Innovationscenter
for Økologisk Landbrug

16. December 2021
En del af projektet WiFi: Winter feeding of organic sows
Skrevet af: Alberto Maresca (SEGES) og Frank Oudshoorn (ICOEL)

Table of Contents

Abbreviations

GFLI:	Global Feed LCA Institute
LCA:	Life Cycle Assessment
LCI:	Life Cycle Inventory
LCIA:	Life Cycle Impact Assessment
PEF:	Product Environmental Footprint
PEFCR:	Product Environmental Footprint Category Rule

1. Introduction: LCA and 'PEF guidelines'

The Life Cycle Assessment (LCA) methodology is a widely used approach to evaluate the environmental impacts related to the life cycle of specific products and activities. The environmental impacts are assessed for a variety of environmental issues (a few examples: climate change, freshwater eutrophication, land use, water scarcity and resource use), by using a specific set of Life Cycle Impact Assessment (LCIA) methods (e.g. the "*Environmental Footprint 2.0*" method (Zampori and Pant, 2019)).

While the current LCA methodology is standardized by the ISO (2006a) and ISO (2006b) standards, different studies can have different focus and may adopt specific methodological choices, which can limit the direct comparability across different LCA studies. To mitigate this problem, the European Commission has been working on a set of guidelines (Zampori and Pant, 2019), i.e. hereon referred to as 'Product Environmental Footprint (PEF) guidelines', that more strictly define the methodological choices that have to be adopted when making a PEF study (/declaration). The 'PEF guidelines' act as an 'umbrella document', where specific product categories can refer to and make specific PEF Category Rules (PEFCR), e.g. the PEFCR for Feed for Food-Producing Animals' (PEFCR Feed, 2020) and the 'PEFCR for Dairy Products' (PEFCR Dairy, 2020) – see more details on the requirements needed in order to make specific PEFCRs in Zampori and Pant (2019). The individual PEFCRs aim to define a very specific set of rules (e.g. choice of functional unit, requirements on primary data, evaluation of the representativeness of the data used, use of specific allocation rules and limitations on the use of secondary data), which favors comparability across products of the same category.

Currently, the PEF project is still on a transition phase (European Commission, 2021), and there is no obligation to follow these guidelines. Despite this, many companies are in the process of implementing / testing these guidelines within their business and research fields, while others have already implemented them as part of their communication / sustainability strategy (see for example DLG (2021) and Aller Aqua A/S (2021)).

2. Overview of the GFLI database

The publicly available Global Feed LCA Institute (GFLI) database is a compilation of feed ingredient datasets collected using the Life Cycle Assessment (LCA) methodology. The 'GFLI methodology and project guidelines' document (GFLI, 2020) describes all the methodological choices adopted to generate the GFLI database, and the reader is kindly requested to consult the former report for additional information.

The GFLI database is a valid source of secondary data for making LCA studies /declarations complying with the 'PEFCR Feed for Food-Producing Animals' (PEFCR Feed, 2020). As such, the database can be used by, for example, feed suppliers in order to calculate the climate footprint of their compound feeds for farm animals (e.g. DLG (2021)).

An important note is that, while the GFLI database is a valid source of secondary data, the list of feed ingredients purchased by the European Commission to support the implementation of the PEFCR Feed (2020) should always be the preferred option (more guidance on the allowed databases can be found in PEFCR Feed (2020), sections 9.3.2.1 and 9.6).

The database can be downloaded (from https://globalfeedlca.org/) and used free of charge, but only in the case of non-commercial uses (more details in the 'End User License Agreement' of the GFLI database). The database is currently available in two forms:

i) LCA impact data (excel format), assessed by means of the following impact assessment methods: "*ReCiPe 2016 midpoint (H)"* and the "*Environmental Footprint 2.0"* method. The two methods provide impact assessment data at the midpoint level for 19 impact categories (see Appendix).

ii) Life Cycle Inventory (LCI) system process data (CSV format), i.e. (aggregated) system process data that could be imported into SimaPro or other software for further analysis.

The GFLI database can be used to quantify the use of resources and the environmental impacts of pollutants emitted during the life cycle of a specific feed ingredient. The database provides data "*at farm*" level (i.e. "*farm gate*") and "*at plant*" level (i.e. "*factory gate*"): "*at farm*" level means that the impacts related to the selected feed ingredient are calculated up to the point that the feed ingredient is ready to be sold and transported elsewhere, but it is still laying at the farm; in a similar manner, "*at plant*" level means that the impacts related to the selected feed ingredient are calculated up to the point that the feed ingredient is ready to be sold and transported elsewhere, but it is still laying at the processing plant (factory). All the processes occurring after these "*gates*" (e.g. the transportation of a feed ingredient to an off-site pig farm) are not included in the database.

3. GFLI database: feed stuffs and compound feeds of imported feed

The GFLI database collects average cultivation data ("*steady state*" condition) for a specific country, and it represents a collection of "*secondary data*". The methodological details on how this modelled in practice can be found in the 'GFLI methodology and project guidelines' document (GFLI, 2020).

Because of the global markets, some feed ingredients can be generated in one country, from crops that are cultivated elsewhere: an example is the "*Crude soybean oil, from crushing (solvent), at plant/ES Economic*" product in the GFLI database. In this (and similar) case(s), FAO trade statistics are used to identify the actual countries supplying soybeans to Spain (i.e. "*ES"*); this information is used to generate the so-called "*market mix*", which represents the average composition of soybeans in Spain (e.g. 65% from Brazil, 25% from USA and 10% from Paraguay); the soybean market mix is then assumed to be used by the Spanish factories in order to produce "*crude soybean oil*". The transportation of soybeans to Spain is included in the database, and the impacts associated to the "*crude soybean oil*" are calculated "*at plant*" level (i.e. up to the "*Spanish factory gate*").

4. Feed produced on farm

Specific LCA studies may be interested in assessing the impacts of local farms. If so, primary activity data describing the local farm will need to be collected, and an estimation of all emissions to the environment (e.g. CO_2 to air, NH3 to air, P to water and Cu to soil) will be required. The 'PEF guidelines' (Zampori and Pant, 2019), and more specific PEFCRs (e.g. PEFCR Feed (2020)), provide a list of minimum data requirements, and emission models to be used, when carrying out a PEF study /declaration (assuming that this is the aim).

It is worth noting that the 'PEF guidelines' require that all the impact categories therein listed are included in the assessment, without any exclusion (see more details in Zampori and Pant (2019) and specific PEFCRs). In some cases, however, the user may only want to carry out a Carbon Footprint assessment (i.e. only focus on climate change), and focus exclusively on the emissions contributing to climate change. This decision is up to the LCA practitioner. However, in these cases, the study cannot be considered as PEF compliant.

5. GFLI database: feed ingredients not yet available

The GFLI database is meant to be regularly updated (possibly on an annual basis). The official website (https://globalfeedlca.org/) should be consulted for this purpose.

At present, the current list of products available in the GFLI database counts 962 items, out of which 103 items are representing European averages, and only 19 items are representative for Denmark. As such, the production of a specific feed ingredient in Denmark that is not available in the GLFI database should (if meaningful) be approximated with its average European production (if available) or with another country's production. The use of alternative databases may be allowed, but only under the conditions defined in the general 'PEF guidelines' and more specific PEFCRs – see Section 2.

6. Waste and side products, and allocation

In the case of multifunctional processes, the GFLI database offers three allocation options: economic, mass, and energy allocation. This allows to split the impacts associated to a specific process (e.g. the cultivation of barley) across all the generated products (i.e. barley grains and barley straw), based on a chosen allocation method (e.g. economic allocation). In general terms, the PEFCR Feed (2020) recommends the use of economic allocation in the cases where a crop generates co-products at the farm and during the processing of feed ingredients; in other cases, the use of alternative allocation methods may be recommended (see PEFCR Feed (2020)).

Waste flows carry no environmental impact, meaning that all the impacts are allocated to the main product(/-s). As such, the manure flow does not have (as a default assumption) any impact coming from the upstream animal husbandry system (the manure flow exits the husbandry system "*free-of-burden*") – following the "*cut-off system modelling approach*". See more details in Section 7.

7. Residual agricultural resources used as feed - WiFi project

The potential use of certain residual flows /by-products is growing interest within the agricultural sector, and an increasing number of studies are evaluating their possible utilization, for example as feed, while trying to evaluate their impacts following the 'PEF guidelines'. It is, however, not always clear how to model these residual flows from an LCA perspective. As mentioned in the Section 6, the PEFCR Feed (2020) recommends the use of economic allocation in the cases where a crop generates co-products at the farm and during the processing of feed ingredients. Under the latter cases, an evaluation of the economic value of the residual flows of interest should be made. In practice, if these residual flows are sold for a price that exceeds their transportation costs, it means that they have an economic value and, as such, they should be carrying a burden coming from their upstream production – for more details, see PEFCR Feed (2020). The GFLI database follows these rules too.

In the real world, the distinction between co-product and waste may not always be clear, but its definition governs how these flows are modelled in LCA (as a function of the specific system model used; see e.g. Ecoinvent (2021)). Its definition is a modelling assumption, and it should be interpreted with due care (during the interpretation of the results).

The WiFi project is looking at the potential use of specific residual agricultural flows as feed to organic sows. Some examples of these flows are malt sprouts, brewer's dregs/grain and waste from cereals used for gin and beer production, waste vegetables from retail and industry, wheat bran, spelt bran, middlings, and other leftovers from milling cereals. As mentioned in the previous lines, an evaluation of their economic value should be made in order to define whether they may be classified as co-products or waste flows. A sensitivity analysis test would be recommendable (/needed), as the results of the LCA study may be very sensitive to this modelling choice / assumption.

Projektet er en del af Organic RDD 6 programmet, som koordineres af ICROFS (Internationalt Center for Forskning i Økologisk Jordbrug og Fødevaresystemer). Det har fået tilskud fra Grønt Udviklings- og Demonstrationsprogram (GUDP) under Ministeriet for Fødevarer, Landbrug og Fiskeri samt fra Svineafgiftsfonden.

Miljø- og Fødevareministeriet
gudp

ICROFS
Organic RDD

Svineafgiftsfonden

References

Aller Aqua A/S, 2021. Carbon footprint of our products [WWW Document]. URL https://www.aller-aqua.com/sustainability/carbon-footprint-of-our-products (accessed 12.8.21).

DLG, 2021. Climate declarations give farmers important data for climate accounts. Article from 10. February 2021. [WWW Document]. URL https://www.dlg.dk/en/dlg-group/sustainability/Klimadeklarering-giver-landmændene-vigtig-data-til-klimaregnskabet (accessed 12.8.21).

Ecoinvent, 2021. System Models [WWW Document]. URL https://ecoinvent.org/the-ecoinvent-database/system-models/ (accessed 12.16.21).

European Commission, 2021. Environmental Footprint [WWW Document]. URL https://eplca.jrc.ec.europa.eu/EnvironmentalFootprint.htm (accessed 12.15.21).

GFLI, 2020. GFLI methodology and project guidelines. 28October2020. The Global Feed LCA Institute.

Huijbregts, M., Steinmann, Z., Elshout, P., Stam, G., Verones, F., Vieira, M., Zijp, M., Hollander, A., van Zelm, R., 2017. ReCiPe 2016 v1.1. A harmonized life cycle impact assessment method at midpoint and endpoint level. Report I: Characterization. RIVM Report 2016-0104. Bilthoven.

ISO, 2006a. DS/EN ISO 14040. Environmental management - Life cycle assessment - Principles and framework.

ISO, 2006b. DS/EN ISO 14044. Environmental management – Life cycle assessment – Requirements and guidelines.

PEFCR Dairy, 2020. Product Environmental Footprint Category Rules for Dairy Products. Version 1.1. February 2020 (original publication date: April 2018). Time validity: 31 December 2021.

PEFCR Feed, 2020. PEFCR Feed for food-producing animals. Version 4.2. February 2020 (original publication date: April 2018). Date of expiration: 31stDecember 2021.

Zampori, L., Pant, R., 2019. Suggestions for updating the Product Environmental Footprint (PEF) method, EUR 29682 EN. Luxembourg. https://doi.org/10.2760/424613

Appendix

List of the impact categories accounted in:

'*ReCiPe 2016 midpoint (H)*' (Huijbregts et al., 2017): global warming (including and excluding land use changes), stratospheric ozone depletion, ionizing radiation, ozone formation (human health), fine particulate matter formation, ozone formation (terrestrial ecosystems), terrestrial acidification, freshwater eutrophication, marine eutrophication, terrestrial ecotoxicity, freshwater ecotoxicity, marine ecotoxicity, human carcinogenic toxicity, human non-carcinogenic toxicity, land use, mineral resource scarcity, fossil resource scarcity, and water consumption.

'*Environmental Footprint 2.0*' (Zampori and Pant, 2019): climate change, ozone depletion, ionizing radiation, photochemical ozone formation, respiratory inorganics, non-cancer human health effects, cancer human health effects, acidification, freshwater-, marine-, and terrestrial eutrophication, freshwater ecotoxicity, land use, water scarcity, resource use energy carriers, resource use (minerals and metals), fossil and biogenic climate change, and land use and transformation climate change.