demands we make on water systems will only increase in the future as incomes rise and the human population grows. For example, global meat consumption is predicted to grow sharply over the next five to ten years, increasing 25% by 2013 and 56% by 2025. Growth will mainly be driven by increased demand from East Asia. Meat production is extremely water intensive: animals not only consume water, but they are fed with grains and grain-based feeds which also require large quantities of water (JP Morgan, 2008). Similarly, the demand for grain to produce biofuels may also accelerate in the years to come, given EU and US policy objectives. Additional uses obviously create greater strain on water resources.

However an increase in water use by one sector need not necessarily harm social or environmental goals, provided that either it is offset by decreases in other demands on the same water source, or that it takes place in areas where there is sufficient water. Simply reducing the UK's WF would not take into account these important issues. We need to address the impact of our WF, not just the WF itself.

Addressing the impact of our water footprint
The impact of an increase or decrease in the UK's WF depends entirely on where water is taken from and when. The increase of a WF in an area where water is plentiful is unlikely to have an adverse effect on society or the environment, but an increase in an area already experiencing water scarcity could result in serious problems, such as the drying up of rivers, the destruction of habitats and livelihoods as well as the extinction of species, in addition to affecting agricultural prices, supplies and local economies.

Seasonality further complicates the analysis. Taking large volumes of water out of a river in the wet season may have perfectly acceptable consequences for ecosystems or for people's livelihoods. Abstracting far smaller volumes during the dry season may have devastating effects for the species dependent on that river – and for communities further downstream. For example, strawberries may be grown in some parts of Spain entirely consistently with environmental objectives. Growing them in certain regions however, using the same amount of irrigation can be devastating, because the water is drawn from aquifers that feed highly sensitive wetland habitats. Similarly, crops grown using rainwater have entirely different impacts from those that depend on irrigation or other sources that use water from important wetlands or rivers.

7.1 BUSINESS

Swiss Re, one of the world's leading global reinsurers, describes the 'global unavailability of water' as the 'one big risk' that will emerge in the future. Water is one of the most significant (and irreplaceable) inputs in the supply chain for food and cotton producers, wholesalers and retailers, who must therefore address the issue of water use and their WF. High water impacts in production locations can compromise the long-term security of the supply chain, the livelihoods of the people in those locations, and the long-term functioning of local ecosystems. Businesses may be directly affected by water shortages either in terms of running out of water for factories and production, or from the price of raw materials. They may also be affected indirectly through higher insurance costs, lending risk and the stability of nations where water is scarce.

Reputational risk
The manner in which companies exploit natural resources is increasingly the subject of public scrutiny (Friends of the Earth, 2005). Where this scrutiny translates into public 'outrage', companies face dramatically amplified risks, especially those judged to be profligate or irresponsible (JP Morgan, 2008). Public perception of the amount of water used by Coca-Cola, the impact of Kenya's cut-flower industry and the impact of the Spanish strawberry industry on that country's hydrology have taken on the dimensions of public campaigns. Reporting companies' water footprints is helping to raise public awareness of the issue and is likely to increase pressure on companies, especially those which align themselves with the 'green' agenda. PricewaterhouseCoopers now advises its clients to consider environmental risk as a 'portfolio issue… in the light of public and media vigilance'; i.e. fund managers should minimise their investment exposure to sectors and companies perceived to be at a high risk of losing market share due to an exposé or litigation (WWF, 2008).

Water: An element of risk management
This increase in business awareness translates into recognition that water management is a matter of risk management. Demands for environmental accountability affect businesses' licence to operate. A recent report from brewing giant SAB-Miller states that 'water scarcity and quality are becoming increasingly urgent and politically sensitive issues and are of immediate relevance to SAB-Miller, given the water-intensive nature of the beverage industry, our reliance on water-intensive raw materials and the fact that some of our companies operate in water-stressed regions and countries' (SAB-Miller, 2007).

Two recent reports on risks to business (JP Morgan, 2008; WWF, 2008) illustrate these points well. Flower growers on the shores of Lake Naivasha, Kenya and vegetable producers in the Lower Guadiana and Murcia/Almeria, Spain are exposed to highly risky futures due (in part) to their own exploitation of the water resource on which their businesses depend. Equally, the Ogallala aquifer, which stretches from Texas to South Dakota, is being lowered at 90 to 150 cm per year and will threaten one third of irrigated agriculture in the USA within the next 40 to 180 years with huge impacts on grain supplies and prices.

More progressive companies are buffering themselves against water shortages, but always at an additional cost, and typically without perfect guarantees. The bottled water company Vittel has been forced to purchase US$9 million worth of land and pay land owners an additional US$24.5 million in subsidies simply to protect the supply of clean water to its bottling plants.

What can business do?
Business can play a key role in improving the management of water resources and reducing the risk of environmental damage. Not only must companies ensure that their own operations make efficient use of water, but they must address the issue of water use throughout the supply chain, making good water management a standard part of supplier contracts. Looking to the future, business development and growth must be informed by consideration for the impact of operations on local water systems.

In summary, companies should:

- Better understand water and related issues (social, economic, environmental);
- Calculate their WF and reduce impacts in areas where water is either already scarce or is likely to become scarce;
- Examine the volumes, impacts and risks of water use along the entire supply chain;
- With other companies, press for sound water management and strong implementation of collective water agreements that provide basic rights of access to water for people and nature;
- Engage with other companies and with academics, government agencies and NGOs to maintain transparency and rigour when measuring and responding to water issues;
- Communicate to consumers and through business-to-business channels their contribution to good water management; and
- Think and act beyond their own footprints.

7.2 GOVERNMENT

Water sustainability is fundamentally about effective collective action by all of those who use and depend on the water supply. Ultimately, therefore, water sustainability is a task for governments. Recent floods and droughts in the UK have highlighted the importance of water management in the UK and the need for joined-up thinking between our built environment and the water regulating services provided by our floodplains and rivers. The droughts in summer 2007 in South East England have also shown that high variation can exist within even small geographic areas. It also showed that our level of water use is rapidly reaching an unsustainable level in many places.

There is also a major role for the Government in addressing the water issues inherent in the goods we import, which make up such a large proportion of the nation's WF. The following highlights the Government's role in policy for the UK and abroad.

Reducing impacts in the UK

Some of the UK's most important freshwater biodiversity is affected by over-abstraction, most critically the internationally important biodiversity of the rivers of Southern and Eastern England. The primary driver of over-abstraction in England is water use for household consumption. Water consumption per person has risen by 1% per year over the last 30 years, and is expected to rise further in the absence of corrective action. A 2005 risk assessment conducted by the Environment Agency identified that over 10% of rivers across England and Wales are at risk from over-abstraction. Some of the most affected include three identified as being of high conservation value under the Habitats Directive – the Itchen and Avon in Hampshire, and the Lambourn in Berkshire.

Evidence shows that water meters can significantly help to reduce water demand. Currently, only a third of households in Wales and England have water meters, in stark contrast to the 100% use of water meters across most of Western Europe. As a result, most households have no incentive or reward for the careful use of water, and face no penalty for wasteful or unnecessary use (WWF, 2007). There is a tremendous amount that government policy could do to reduce future water use through the proper design of all new houses built in the UK. Similarly, within the UK, there are two major pieces of legislation, which, if enforced, would go a long way to addressing negative WF impacts, namely the Habitats Directive and the Water Framework Directive, both of which seek to govern the abstraction of rivers through sustainable (hydrological) use.

Reducing impacts globally

The WF analysis in this paper shows that the UK Government must consider freshwater use as part of future economic development and livelihood strategies in countries from which we import products. Decisions about development strategies should consider the long-term, sustainable use of water in those locations.

A recent DFID white paper, 'Eliminating world poverty: making governance work for the poor', expresses a need for 'ensuring that growth is based on sustainable use of natural resources, given rising worldwide consumption and threat of climate change'. A section on 'using natural resources for sustainable growth' mentions how 'natural capital' is disproportionately important in developing countries. The UK is pledged 'with international partners, [to] help countries to make efficient use of natural resources, especially water and energy' and to 'reduce the impact of UK consumption production and procurement on the global environment' (DFID, 2006).

There is also room for ensuring that making development strategies 'climate smart' includes making them 'water smart' as well. Water is, in so many ways, the 'so what?' part of climate change. But it is the variability of rainfall, the timing and quantity of water, and our ability or inability to capture and use water that will be some of the clear challenges of climate change. As such, UK politicians must understand water in its full context, and take steps to attain a basic standard of literacy in this debate so that they understand that water management, internally and externally, is a critical issue.

What can UK Government do?

Globally:

- Incorporate sound water management as a key plank of UK aid strategy with a much higher priority and funding allocation;
- Measure the water needed to meet food security/consumption for the UK, the EU and globally and the implications for UK policy support;
- Facilitate dialogue and links (at UK and EU levels) between business and government with regard to impacts on water sources at production sites;
- Support EU, World Bank and other bilateral and multilateral lenders to ensure that their aid portfolios are 'waterproofed'; and
- Undertake sample water audits of government programmes to ensure that they do not have adverse unintended consequences on water, or promote misallocation of water resources.

In the UK:

- Manage UK water resources more sustainably;
- Increase household water metering with affordable pricing;
- Rehabilitate degraded ecosystems and, where possible, restore lost ecosystems;
- Ensure that water-efficient appliances are required in new and existing homes;
- Develop water 'neutral' residential and business property; and
- Encourage other EU governments to implement fully the Water Framework Directive and Habitats Directive.

7.3 CONSUMERS/CITIZENS

Reducing the impacts of water use arising from the consumption of food and cotton is not solely the responsibility of the consumer/citizen, however we can play a positive role in lobbying Government and demanding better performance from business in terms of its impact on water sources. This of course addresses indirect impacts of water use through virtual water, but there are also many things we as individuals can do to address our own direct water use, starting with reducing the amount of water we use and the amount of food we waste at home.

We can also evaluate our own WF to become more aware of the role of water in our daily lives (using online calculators such as WaterFootprint.Org (2004)). People may, as a consequence, choose to reduce the consumption of highly water-intensive commodities, although the connection between individual action and any water that could be 'saved' by this action can be hard to monitor.

A small segment of UK society (possibly about 5%, perhaps as large as 10%) has become more attuned to environmental and development issues and decides what products to buy based on concerns such as ethical, fair-trade, organic, seasonal, local, food miles etc. Moving the other 90–95% of the population is the harder task and could be more effectively achieved through direct work with supermarkets and their suppliers to source products sustainably. Ultimately all consumers benefit from long-term gains in increased sustainability, and can adjust to variations in the range of products available. Consumers and citizens alike however, should demand of business and government that the water used on their behalf is well managed.

What can UK consumers/citizens do?

- Waste less food and recycle products, therefore wasting less water;
- Demand household water metering and affordable pricing from government;
- Pressure retailers and food manufacturers to deliver water sustainability through their stores and crucially in their supply chains;
- Support and pressure UK government to implement fully policies relating to the sustainable use of UK water resources (Habitats Directive, Water Framework Directive) and external water resources (UN Convention); and
- Support campaigns related to water management issues such as 'End Water Poverty' http://www.endwaterpoverty.org/ and 'Blueprint for Water' http://www.blueprintforwater.org.uk/

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REFERENCES

Allan, JA. 1998. Virtual water: A strategic resource global solutions to regional deficits. *Ground Water* 36(4): 545-546.

Allan, JA. 1999. Productive efficiency and allocative efficiency: Why better water management may not solve the problem. *Agricultural Water Management* 40(1): 71-75.

Allan, JA. 2001. *The Middle East water question: Hydropolitics and the global economy*. I.B. Tauris, London.

Allen, RG, Pereira, LS, Raes, D and Smith, M. 1998. *Crop evapotranspiration – guidelines for computing crop water requirements. FAO Irrigation and Drainage Paper* 56. FAO, Rome, Italy.

Beaufoy, G. 2005. *The tomato report: Assessment of tomato horticulture in the Mediterranean (policy, environmental impact, trade)*. WWF, Madrid.

Chapagain, AK and Hoekstra, AY. 2003. *Virtual water flows between nations in relation to trade in livestock and livestock products. Value of Water Research Report Series No. 13.* UNESCO-IHE.

Chapagain, AK and Hoekstra, AY. 2004. *Water footprints of nations. Value of Water Research Report Series No. 16.* UNESCO-IHE, Delft, the Netherlands.

Chapagain, AK, Hoekstra, AY, Savenije, HHG and Gautam, R. 2006. The water footprint of cotton consumption: An assessment of the impact of worldwide consumption of cotton products on the water resources in the cotton producing countries. *Ecological Economics* 60(1): 186-203.

Chapagain, AK and Orr, S. 2008. An improved water footprint methodology linking global consumption to local water resources: A case of Spanish tomatoes. *Journal of Environmental Management*: (In press, doi:10.1016/j.jenvman.2008.1006.1006).

Cuenca, RH. 1989. *Irrigation system design: An engineering approach.* Prentice-Hall, Englewood Cliffs, New Jersey.

DEFRA. 2005. *The validity of food miles as an indicator of sustainable development.* DEFRA Report. UK.

DFID. 2006. *Eliminating World Poverty Making Governance Work for the Poor: A White Paper on International Development.* Department for International Development, London, UK.

Downward, SR and Taylor, R. 2007. An assessment of Spain's Programa AGUA and its implications for sustainable water management in the province of Almeria, southeast Spain. *Journal of Environmental Management* 82(2): 277-289.

Falkenmark, M and Lannerstad, M. 2004. Consumptive water use to feed humanity – curing a blind spot. *Hydrology and Earth System Sciences Discussions* 1: 7-40.

FAO. 1992 [Developed by: Martin Smith]. *CROPWAT: A computer program for irrigation planning and management.* Food and Agriculture Organization of the United Nations, Rome, Italy.

FAO. 1993 [Developed by: Martin Smith]. *CLIMWAT for CROPWAT: A climatic database for irrigation planning and management.* Food and Agriculture Organization of the United Nations, Rome, Italy.

FAO. 2001 [CD ROM]. FAOCLIM2: *World-Wide Agroclimatic database.* Food and Agriculture Organization of the United Nations, Rome, Italy.

FAO. 2007. AQUASTAT o*nline database.* Available from: http://www.fao.org/nr/water/aquastat/data/query/index.html. [Accessed 11 November 2007].

FAOSTAT data. 2008a. *FAO Statistical Databases*. Available from: http://faostat.fao.org/ [Accessed 10 January 2008].

FAOSTAT data. 2008b. *FAO Statistical Databases*, Archives. Available from: http://faostat.fao.org/site/370/default.aspx. [Accessed 15 Jan 2008].

Fernandes, C, Cora, JE and Araujo, JACd. 2003. Reference evapotranspiration estimation inside greenhouses. *Scientia Agricola* 3(60): 591-594.

Fernàndez, MD. 2000. *Necesidades hidricas y programación de riegos en los cultivos hortícolas en invernadero ysuelo enarenado de Almería. Doctoral Thesis*. Universidad de Almería, España.

Friends of the Earth. 2005. *The Tyranny of Free Trade; wasted natural wealth and lost livelihoods, Issue 109*. Hong Kong.

Glantz, MH. 1998. Creeping environmental problems in the Aral Sea basin. In: *Central Eurasian water crisis: Caspian, Aral and Dead Seas*, eds. Kobori I and Glantz MH, United Nations University Press, New York.

Hall, M, Dixon, J, Gulliver, A and Gibbon, D, eds. 2001. *Farming Systems and Poverty: Improving farmer's livelihoods in a changing world.* FAO and World Bank, Rome and Washington.

Harmato, Saloke, VM, Babel, MS and Tantau, HJ. 2004. Water requirement of drip irrigated tomatoes grown in greenhouse in tropical environment. *Agricultural Water Management* (71): 225-242.

Hoekstra, AY and Chapagain, AK. 2008. *Globalization of Water: Sharing the Planet's Freshwater Resources*. Blackwell Publishing Ltd, Oxford, UK.

ITC. 1999 [CD-ROM]. *PC-TAS version 1995-1999 in HS or SITC*. International Trade Centre, Geneva.

ITC. 2004 [CD-ROM]. *PC-TAS version 1997-2001 in HS or SITC*. International Trade Centre, Geneva.

ITC. 2006 [CD-ROM]. *PC-TAS version 2000-2004 in HS or SITC*. International Trade Centre, Geneva.

IWMI. 2006. *Insights from the Comprehensive Assessment of Water Management in Agriculture.* International Water Management Institute, Colombo, Sri Lanka.

IWMI. 2007. *Water for Food, Water for Life: A Comprehensive Assessment of Water in Agriculture.* Earthscan, London.

Jensen, ME, Burman, RD and Allen, RG, eds. 1990. *Evapotranspiration and irrigation water requirements*. Amer. Soc. of Civil Engineers, New York.

Jones, A. 2001. *Eating Oil: Food supply in a changing climate.* Sustain and the Elm Farm Research Centre.

JP Morgan. 2008. *Watching water: A guide to evaluating corporate risks in a thirsty world.* Available from: http://pdf.wri.org/jpmorgan_watching_water.pdf. [Accessed 10 June 2008].

Kent. 2002. *Groundwater Mining of the Souss Valley Alluvial Aquifer, Morocco.* Available from: http://gsa.confex.com/gsa/2002AM/finalprogram/abstract_40263.htm. [Accessed 10 March 2008].

Martínez-Fernández, J and Selma, MA. 2004. Assessing the sustainability of Mediterranean intensive agricultural systems through the combined use of dynamic system models, environmental modelling and geographical information systems. *Handbook of sustainable development planning: studies in modelling and decision support*. Edward Elgar Publishing, Cheltenham.

Mitchel, T. 2003. TYN CY 1.1. In: Tyndall Centre for Climate Change Research, Climatic Research Unit, University of East Anglia, UK.

Nash, E. 2008. Spain's drought: a glimpse of our future? [online]. http://www.independent.co.uk/news/world/europe/spains-drought-a-glimpse-of-our-future-833587.html [Accessed 24 May 2008].

Orgaz, F, Fernandez, MD, Bonachela, S, Gallardo, M and Fereres, E. 2005. Evapotranspiration of horticultural crops in an unheated plastic greenhouse. *Agricultural Water Management* 72(2): 81-96.

Pereira, LS, Cordery, I and Iacovides, I. 2002. *Coping with water scarcity. International Hydrological Programme*, UNESCO, Paris.

Pildat. 2003. *Issues of water resources in Pakistan. Briefing paper for Pakistani parliamentarians No 7.* Pakistani Institute of Legislative Development and Transparency.

Pretty, J, Lang, T, Morison, J and Ball, AS. 2005. Food miles and farm costs: The full cost of the British food basket. *Food Policy* 30(1): 1-20.

Rosenthal, E. 2008. In Spain, water is a new battleground [online]. http://www.nytimes.com/2008/06/03/world/europe/03dry.html?_r=2&hp&oref=slogin&oref=slogin [Accessed June 3, 2008].

SAB-Miller. 2007. *Water – the challenge for the future.* Available from: http://www.sabmiller.com/NR/rdonlyres/58E03323-B96C-46B1-A839-60CA67A6AFDF/0/SABMiller_plc_waterreport_2007.pdf

Smakhtin, V, Revenga, C and Döll, P. 2004. *Taking into account environmental water requirements in global-scale water resources assessments. Comprehensive Assessment Research Report 2*. Comprehensive Assessment Secretariat, Colombo, Sri Lanka.

Soth, J, Grasser, C and Salerno, R. 1999. *The impact of cotton on fresh water resources and ecosystems: A preliminary analysis*. WWF, Gland, Switzerland.

Tayaa. 2007. *Souss Massa Hydrological Study Report.* WWF, Godalming, UK.

UNEP. 2002. *Global environment outlook 3: Past, present and future perspectives*. Earthscan Publications Ltd, London, UK.

UNESCO-WWAP. 2003. *Water for people, water for life – United Nations World Water Development Report*. UNESCO Publishing, Paris.

UNESCO-WWAP. 2006. Water, *a Shared Responsibility.* United Nations Educational, Scientific and Cultural Organization (UNESCO), Paris.

USDA. 2004. Cotton: *World markets and trade*. Available from: http://www.fas.usda.gov/cotton/circular/2004/07/CottonWMT.pdf. [Accessed 4 August 2004].

Wackernagel, M and Jonathan, L. 2001. *Measuring sustainable development: Ecological footprints.* Centre for Sustainability Studies, Universidad Anahuac de Xalapa, Mexico.

Wackernagel, M and Rees, W. 1996. *Our ecological footprint: Reducing human impact on the earth.* New Society Publishers, Gabriola Island, B.C., Canada.

Water Footprint.org. 2004. *Water Footprint Calculator.* Available from: http://www.waterfootprint.org/?page=files/WaterFootprintCalculator.

WWF. 2004. *Living planet report 2004*. WWF.

WWF. 2007. *Waste Not, Want Not: Sustainable water tariffs.* WWF-UK, Godalming, UK.

WWF. 2008. *Water at risk.* WWF-UK, Godalming, UK (in press).

Zygmunt, J. 2007. *Hidden waters.* WaterWise, London.

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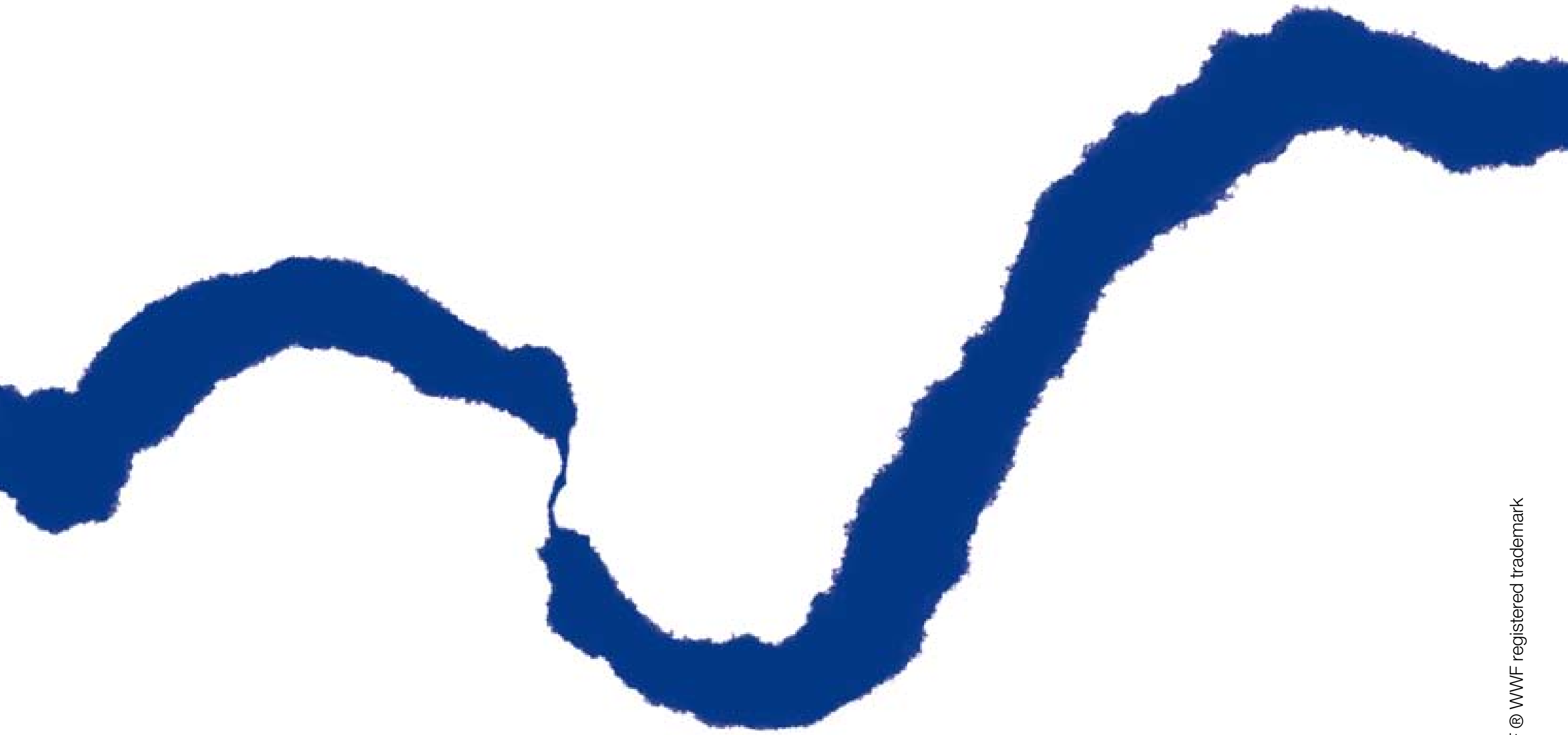

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