Fact Sheet: Tough Questions about Beef Sustainability

Project Title: How Do You Know If You are Looking at a Comprehensive and High-Quality Life Cycle Assessment Study?

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There is no single established approach for determining whether or not a life cycle assessment (LCA) is of high quality. This is partly because a LCA can be conducted for numerous reasons with different levels of rigor required for different goals. For example, a LCA intended to identify hotspots in a supply chain may not require exceedingly high data quality, whereas an assessment which is making a direct comparison of two products, for example in a green procurement situation, may need greater data accuracy and uniform data quality for both systems to support the decision. Nevertheless, international standards provide a minimum set of criteria against which the quality of a LCA study should be assessed and include guidance on the critical review required for different applications (ISO 14044:2006, 2006). If the LCA received a critical review, the results should be more reliable. Thus, aspects of the study that a peer reviewer would typically evaluate are also relevant in assessing the quality of any study. The main issues to look for in a LCA study is compliance with the ISO standards. To be defined as a comprehensive LCA, two hallmarks are associated with the goal and scope. First, the study should be a cradleto-grave assessment, accounting for all extractions from nature required for producing the good or service, as well as accounting for the disposal and subsequent emissions associated with the final disposition of the product, including any packaging materials associated with its supply chain.

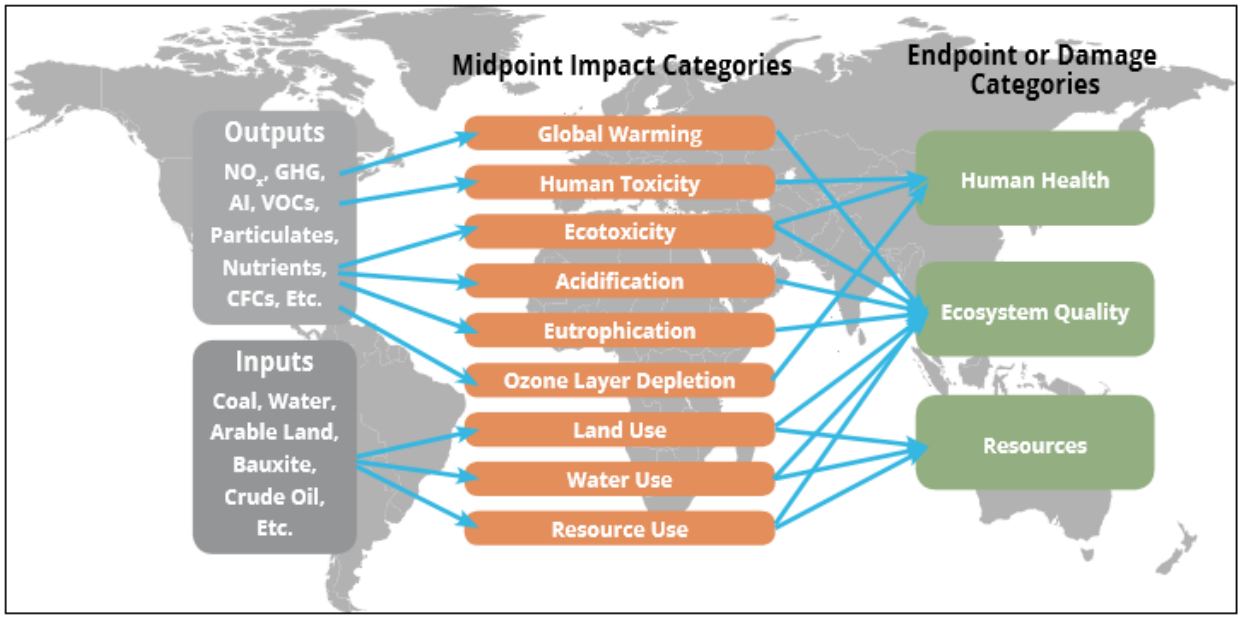

Figure 1. Impact World+ Methodology Framework (adapted from www.impactworldplus.org).

Second, a comprehensive LCA should include multiple impact categories which span major areas of production. These are generally considered to be human health, ecosystems, and resources (shown in Figure 1).[1] A life cycle impact assessment (LCIA) uses causal modeling to link resource use and emissions to midpoint categories, which are further combined to quantify impacts to endpoint

categories or areas of production. One of the fundamental reasons for performing a LCA is to evaluate potential trade-offs among various impacts between stages of the supply chain. Therefore, studies which are focused on a single (i. e. footprints) or relatively few impact metrics are less comprehensive, because the ability to identify trade-offs is limited.

Table 1. Eco-profile data sources (Battagliese et al., 2013)

Eco-Profile	Source, Year	Comments
Cardboard, recycled	Ecoinvent 2.2, 2010	Ecoinvent profile: corrugated board, recycling fiber, double wall, at plant/RER U
Paper		Ecoinvent profile: Paper, wood free, uncoated at non-integrated mill /RER U
Polypropylene	BASF, 1996	
Wood pallets		Ecoinvent profile: wood container and pallet manufacturing (USA Input Output Database)

BASF data sources are internal data, while others are external to BASF. Internal data is confidential to BASF; however, full disclosure was provided to NSF International for verification purposes.

The most important characteristic of a high-quality LCA is transparency of the data and data sources. Transparency allows users and reviewers to evaluate, in detail, the foundational information which has been used to support the study conclusions. However, situations exist where complete transparency is not possible due to aggregation and use of confidential data or trade secrets. In these cases, an explanation of aggregation and reasons for nontransparent data should be provided. Table 1 provides a sample of data sourcing with an appropriate note regarding confidential data coupled with a third-party review.

Table 2. Results of 1,000 Monte Carlo runs for uncertainty analysis of dry whey from cradle-to-customer per ton of dry whey solids (Kim et al., 2013).

Impact Category	Unit	Mean	CV (%)	95% CI	
Climate change	Kg CO_2e	1.21E+ 04	15.3	9.11E+03	1.61E+04
Cumulative energy demand	MJ	5.81E+ 04	28.5	4.09E+04	8.93E+04
Freshwater depletion	m^3	1.45E+ 03	16.2	1.05E+03	2.00E+03
Marine eutrophication	kg N eq.	3.73E+ 01	12.2	2.92E+01	4.77E+01
Photochemical oxidant formation	kg NMVOC	4.40E+ 01	12.9	3.33E+01	5.60E+01
Freshwater eutrophication	kg P eq.	7.52E+ 00	15.6	5.53E+00	1.01E+01
Ecosystems	Species/year	3.51E− 04	13.4	2.70E-04	4.54E-04
Human toxicity	CTUh	2.27E− 04	116	7.78E-05	7.29E-04
Ecotoxicity	CTUe	7.57E+ 04	14.9	5.69E+04	1.01E+05

Another characteristic is an analysis of the data quality which was achieved in the inventory phase as it relates to the ability of the authors to achieve the goal of the study. As mentioned previously, high-quality data, the absence of gaps in data for unit processes and the utilization of primary data rather than secondary data are all characteristics of higher-quality studies. The paper should provide a discussion of whether data gaps or the use of proxy or surrogate datasets may have impacted the study conclusions. The influence of modeling assumptions on the study results – such as choice of allocation procedures and decisions to include or exclude some aspects of the supply chain – should

be evaluated through scenario analysis. High-quality studies will also include uncertainty analysis. Typically, Monte Carlo simulation is used to demonstrate the effects of data input uncertainty on LCA results, as shown in the example in Table 2. Finally, a section in the paper which discusses the study limitations with respect to conclusions also demonstrates quality in the results.

Bottom line: A comprehensive, high-quality life cycle assessment will be a cradle-to-grave assessment with multiple impact categories, spanning major areas of production and in compliance with ISO standards. In addition to these characteristics, the data used in the assessment should be transparent and a thorough analysis of the quality of the data as it pertains to the results should be performed. Studies which are focused on a single (i. e., footprints) or relatively few impact metrics are less comprehensive, because the ability to identify trade-offs is limited.

Literature Cited

1. Battagliese, T., J. Andrade, I. Schulze, B. Uhlman, and C. Barcan. 2013. More Sustainable Beef Optimization Project: Phase 1 Final Report. June 2013.

2. ISO 14044:2006. 2006. Environmental management - Life cycle assessment — Requirements and guidelines. 2006.

3. Kim, D., G. Thoma, D. W. Nutter, F. Milani, R. Ulrich, and G. A. Norris. 2013. Life cycle assessment of cheese and whey production in the USA. Int. J. Life Cycle Assess. 18:1019–1035. Available from: http://link.springer.com/ article/10.1007%2Fs11367-013-0553-9