Comparison of Water Scarcity Methods: Meat & vegetarian Burger Case Study

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Case study description

This case study is based on a life cycle assessment (LCA) previously performed with an external consultant (summary published in Nestlé 2015, page 157). It compares the environmental (in particular water) impacts of a beef burger with a vegetarian alternative (based on soy and wheat proteins). All ingredients are sourced, alternatively, from water scarce and water abundant areas. The assessment only takes into account the meat/meat replacement part of the burger, not the bun, tomatoes, lettuce, etc.

The initial assessment showed that taking water at inventory level is not helpful to understand water impacts in agriculture: water (most importantly through irrigation) is principally used in areas where there is not enough water available, reinforcing the impact of water consumption. Therefore there was the desire to complement the study with a specific evaluation of water impacts, and compare results obtained using different water scarcity methods. Furthermore, given that some of the ingredients sourced for the assessment originate from very large countries (e.g. soy from US, Brazil), an evaluation at sub-country level has also been performed. This allows identifying whether regional data for water scarcity is preferable to country averages.

Methods

The exact recipes of the burgers that were used in this case study are confidential. Therefore, simplified recipes are used with ingredient compositions that could be relevant but do not exactly correspond to the products on the market. The ingredients and quantities that have been used in this assessment can be found in Table 1.

Table 1: Ingredients and quantities of vegetarian and beef burgers

[g]	Vegetarian	Meat
Beef	0	68
Sunflower oil	8	0
Onion	12	6
Wheat	21	6.5
Soybean	24	0
Egg	3	6
Water	7	3.5
Total weight	**75**	**90**

Note that the total weight of the two burgers is not identical, but this corresponds to the products typically used on the market. The functional unit in this assessment is 1 burger.

The for each ingredient, two sourcing options are assessed: one where the ingredient is sourced from a likely sourcing country that has abundant amounts of water ("Abundant"), one where the ingredient is sourced from a likely sourcing country that has high water scarcity ("Scarce"). The countries that have been chosen for the different ingredients can be found in Table 2.

Table 2: Sourcing regions for ingredients

	abundant	**scarce**
Beef	Brazil	US
Sunflower oil	Hungary	Russia
Onion	Netherlands	India
Wheat	Canada	Australia
Soybean	Brazil	US
Egg	Netherlands	France
Water	negligible – not regionalized	

In addition to the water consumption at inventory level, six scarcity methods with data at country level have been assessed:

- AWaRe 100 (which is the recommended default approach)
- AWaRe 10 (cut-off the maximal water scarcity at 10)
- AWaRe 1000 (cut-off the maximal water scarcity at 1000)
- AWaRe EWR 150% (increasing the environmental water requirements to 150%)
- DTA (demand to availability)
- DTAx (demand to availability with an exposing factor x)

Further description of all above approaches can be found in the report from the Pellston workshop (Boulay et al. 2016) in which these methods have been extensively discussed.

Finally, the AWaRe 100 method has also been regionalized to a province level (except for the smaller countries New Zealand, Netherlands, Hungary, and France). For this approach, regional production data on above process has been gathered from various sources. Where appropriate, sub-processes (such as feed for livestock) has also been gathered at provincial level. Based on the regional production distribution, country-average water scarcity factors taking into account the process-specific regional water requirements have been generated. Those values can be found in

Table 3. As can be seen, the difference between country scarcity value and crop scarcity value is very small for certain countries and ingredients (e.g. Onion in India), whereas for other countries and ingredients, the difference is considerable (e.g. soybean in the United States of America).

Table 3: Crop- and country-specific water scarcity factors

Country	Crop	Characterization Factor
Australia	Wheat	61.04
	Country average	73.66
Brazil	Beef	1.11
	Soybean	0.99
	Country average	2.45
India	Onion	20.33
	Country average	27.70
Russia	Sunflower	11.37
	Country average	19.97
United States of America	Beef	19.09
	Soybean	3.32
	Wheat	14.99
	Country average	36.49

Comparison of Results

On overview of the results from the different water scarcity methods can be found in Figure 1.

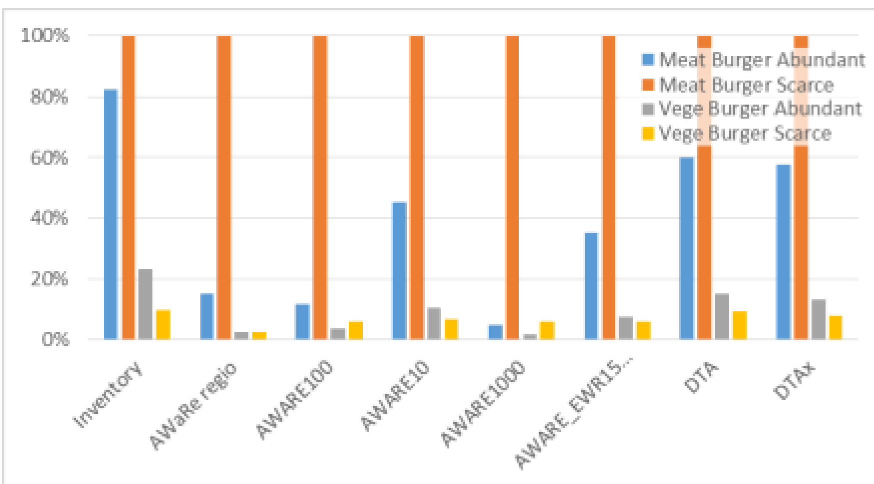

Figure 1: Water consumption calculated with different scarcity methodologies (linear scale)

The comparison of different methodologies clearly shows big differences between the inventory level calculation and all scarcity based approaches: At inventory, water consumption of the “Meat Burger Abundant” scenario is very close to the maximum (“Meat Burger Scarce”). Furthermore, the highest results (among all methods) are also obtained for both vegetarian burgers.

The other extreme can be found in the AWaRe 1000 method: very low scores are obtained for all other burger types, and the “Meat Burger Abundant” scenario actually has a lower score than the “Vege Burger Scarce” scenario (Figure 2 in the appendix shows the data from Figure 1 in logarithmic scale for better insight).

The difference between the various scarcity methods are rather small: AWaRe_EWR150%, DTA, and DTAx very much resemble AWaRe 10, whereas AWaRe 1000 and AWaRe region are quite similar to AWaRe 100 (the default). Those differences can be explained by looking more closely at the underlying data. These differences can be mostly explained by the spread of the different scarcity methods: the characterization factors in the present study spread by a factor of 2.04 and 3.31 respectively in the DTA and DTAx methods. This “pulls up” the water scarcity results for “Meat Burger Abundant” and both vegetarian scenarios as compared to the AWaRe 100 method (with a spread factor of 57.21). AWaRe 1000 has an even higher spread factor of 245.49, “pushing down” the above three scenarios.

Interestingly, the “AWaRe region” method does not result in a very different end result, despite big differences in the scarcity of certain ingredients (as shown in

Table 3). This is likely also due to the fact that its spread factor is very close to that of the default methods (61.73).

Learnings and potential issues to address

Based on the above results, it can be seen that the AWaRe 100 method (default method recommended in the WULCA process) is suited for water scarcity assessments. As compared to the inventory results, additional insight is provided using AWaRe 100. No specific issues could be identified in the current case study.

References

Nestlé 2015, Nestlé in society – Creating Shared Value and meeting our commitments 2014 – Full report, available here.

Boulay, A.-M., Pfister, S., Motoshita, M., Schenker, U., Benini, L., Gheewala, S., … Harding, K. (2016). Water use related impacts: water scarcity and human health effects. In Global guidance on environmental life cycle impact assessment indicators. UNEP-SETAC Life Cycle Initiative.

Appendix

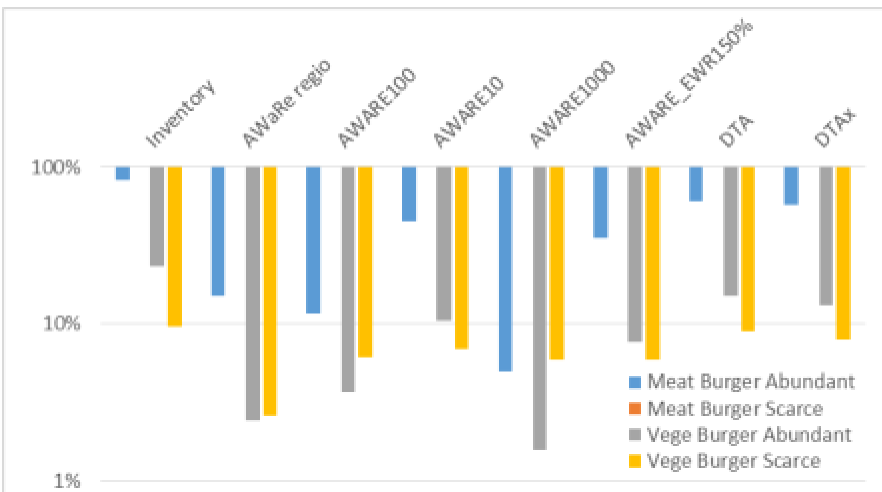

Figure 2: Comparison of water consumption using different scarcity methods - logarithmic scale for the data presented in Figure 1