Towards sustainable sugar sourcing in Europe

Water footprint sustainability assessment (WFSA)

August 2011
Acknowledgements

This report is a product of cooperation between partners. We’d like to thank everyone who helped bring it to life, including:

- Our suppliers who provided us with invaluable local data;
- The providers of our case studies (British Sugar, Suiker Unie, Tereos, Cristal Union and Azucarera);
- The Water Footprint Network;
- Our global water stewardship partner, WWF;
- denkstatt;
- Vienna University of Technology.
1. Introduction

Water sustainability is one of the highest priorities of Coca-Cola. It is an essential part of our products, our production processes and our supply chain. As such, protecting this most precious natural resource is essential for the sustainability of our business and the communities we serve.

As a result, we went on to assess the overall water footprint of our sugar use in Europe, which comes to 80% from locally grown beet. In September last year, we published our first summary report, Product Water Footprint Assessments.

Next step: sustainability of our water footprint

Now, we are moving to the next stage in our journey, by looking at the sustainability of the water footprint of sugar beet. This is because the key question is not how big is our water footprint, but what is its impact?

Gaining this understanding not only makes environmental sense, but also provides us with clearer guidance on which parts of the supply chain to focus on, and how to prioritise action.

The sustainability of a water footprint entirely depends on local factors: large water footprints can be sustainable in water-rich areas, whereas very small water footprints might compromise sustainability in water-scarce areas.

This report aims to propose a methodology for sustainability impact assessment of water use, and to share key learnings with stakeholders and experts in this field.

There are many challenges ahead. Water footprint analysis and accounting is still an emerging science and intensive cooperation, knowledge-sharing and engagement between all stakeholders is essential if we are to progress.
2. Our water footprint approach

In our Product Water Footprint Assessments report of last year, we addressed the issue of water footprint accounting for sugar beet. Together with our suppliers, this involved a comprehensive ‘mapping out’ of the supply chain, including collecting all relevant data on the three principle types of water use: green, blue and grey water footprints.

**Green water footprint**
Evapo-transpiration of rainwater stored in the soil as moisture, including rainwater incorporated in the crop.

**Blue water footprint**
Surface or ground water evaporated or incorporated into a product, e.g. agriculture irrigation.

**Grey water footprint**
The volume of freshwater needed to dilute pollution to agreed quality standards, e.g. industrial water pollutants and fertiliser residuals.

In addition to these definitions, we used a ‘net green’ approach, defined as the difference between rainwater used by the cultivated crop and by natural vegetation. Our calculation of the green water footprint has shown that (potential) natural vegetation consumes more water than sugar beet, so we set the ‘net green’ water footprint to zero.

The key question is not how big is our water footprint, but what is its impact?
The top-line results of water footprints per kg of refined sugar from beet can be seen on the right, showing a wide variety of water footprints depending on climatic areas and growing conditions. In most countries, we found that sugar beet is mainly rain-fed, so actually very little irrigated.

We also learned that, in many European countries, sugar refiners have long-established relationships with beet farmers to advise on best practices in fertiliser and pesticide management. Many refiners also reuse the water pressed out of the beet in the refining process to reuse for beet washing. For more information, please see the ‘EU beet and sugar sector’ report on www.cefs.org.

In this report, we are moving onto the next stage of our water footprint assessment: from accounting to sustainability impacts.

This is pioneering work. Most projects so far have been carried out at catchment area or river basin level, where a reasonable comparison between water footprints and water availability can be made. This study is breaking new ground by attempting to develop a practicable methodology to evaluate water sustainability as it related to the same product (beet sugar) in many different European regions.

Throughout the process, we worked with a ‘sounding board’, consisting of representatives of sugar factories, NGOs, our bottling partners, and our own in-house team. The members of the sounding board were asked for feedback and advice regarding the approach for the sustainability assessment, and critically reviewed the project results.

**Case study: Suiker Unie in the Netherlands**

Suiker Unie develops, produces and markets sugar and sugar specialties at its state-of-the art factories in the Netherlands and Germany.

From the seed of the beets to the final delivery of the product, Suiker Unie ensures quality and sustainability throughout the chain.

This includes maintaining the quality of the soil, and of the surface and ground water where the beets are grown.

The company uses a sophisticated computer program called ‘UNITIP’ to help growers record exact data about the cultivation of their crop. This includes the mechanisation (ploughing, sowing, etc), use of fertilisers, crop protection chemicals, crop yield and delivery of sugar beets to the factory per plot. Using these, the program calculates the environmental impact of the crop cultivation, per tonne of produced sugar.

The farmers can analyse the data to benchmark their results against other farmers in the region, while Suiker Unie can use it to advise its growers individually, and as a whole.

This support has led to much higher sugar yields and to the correct amount of fertiliser being used. The use of nitrogen has fallen by approximately 50 percent per tonne of sugar over the past 20-25 years. At the sugar factory, this had led to about the same reduction of ammonia. And, on the farms, there is no more over-fertilisation and the quality of soil and water is guaranteed.
3. Water footprint sustainability assessment (WFSA)

A global and local issue
Today, nearly one billion people lack access to clean water. If current water consumption patterns continue, two-thirds of the world’s population will live in water-stressed conditions by 2025.

Agriculture plays a fundamental role in the equation. An incredible 70 percent of the total freshwater withdrawn by humans goes to irrigated agricultural use, while agriculture as a whole accounts for 86 percent of worldwide freshwater use.

This makes the ‘embedded water’ of products – the water used in their supply chain and manufacture – all the more important to quantify and control.

Although the limitation of freshwater resources applies at a global level, it varies tremendously at a local level. Therefore, any sustainability assessment of the water footprint of a product such as sugar has to consider the global and local aspects.

Considerations of water footprint sustainability
The efficient and sustainable use of freshwater in food production is key to achieving a secure food supply for the world’s growing population.

In practice, this is far from simple. For example, the water footprint of sugar beet in Spain is lower than in Romania – but does this mean it is ‘better’ for the environment? The lowest water footprint per kilogramme of a given product is not necessarily the most sustainable, making direct comparisons misleading. The key question is whether the production and supply chain of a certain product is water-sustainable, balancing its use with the availability and quality of water and fertile soil. Following the water footprint accounting, we wanted to determine the specific impact of the water footprint of beet sugar on a regional level.

The key question is whether the production and supply chain of a certain product is water-sustainable, balancing its use with the availability and quality of water and fertile soil.

Case study
British Sugar
The leading sugar supplier, British Sugar, produces over one million tonnes of sugar in the UK every year. It uses water throughout the sugar manufacturing process - for cleaning, heat transfer, cooling and moving sugar beet around the factory.

The company is committed to improving its water efficiency, by setting improvement targets. Regular independent water audits help to review its progress and identify further opportunities to recycle water. The audits identify exactly where water is used on site and assess how much is needed at that point in the process. This allows the correct type of water to be matched against the use, with recycled water sources prioritised ahead of freshwater sources.

The audits have confirmed the best practice of this approach, with around 75 percent of water used in British Sugar’s factories coming from a recycled source. Water is then treated on-site before discharge and quality levels are strictly controlled by the Environment Agency. With efficient water management processes in place, the sugar factories have become net exporters of clean recycled water to local water courses.

Sustainable use of freshwater in food production is key to achieving a secure food supply.
3. Water footprint sustainability assessment

The starting point for a water footprint sustainability assessment (WFSA) has to be at the local level. For this reason, for our assessment, we selected six countries where we purchase sugar from beet.

We aimed for a balanced selection of countries with high and low water footprints for sugar beet in combination with high and low water stress. In total, these countries represent about half of our total European beet sugar use.

Selected regions and area of assessment
We selected six countries where we purchase sugar from beet. As some of the sugar beet growing areas stretch over several river basins, we further split them into 10 regions to assess water sustainability at a catchment level.

- Spain Region 1 See page 10
- Spain Region 2 See page 11
- Spain Region 3 See page 12
- France Region 4 See page 13
- UK Region 5 See page 14
- Belgium/southern NL Region 6 See page 15
- Netherlands north Region 7 See page 16
- Romania Region 8 See page 16
- Romania Region 9 See page 17
- Greece Region 10 See page 17

* Area of influence - 70km*

* In consultation with our suppliers, we defined an average beet-growing radius around each refinery of about 70km.
3. Water footprint sustainability assessment

Considered impacts

Over-exploitation of water resources in terms of quantity or quality may lead to primary and secondary impacts. Primary impacts include compromising environmental flow requirements (i.e. sustainable river flows for ecosystems and human life), or ambient water quality standards.

Secondary impacts may include drinking water shortages, loss of biodiversity and other ecological, economic or social factors.

We therefore formulated a set of key questions to assess primary impacts of water use on blue water (water quantity) and grey water (water quality). We could not include an assessment of green water impacts (evapotranspiration) in this study as there is currently no practical and scientific approach available. On the other side, we discussed but did not quantify any ‘positive water impacts’, for example where sugar refining provides benefits for environment (e.g. the biodiversity benefits of water storage ponds).

For the Blue water footprint impact, we measured these through the river flows, which include surface water as well as some (resurfaced) groundwater.

We then investigated local water related problems – in terms of environment, society and economy – to enable us to assess secondary impacts, where primary water footprint impacts were found.

As the production of sugar is only one of several water-consumers in a region, the question must be twofold: are freshwater resources in the region over-exploited, and which share of the exploitation can be attributed to the sugar production?

Case study: Tereos Sucre

France-based Tereos is a major European and international supplier of beet and cane sugar. At its sugar beet factory at Boiry Sainte Rictrude, in the northern Pas de Calais region of France, the company extracts sugar for its clients – including Coca-Cola – from beets grown directly around the plant.

With beets consisting of 75 percent water, Tereos ensures as little as possible is wasted. It uses the beet water to make almost all of the steam it needs in the production process, and then stores the rest in lagoons.

These cover an area of 110ha, providing an outstanding water reserve for migratory birds from Northern Europe. In a study of the area, which has been officially classified as a nature reserve, the Natural History Museum has counted 40 different species of birds. This shows that with these lagoons, Tereos is doing far more than simply storing water – it is promoting biodiversity.

And Tereos’ imaginative use of its by-produced water doesn't stop there. After decanting and purification, the stored waters are used to irrigate and provide essential nutrients for potato crops, saving local farmers the need to draw on precious reserves of groundwater. The water also helps farmers reduce their use of chemical fertilisers. Alternatively, coming full circle, the stored water is also used back in the factory.

Over-exploitation of water resources can lead to loss of biodiversity and cause other ecological, economic and social problems.
3. Water footprint sustainability assessment: Scope

The sustainability assessment: primary and secondary impacts
General sequence of the selected approach

**Primary impacts:**
- defining the sugar regions – areas of interest

**Secondary impacts:**
- what are the indirect effects?

**Environment e.g.**
- Loss of biodiversity
- Decrease of ground water recharge
- Risk of salt water intrusion
- Eutrophication

**Society e.g.**
- Access to drinking water
- Access to ground water
- Loss of fisheries,
- Loss of farming, grazing, hunting opportunities
- Cultural & leisure activities

**Economy e.g.**
- Opportunity costs (crop per drop)
- Disruption of water supply
- Hydropower generated potential
- Increasing water costs
- Navigation
- Tourism activities

**Case study: Cristal Union**

Cristal Union is a cooperative of French sugar beet growers. Together its members hold about 18 percent of the sugar beet acreage in France and produce around 700,000 tonnes of sugar a year. In addition to producing sugar for its own two popular retail brands, Cristal Union is also a major supplier to the food industry – including Coca-Cola.

To save water and reduce its water footprint, Cristal Union has introduced the agricultural practice of ‘water spreading’ at its sugar plant in Sillery, in France’s Champagne-Ardenne region. This involves collecting run-off from the water used to wash the beets and spreading it across its fields to water the crops.

The local water regulatory authority and ANTEA, an accredited hydro-geological company, helped Cristal Union evaluate the impact of the Sillery plant on local water resources. Working in collaboration with the Water Footprint Network, Cristal Union used scientific data from local agronomical research and extensive measurements of the water quality to re-calculate the plant’s water footprint. It paid particular attention to the use of water spreading.

The study showed that water spreading, when performed in accordance with the best available technology, can result in a lower water footprint. Unlike fertilisation, which generates a ‘grey’ water footprint by releasing (or leaching) contaminants, water spreading does only partly cause additional leaching. It also replenishes the groundwater, although this effect was not taken into account when the water footprint of the sugar produced at Sillery was re-calculated.

The new water footprint indicates the availability and quality of the local water supply are compatible with Sillery’s sugar-growing activities; and the latest observations show improvements to the local environment.
3. Water footprint sustainability assessment

Blue water footprint

The blue water footprint sustainability impact assesses the sustainability of the available freshwater sources in the sugar beet growing area and the share of sugar beet in their exploitation.

1. Is there a water quantity problem in the region?

The amount of runoff water in the area is considered as available freshwater. This is calculated from water measurements in the region based on the area-specific runoff (e.g. mm/month). As proposed by the Water Footprint Network, environmental flow requirements (EFR) are calculated as 80 percent of the pre-1960 monthly runoff (natural flow) and then compared to the actual flow after 1980. Sustainability boundaries are +/- 20 percent of the natural flow (see below).

Example

<table>
<thead>
<tr>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
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<tr>
<td>18</td>
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<td>2</td>
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</table>

Available fresh water in the region under natural conditions
Environmental flow requirements (EFR)
Actual runoff (after 1980)

Assessment

No risk

Moderate risk
Limits moderately exceeded* in maximum 1 of 3 driest months. Limits moderately exceeded * in maximum 3 months per year

Severe risk
Limits severely exceeded** at least 1 month negative annual balance***

2. What is the share of the blue WFP of sugar beet, compared to all blue water available in the region?

Based on the blue water footprint of sugar production in the region from water footprint accounting, the share of the blue water footprint on the available blue water of the region (natural flow minus environmental flow requirements) is calculated.

Example

% blue water used by sugar beet

Total blue water consumed in the region

Assessment

Low share below 1%
Moderate share 1% - 30%
Dominant share over 30%

3. What is the relation between sugar beet's blue water WFP and its proportional share in arable land?

The proportional share is based on the assumption that each hectare of arable land in a given region is entitled to the same amount of blue water. The available blue water in the region is then divided by the hectares of arable land. This amount of water per hectare is compared with the real blue water consumption per hectare for sugar production. The result indicates if sugar beet uses its proportional share of blue water, or more.

Example

Proportional share = blue water for consumption ÷ arable land

Beet real use 320m3/ha
Water use below proportional share

Beet potential use 400m3/ha
Use is over proportional share (Factor > 1 to 3)

Assessment

Use corresponds to proportional share
Use is critically over proportional share (> Factor 3)

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* Limits moderately exceeded = actual flow between 80% and 60% of natural flow
** Limits severely exceeded = actual flow below 60% of natural flow
*** Annual runoff after 1980 minus environmental flow requirements
3. **Water footprint sustainability assessment** Grey water footprint

**Grey water footprint**
The grey water footprint sustainability impact assessment evaluates the sustainability of local water quality in the region and the share of sugar beet in its pollution.

1. **Is there a water quality problem in the region?**

The sustainability assessment of the grey water footprint of a region is based on measuring the amount of nitrate, ammonia, phosphorus and the organic pollutants BOD₅ in surface waters and nitrate in groundwater. Latest available data were collected for several water quality monitoring stations in a region and compared to the national or type-specific limit values of the national or regional regulations.

2. **What is the share of the grey WFP of sugar beet, compared to all grey water in the region?**

In order to simplify the calculations in respect to grey water, substance loads have been used instead of the grey water footprint.
- The potential pollution load is the result of the limit values for ‘good water quality’ levels¹, minus the natural concentrations, multiplied by the available fresh water (actual flow).
- The total pollution load in a region is estimated based on the average measured concentrations, minus natural concentrations, multiplied by available fresh water.
- Sugar production’s contribution to a region’s actual and potential pollution load is calculated using pollution load data from WFP accounting.
- Finally, the share of the grey water footprint of sugar production is assessed.

3. **What is the proportional share of sugar’s grey water WFP?**

The proportional share is based on the assumption that each hectare of arable land is attributed the same amount of grey water. The pollution load attributed to agricultural products (production and processing) is the total potential pollution load minus pollution from the local population, including average-level industrial activity. The comparison with the real load from sugar production indicates if sugar beet uses its proportional share of grey water, or more.

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¹ These are legally set limits for maximal concentrations in water bodies to achieve acceptable water quality

* One station with more that 10% of measurements exceeding limits and/or yearly average of at least one station is over the limits

** 30% of the stations with more that 10% of measurements exceeding limits and/or average of 30% of stations is above limits
4. Regional overview and results

Using our methodology, we identified a level of risk for each region, based on two main sustainability criteria:

- Is beet sugar production meeting the of environmental flow requirements of surface water (water quantity)?
- Is it meeting the environmental quality standards in surface waters and ground waters?

Regions where sugar production posed a threat to specific sustainability criteria were identified.

These can now serve as models on which we can build detailed investigations, and developing measures to improve the situation.

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### Region 1: Spain

**Blue water footprint sustainability assessment**
- Assessment reveals a severe water scarcity risk, not accounting for historic water transfers in the region, see page 18.
- Share of blue water consumed for sugar production in the available blue water of the region is moderate.

<table>
<thead>
<tr>
<th>Water quantity problems in the region?</th>
<th>No risk</th>
<th>Moderate</th>
<th>Severe</th>
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<td>Share of the blue water consumption related to the blue WF of sugar production</td>
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<td>Moderate</td>
<td>Dominant</td>
</tr>
<tr>
<td>Relation between blue water of sugar beet and its proportional share</td>
<td>Within proportional share</td>
<td>Moderate</td>
<td>Critical</td>
</tr>
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</table>

**Grey water footprint sustainability assessment**
- Severe quality problems caused by nitrate in ground and surface waters.
- Ammonia, BOD₅, and total phosphor are causing moderate quality problems.
- The role of sugar production in quality problems is small for nitrate, BOD₅, and total phosphor in surface water.

<table>
<thead>
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<td>Pₑ SW</td>
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<tr>
<td>Share of the grey WFP of sugar on the totally consumed grey water of the region</td>
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<td>NO₃ₑ GW</td>
<td>NO₃ₑ SW</td>
<td>NH₃ₑ SW</td>
</tr>
</tbody>
</table>

**Grey water pollutants key**
- NO₃ₑ GW: Nitrate in ground water
- NO₃ₑ SW: Nitrate in surface water
- NH₃ₑ GW: Ammonia in surface water
- BOD₅ₑ SW: Total phosphor surface water
4. Regional overview and results continued

Region 2: Spain

Blue water footprint sustainability assessment
• Severe water scarcity risk, not accounting for historic water transfers in the region, see page 18.
• Sugar production accounts for a moderate share of blue water consumption.
• Blue water used for sugar production far exceeds its proportional share.

Grey water footprint sustainability assessment
• Phosphor content in surface water seems to be a problem in this region.
• Moderate quality problems caused by nitrate in ground and surface waters and ammonia in surface water.
• Sugar production has moderate role in regional quality problems derived from nitrate, ammonia and BOD$_5$ in surface water and nitrate in groundwater.
• Negligible role regarding phosphor in surface water.

Water quality problems in the region?

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<tbody>
<tr>
<td>BOD$_5$ SW</td>
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<td>NO$_3$ GW</td>
<td>P SW</td>
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<td></td>
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Share of the grey WFP of sugar on the available grey water of the region

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Relation between grey water of sugar beet and its proportional share

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Grey water pollutants key
- NO$_3$ GW: Nitrate in ground water
- NO$_3$ SW: Nitrate in surface water
- NH$_3$ SW: Ammonia in surface water
- BOD$_5$ SW: BOD$_5$ in surface water
- P SW: Total phosphor surface water
- P GW: Total phosphor groundwater
4. Regional overview and results continued

Region 3: Spain

Blue water footprint sustainability assessment
- Moderate water scarcity risk, not accounting for historic water transfers in the region, see page 18.
- Moderate share of the blue water consumed for sugar production.
- Blue water used for sugar production three times higher than its proportional share.

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Grey water footprint sustainability assessment
- Nitrate in ground and surface water together with phosphorus in surface water causing quality limits to be moderately exceeded.
- Sugar production only playing a small role in the local water quality problems.

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GW | | NO
P
SW |
| Nitrate in surface water | NO
SW | NO
BOD
SW | P
SW |
| Ammonia in surface water | NO
SW | NO
BOD
SW | P
SW |
| BOD in surface water | NO
SW | NO
BOD
SW | P
SW |
| Total phosphorus surface water | NO
SW | NO
BOD
SW | P
SW |

Grey water pollutants key
- NO: Nitrate in ground water
- BOD: BOD in surface water
- P: Total phosphorus surface water
- SW: Surface water
- GW: Ground water
- NH: Ammonia in surface water
4. Regional overview and results continued

Region 4: France

Blue water footprint sustainability assessment

- No runoff data before 1960, so detailed analysis of the blue water not possible.
- Former study shows that sugar beet is barely irrigated.
- Regular yearly precipitation of approx. 640 mm; presumption that environmental flow requirements are being met.
- Current runoff data shows that the share of blue water consumption from sugar production is moderate.
- Blue water used for sugar production is below its proportional share.

Grey water footprint sustainability assessment

- Local water quality measurements show that limits are severely exceeded for nitrate in surface water, and moderately exceeded for nitrate in groundwater and total phosphor in surface water.
- No quality problems concerning ammonia and BOD₅ in surface water.
- When the loads from sugar production are put in the regional context, the moderate shares for nitrate in the groundwater stand out. However, all loads are below their proportional shares.

Water quantity problems in the region?

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Grey water footprint sustainability assessment

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Grey water pollutants key

- NO₃ GW: Nitrate in ground water
- NO₃ SW: Nitrate in surface water
- NH₃ SW: Ammonia in surface water
- BOD₅ SW: BOD₅ in surface water
- P SW: Total phosphor surface water
The Coca-Cola Company  
Water footprint sustainability assessment (WFSA)

4. Regional overview and results continued

### Region 5: Great Britain

**Blue water footprint sustainability assessment**
- No runoff data before 1960, so detailed analysis of the blue water in the region not possible.
- Former study shows that sugar beet is barely irrigated.
- Annual precipitation approx. 600 mm (and over 40 mm in the summer months); presumption that the environmental flow requirements are being met.
- Share of the blue water consumption from sugar production was calculated with the current runoff data and is classified as low.
- Blue water used for sugar production is far below its proportional share.

<table>
<thead>
<tr>
<th>Water quantity problems in the region?</th>
<th>No risk</th>
<th>Moderate</th>
<th>Severe</th>
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<tbody>
<tr>
<td>Share of the blue water consumption related to the blue WF of sugar production</td>
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<td>Relation between blue water of sugar beet and its proportional share</td>
<td>Within proportional share</td>
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**Grey water footprint sustainability assessment**
- Local water quality measurement reveals that limits are severely exceeded for nitrate, ammonia and total phosphor in surface water, and moderately exceeded for nitrate in groundwater and BOD₅ in surface water.
- When the loads from sugar production are put in the regional context, the moderate shares for nitrate in groundwater stand out.
- Moderate shares in actual loads for ammonia and BOD₅ in surface water.
- All loads are below their proportional shares. In the case of total phosphor, the emissions calculated for the population already reach the potential load.

<table>
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<tr>
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<th>Slightly over threshold</th>
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<tr>
<td>Share of the grey WFP of sugar on the available grey water of the region</td>
<td>NO₃ SW NH₃ SW BOD₅ SW P SW</td>
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<td>NO₃ SW NH₃ SW P SW</td>
</tr>
<tr>
<td>Share of the grey WFP of sugar on the totally consumed grey water of the region</td>
<td>NO₃ P SW SW</td>
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<td></td>
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<td>Relation between grey water of sugar beet and its proportional share</td>
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**Grey water pollutants key**
- NO₃ GW: Nitrate in ground water
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- BOD₅ SW: BOD₅ in surface water
- P SW: Total phosphor surface water
4. Regional overview and results continued

**Region 6: Belgium/southern Netherlands**

### Blue water footprint sustainability assessment
- No runoff data before 1960, so no detailed analysis of the blue water in the region was possible.
- Former study shows that sugar beet is barely irrigated.
- Even distribution of rainfall throughout the year with the average annual precipitation exceeding 700 mm; presumption that the environmental flow requirements are being met.
- Blue water consumption from sugar production has a very low share of the available blue water in the region.
- Blue water used for sugar production is far below its proportional share.

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### Grey water footprint sustainability assessment
- Local water quality measurements reveal that limits are severely exceeded for all parameters except for nitrate in surface water.
- No nitrate measurements in groundwater have been found, but studies state that high nitrate concentrations have been found in groundwater.
- Moderate shares in potential and actual loads are found for nitrate in groundwater and ammonia in surface water.
- For all pollutants, loads are clearly below their proportional shares.

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**Grey water pollutants key**
- NO₃<sub>GW</sub> Nitrates in groundwater
- NO₃<sub>SW</sub> Nitrates in surface water
- NH₄<sub>SW</sub> Ammonia in surface water
- BOD₅<sub>SW</sub> Total phosphorus in surface water
4. Regional overview and results continued

**Region 7: Netherlands**

**Blue water footprint sustainability assessment**
- The highly artificial water situation of this region made it impossible to find useable water discharge data, so no assessment could be conducted.

**Grey water footprint sustainability assessment**
- Due to the lack of water quality information, together with the unusable discharge data, a regional water footprint sustainability assessment was not feasible.

**Region 8: Romania**

**Blue water footprint sustainability assessment**
- Environmental flow requirements are met in the three driest months but slightly exceeded in February.
- This results in a moderate water scarcity risk for this region.
- In this region, blue water is consumed neither for irrigation nor in the sugar refining process.

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**Grey water footprint sustainability assessment**
- No measurements of nitrate in groundwater found.
- Limits are severely exceeded for ammonia and total phosphor in surface water.
- The role of the sugar production in the regional water quality is estimated as moderate for nitrate, ammonia and BOD₅ in surface water.
- Total phosphor from sugar production has negligible role in regional water quality.

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**Grey water pollutants key**
- NO₃: Nitrate in groundwater
- NO₃: Nitrate in surface water
- P: Ammonia in surface water
- BOD₅: Total phosphor surface water
4. Regional overview and results continued

## Region 9: Romania

### Blue water footprint sustainability assessment
- No runoff data before 1960, so no detailed analysis of the blue water in the region was possible.
- Former study shows that sugar beet is barely irrigated.
- Yearly rainfall average 590 mm (between 55 and 100 mm in the summer months); presumption that environmental flow requirements are being met.
- Very low share of sugar production in the available blue water.

### Grey water footprint sustainability assessment
- No measurements of nitrate in groundwater could be found.
- Limits are severely exceeded for ammonia and total phosphor in surface water and moderately exceeded for BOD$_5$ in surface water.
- Whereas, total phosphor from sugar production hardly plays a role, the importance of the sugar production in the regional water quality was estimated as moderate for ammonia and BOD$_5$ in surface water.

### Water quantity problems in the region?
- **No risk**  
  - Presumed
  - Moderate
  - Severe

### Share of the blue water consumption related to the blue WF of sugar production
- **Low share**  
  - Presumed
  - Moderate
  - Dominant

### Relation between blue water of sugar beet and its proportional share
- **Within proportional share**  
  - Presumed
  - Moderate
  - Critical

### Water quality problems in the region?
- **Within threshold**
- **Slightly over threshold**
- **Severely over threshold**

### Share of the grey WFP of sugar on the available grey water of the region
- **Within proportional share**
- **Moderate**
- **Critical**

### Share of the grey WFP of sugar on the totally consumed grey water of the region
- **Within proportional share**
- **Moderate**
- **Critical**

### Relation between grey water of sugar beet and its proportional share
- **Within proportional share**
- **Moderate**
- **Critical**

## Region 10: Greece

- No available discharge data, making assessment unfeasible.
- However, as part of a Mediterranean region, this area shows a relatively low rainfall average (458 mm per year) with values between 21 and 32 mm for the three driest months.
- For this reason, water quantity and quality problems cannot be excluded.
5. European overview and results

When we combine these regional investigations, we can build an overall view of water quality, quantity and assess the potential impact of sugar production.

- For two out of ten regions, the application of the selected approach was not possible due to the lack of data.
- In one region, the results indicate a severe water availability risk with a relatively high share of sugar beet growing.

Secondary impact assessment
The primary impacts of unsustainable water use can result in secondary impacts – such as drinking water shortages and loss of biodiversity. However, we found it difficult to attribute this to agricultural activities alone, and even more specifically to sugar beet growing. The loss of biodiversity, for example, is often caused by a multitude of influences, not by one activity alone.

Two regions in Spain (1 and 2) show severe water footprint sustainability impacts in terms of available freshwater. However, in only one of these is the role of sugar production in the regional situation considered important (region 2). In region 3, there is a moderate water footprint impact; but with a high share of sugar beet growing.

Another ‘hotspot’ region is Greece. We know from previous accounting work that the water footprint of sugar from beet is higher than in the other regions, with a substantial share of blue water use due to irrigation. We know this is a water-stressed region, but no data was found to assess the actual sustainability impacts.

Four regions (France, Great Britain, Belgium, Romania) show very low water footprint sustainability impacts for available water quantity. The Netherlands could not be assessed under the chosen methodology as water is so regulated that natural and current flows are impossible to assess. However, it is safe to assume that there are no water availability issues in the Netherlands.

In terms of water quality, the impact of sugar production is not considered severe in any of the regions. Nevertheless, there are areas with severe risk of a water quality problem for nitrate in groundwater and ammonia in surface water in which sugar production might play a relevant role. The effect of ammonia discharges from the sugar plants on water quality should be taken more into account. Water footprint accounting is still not accurate enough to draw specific conclusions on nitrate in groundwater, and there are indications that nitrate losses from sugar beet are significantly overestimated.

Addressing the ‘hotspots’
The findings concerning ‘hotspots’ make it clear that engagement is needed with specific suppliers, to look at the actual local water supply situation, current irrigation techniques and opportunities to support local projects to address impacts.

Spain
When looking more deeply into the supply chain in Spain, we found that a number of aspects have not been captured by the methodology and substantially change the impact picture:

- Spain has a long history of water transfers from mountainous areas to the nearby agricultural plains by canals. Our methodology only considered the water generated in the agricultural area itself and therefore showed a severe deficit, which might not exist, at least to that extent, in reality.
- Regional authorities and stakeholders in the sugar growing regions have set up an ambitious plan to modernise the irrigation techniques moving from flood irrigation to automated sprinkler systems over a 13-year period. This is expected to reduce the water need per hectare by about 50 percent, shrink the blue water footprint of growing sugar beet and therefore the share of sugar beet growing in the overall regional water use.
- New seed technologies (seed coating) and irrigation techniques are also helping to reduce the need for pesticides and fertilisers, which further reduces the grey water footprint of sugar beet growing.
6. What are the methodological limitations?

A methodology always needs to be based on a uniform approach and standardised requirements, consistent across all areas.

As we found out when looking deeper into the actual situation on the ground in Spain, local variability (for example historic local water transfers) is not captured and can distort the final picture.

In these early pilot study stages, limited data is the biggest limiting factor. Sustainability impact assessments require substantial data inputs to define environmental flow requirements, which are often not available, or in certain environments (e.g. the Netherlands), are impossible to establish.

Because we don’t have all the data at our fingertips, we have to work with a lot of assumptions, some of which are questionable. For example, the assumption that 10 percent of nitrates applied as fertiliser (kg/ha) leaks into the groundwater requires further investigation. We also found that the local view of what constitutes a sustainable environmental flow can be very different from the academic view (between 10-80 percent of natural flow).

We are also limited by the scale of data that, ideally, should be accumulated. For example, building a comprehensive oversight of secondary impacts requires local cooperation of industry, agriculture and authorities, which is beyond the capacity of one company.

Finally, this approach only addresses the question of regional (geographical) sustainability of water use. The bigger questions of whether the production of a certain product is justified from the global perspective of availability of water and fertile soil, are not addressed and go far beyond the subject that can be covered here.

Case study: Azucarera

Irrigation systems are often needed in modern agriculture, but they can also be wasteful and inefficient. In Spain, the sugar company Azucarera is working with its sugar beet farmers to promote the efficient and responsible use of water by modernising their irrigation infrastructure. In the past few years, investments have been made in automated systems which now cover 155,000 hectares where beet is grown. The benefits are clear to see: reduced water losses; higher crop yields by applying water more efficiently; and, because they use less power, lower running costs.

Azucarera’s technicians conduct regular reviews to make sure growers’ irrigation systems are performing at their best. Farmers are shown how to measure the amount of water they are using, and how to correct any deficiencies. Last year the team inspected over 1,300 systems.

Azucarera’s work goes beyond providing a fully working and modern irrigation system. Its agricultural experts also analyse rainfall levels and the needs of the beet crop to assess the optimum water requirement. Each week this data is sent to beet growers and technicians by text messaging, with precise advice on how much water should be applied to the crop. This helps to ensure that water is only applied when it’s needed, and saves on significant wastage. Last year Azucarera’s agriculture team sent around 58,000 text messages with irrigation recommendations.

The bigger questions of whether the production of a certain product is justified from the global perspective of availability of water and fertile soil, are not addressed and go far beyond the subject that can be covered here.
7. Conclusions and further actions

This document proposes an approach for assessing water footprint sustainability and to help businesses define their responses. It is far from being the final answer – it is more the starting point for a wider discussion.

It provides ideas and guidance, but also raises questions - not least, what are we going to do as a result?

- **Take Action**
  For any company concerned with long-term supply security, ignoring water footprinting is not an option. Whilst this proposed methodology for water footprint sustainability assessments is far from being perfect, it helps direct attention to areas and issues in the supply chain, where it really matters and opens the opportunity to engage with suppliers on improving the water footprint sustainability of the supply chain.

- **Close data gaps**
  Lack of available data means that a water footprint sustainability assessment of the regional crop production is not possible in some countries. Further research should be conducted in cooperation with national partners, industry and authorities in order to gain an overview of the local water situation and also to assess the water footprint impacts of agricultural commodities at a river basin level.

- **Address hotspot areas through joint projects**
  So far, we only have a basic assessment of environmental, economic and social impacts within a region’s catchment area. Therefore, a better understanding of the hotspot areas, along with partnership projects that address specific local impacts, should be developed in conjunction with local industry and supply chain partners.

- **Share best practice**
  There seem to be further opportunities to increase cooperation to boost best practice and share experiences on water management between agriculture and industry, in and outside of Europe. Issues such as efficient irrigation, or plant-specific use of fertilisers in the field, can help to reduce local impacts. Our case studies show this best practice and willingness to share knowledge already in action. Some suppliers are starting their own investigations to further reduce water footprint impacts.

- **Engage the wider industry**
  Agricultural commodities are often closely interlinked. Sugar beet is a rotational crop, used to help the soil recover and break up every three to four years. In other years, the same field will grow corn, potatoes or wheat, which means a sensible long-term sustainability strategy for sugar beet needs to work at a farm level and across the wider food industry.

- **Boost transparency and communication**
  Increased transparency and communication of water sustainability in the sugar supply chain drives improvements in the industry. The involvement of other stakeholders in our sounding board showed this to be true, adding impetus for our study.
Glossary of terms

Blue water footprint
Volume of surface and groundwater consumed as a result of the production of a good or service. Consumption refers to the volume of freshwater used and then evaporated, or incorporated into a product. It also includes water abstracted from surface or groundwater in a catchment and returned to another catchment or the sea. It is the amount of water abstracted from ground or surface water that does not return to the catchment from which it was withdrawn.

Catchment area
Area of land where surface water from rain and melting snow or ice converges to a single point, usually the exit of the basin, where the waters join another waterbody, such as a river, lake, reservoir, estuary, wetland, sea, or ocean. Similar terms are drainage basin, river basin and watershed.

Environmental flow requirements
The quantity and timing of water flows required to sustain freshwater and estuarine ecosystems and the human livelihoods and well-being that depend on these ecosystems.

Green water footprint
Volume of rainwater consumed during the production process. This is particularly relevant for agricultural and forestry products (products based on crops or wood), where it refers to the total rainwater evapotranspiration (from fields and plantations) plus the water incorporated into the harvested crop or wood.

Grey water footprint
The grey water footprint of a product is an indicator of freshwater pollution that can be associated with the production of a product over its full supply chain. It is defined as the volume of freshwater that is required to assimilate the load of pollutants based on existing ambient water quality standards. It is calculated as the volume of water that is required to dilute pollutants to such an extent that the quality of the water remains above agreed water quality standards.

Leaching
Leaching of soil occurs naturally and is part of the process of soil formation. When soil becomes saturated with rainwater, water travels downward into groundwater and eventually rivers or lakes. In the process, substances such as iron, aluminum, calcium and organic matter are carried into the soil or washed away. Leaching becomes a problem when pesticides and fertilisers from the soil are leached into water supplies.

Region
In this study, a region is where the water footprint of sugar production occurs. It includes the sugar factory and the sugar beet growing areas, assuming that a sugar factory is mainly supplied by surrounding beet-growing areas within an approximate 70km radius. Where regions of sugar factories overlap, all overlapping areas were considered as one region in the sustainability assessment.

Water footprint
The water footprint is an indicator of freshwater use that looks at both direct and indirect water use of a consumer or producer. The water footprint of an individual, community or business is defined as the total volume of freshwater that is used to produce the goods and services consumed by the individual or community, or produced by the business. Water use is measured in terms of water volumes consumed (evaporated) and/or polluted per unit of time. A water footprint can be calculated for a particular product, for any well-defined group of consumers (e.g. an individual, family, village, city, province, state or nation) or producers (e.g. a public organisation, private enterprise or economic sector). The water footprint is a geographically explicit indicator, not only showing volumes of water use and pollution, but also the locations.

Water footprint accounting
The step in a water footprint assessment that refers to collecting factual empirical data on water footprints with a scope and depth as per the defined methodology.

Water footprint assessment
Quantifying a water footprint, assessing its impacts and formulating a response. The assessment includes four phases: setting goals and scope; water footprint accounting; water footprint sustainability assessment; and water footprint response formulation.

Water footprint sustainability assessment
Assessing the sustainability of a water footprint from an environmental, social and economic perspective, at local, river basin, and global level. For this study, only local and partly river basin perspectives were investigated.
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