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Short Communication

From ISO14046 to water footprint labeling: A case study of indicators applied to milk production in south-eastern Australia

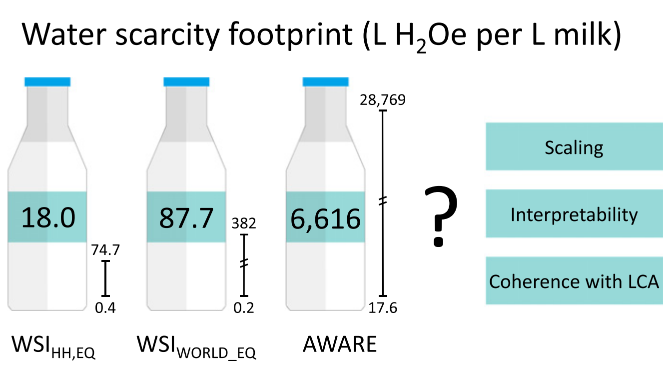
Bradley Ridoutt [a,b,*], Danni Hodges [a]

[a] Commonwealth Scientific and Industrial Research Organisation (CSIRO) Agriculture and Food, Private Bag 10, Clayton South, Victoria 3169, Australia
[b] University of the Free State, Department of Agricultural Economics, Bloemfontein 9300, South Africa

HIGHLIGHTS

- ISO14046 can support product water footprint labeling and corporate reporting.
- Water scarcity footprints were calculated for milk production on 75 farms.
- Different indicators produced results varying by a factor >300.
- For labels to be comparable, program operators must specify the indicator.
- Indicators vary in scaling, interpretability and coherence with LCA.

GRAPHICAL ABSTRACT



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ABSTRACT

ISO14046 sets out principles, requirements and guidelines for the quantification of a water footprint taking a life cycle perspective. The international standard is intended to support product water footprint labeling and corporate sustainability reporting. However, the document is not prescriptive in regard to the use of any one specific water footprint indicator. In this study, water scarcity footprints were calculated for milk production on 75 farms in three parts of south-eastern Australia. Three indicators, with distinctly different conceptual basis and model structure, were applied. Included was the AWARE indicator recently developed under the UNEP-SETAC Life Cycle Initiative. The different indicator results were highly correlated (Spearman's rank correlation 0.91–0.99) and the life cycle stages and processes identified as important were the same. Therefore, all three indicators were considered suitable for informing internal strategic action. However, the different indicators produced results which differed greatly in absolute value, in some cases by a factor of >300. To enable consumers and others to make comparisons between the water scarcity footprints of different products or organisations, program (or scheme) operators will need to specify the indicator to be used. The three indicators were assessed according to scaling, interpretability and coherence with LCA results, and found to differ in terms of suitability for use in a water footprint program. The AWARE indicator was deemed to be least suitable.

1. Introduction

In August 2014, the International Organisation for Standardization (ISO) published an international standard describing principles, requirements and guidelines for the quantification of a water footprint

* Corresponding author at.
E-mail address: brad.ridoutt@csiro.au (B. Ridoutt).

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(ISO14046, 2014). This international standard was developed in response to the market demand for metrics which assess water use from a life cycle perspective. Water use efficiency (WUE) labeling is already widely used and is mandatory for certain types of water using appliances in some jurisdictions. However, WUE labeling of products only makes sense where the vast majority of water use occurs in the use phase, such as a laundry washing machine or a dishwasher. For many other types of goods, such as food and grocery products, significant water use occurs along the supply chain in different locations and involving different types of water. The simple aggregation of different types of water use along a supply chain cannot generally be justified as there is an absence of environmental equivalence (Ridoutt et al., 2015, 2016). For example, small quantities of water consumption in a region of high water scarcity could be of greater environmental concern than larger quantities of water consumption in a region of water abundance where pressures on water resources are few. As such ISO14046 is an important contribution to environmental management, providing the basis for quantifying and reporting the potential environmental impacts related to water use associated with products, services and even organisations, taking a life cycle perspective.

A defining feature of the standard is that the term *water footprint* can only be used after impact assessment modelling and not applied to water footprint inventory results or other virtual water calculations. The standard also takes a comprehensive view of water use, including both water consumption and pollution. Use of the term *water footprint* is limited to the situation where all relevant impacts related to water use have been assessed. This gives rise to a variety of qualified water footprints where only a selection of impacts are included in the scope, for example the *water scarcity footprint*, where the assessment is limited to the impacts of consumptive water use and excludes water degradation.

Already, ISO14046 is in use in industry in strategic, life cycle-based studies intended to inform about water use impacts and opportunities for impact reduction. The next development is expected to be the application of the international standard in making water footprint claims, which might include product labeling and corporate reporting. Following the example of carbon footprinting, it seems most likely that manufacturers, importers, distributors, retailers and others seeking to make water footprint claims will prefer to do so under an independently operated water footprint program or scheme. It will be the responsibility of program operators to develop program rules that safeguard the quality and support the comparability of water footprint claims made under a program. For the water scarcity footprint, program rules will need to include the specific characterisation factors to be applied in the impact assessment phase as ISO14046 is not prescriptive in this regard. This is akin to a carbon footprint program operator specifying the particular global warming potentials to be applied to the emissions and removals of different greenhouse gases.

Recently, the UNEP-SETAC Life Cycle Initiative has been active in developing new recommendations for life cycle impact assessment (Frischknecht et al., 2016), including the development of an impact assessment model intended for use in the calculation of a water scarcity footprint (Boulay et al., 2015). This new water scarcity indicator, termed AWARE, is now available online for testing (http://www.wulca-waterlca.org/). The purpose of this study was to compare water scarcity footprint results obtained using AWARE with results obtained using two other water scarcity indicators, using milk production in south-eastern Australia as a case study. Several studies have previously investigated the life cycle water use and water footprint of milk and dairy products (De Boer et al., 2013; González-García et al., 2013; Huang et al., 2014; Owusu-Sekyere et al., 2016; Palhares and Pezzopane, 2015; Ridoutt et al., 2010; Roibás et al., 2016; Sultana et al., 2014, 2015; Willers et al., 2014; Zonderland-Thomassen and Ledgard, 2012). These studies have generally highlighted the importance of irrigation in feed supply where this occurs. The present study is differentiated from these earlier studies by its focus on water scarcity characterisation models and their suitability to support water footprint claims based on ISO14046. As such, this study has relevance beyond the dairy industry and is intended to inform the development of water footprint programs that can be applied to any product category.

2. Methods and data

The case study involved the production of 1 L of fat and protein corrected milk (FPCM; 4.0% fat and 3.3% protein; IDF, 2010) at farm gate. In total, 75 farms were studied, equally divided across the three major dairy producing regions of the state of Victoria, in the south-east of Australia (Gippsland, South West, and North; Table 1). All farms were conventional pasture-based systems supplemented by purchased fodder and concentrate. For each farm, data for the financial year 2015–2016, describing farm structure, resource use and production outputs, were obtained from a large government-sponsored farm benchmarking study (Victorian Government, 2016). Data describing water use in milking sheds was obtained from another government benchmarking study (Victorian Government, 2010). An economic approach was used to allocate water use between milk and other products based on milk income as a proportion of total farm income (Table 1).

A water balance approach was used to determine consumptive water use on each farm, following Ridoutt et al. (2010, 2012a, 2012b). The baseline situation (no dairy production) was modelled using the generalised equation of Zhang et al. (2001), relating evapotranspiration (ET) to precipitation (P) for grassed catchments. The difference between ET and P was taken to represent the contribution of the land base to local water resources. The modelling was then repeated, taking into account irrigation inputs (if any), the collection of runoff in farm dams, losses via evaporation from dams and effluent management ponds, and the return to pasture of water from the effluent management system and urine from roaming cattle. The sum of irrigation inputs and the change in drainage/runoff relative to the baseline system was regarded as consumptive water use on farm.

Irrigation water use associated with the cultivation of purchased feed (L/t) was calculated using regional data for agricultural commodity production and water use on Australian farms published by the Australian Bureau of Statistics (ABS, 2016a, 2016b). Assessments were performed at the spatial scale of Statistical Area Level 4 (SA4), which

Table 1
Summary of the dairy production systems in the three regions of Victoria, Australia (mean of 25 farms in each region).

Parameter	Region Gippsland	South West	North
Farm characteristics			
Grazing area, ha/farm	122	160	142
Cropping area, ha/farm	79	238	92
Number of milkers, head/farm	291	450	367
Milk production, L FPCM/head/year	6738	7094	7255
Farm income from milk, %	91.3	92.3	91.7
Precipitation, mm/year	773	679	468
Water use on farm			
Irrigation, ML/farm/year	139	49	930
Milking shed, L/milker/day	39.5	36.2	53.0
Drinking water requirements, L/head/day			
Lactating cow	150	150	150
Heifer <1 year old	50	50	50
Heifer >1 year old	80	80	80
Bull	70	70	70
Purchased feed, t/farm/year			
Fodder	166	371	635
Concentrate	597	1012	855
Other major inputs, $/farm/year			
Electricity	15,587	20,060	19,458
Fuel/Oil	10,003	16,973	17,502
Fertiliser	59,627	87,102	48,430