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RAPPORT

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ENVIRONMENTAL FOOTPRINT METHODS AND ORGANIC AGRICULTURE

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Aim and workflow

The “Innovation Centre for Organic Farming P/S” asked “SEGES Innovation P/S” to generate a short report that could summarize some key aspects from the Environmental Footprint methods, with focus on organic agriculture. The selected key aspects were i) organic agriculture, ii) land use change (LUC), iii) carbon sinks other than LUC, iv) N balance, v) fertilizers from residual resources, and vi) biodiversity.

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Abbreviations

CFF: circular footprint formula, **C-sink**: carbon sink, **EF**: environmental footprint, **GHG**: greenhouse gas, **LCA**: life cycle assessment, **LUC**: land use change, **OEF**: organizational environmental footprint, **PEF**: product environmental footprint

Introduction: Environmental Footprint methods

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 methods (e.g. the Environmental Footprint 3.1 method (EF 3.1)).

While the current LCA methodology is standardized by the ISO 14040:2006 and ISO 14044:2006 standards, different studies can have different focus and may adopt specific methodological choices, limiting the direct comparability across different LCA studies. To mitigate this problem, the European Commission has been working on a set of guidelines that defines the methodological details required to make an Environmental Footprint (EF) declaration, on products (PEF) (European Commission, 2021a) and on organizations (OEF) (European Commission, 2021b). The methodology has been recommended to be used by the European Commission via the Commission Recommendation 2021/9332/EU, but there is no obligation to follow these guidelines yet because the EF methods are on a "transition phase" , which is defined as "*the period between the end of the Environmental Footprint pilot phase and the possible adoption of policies implementing the Product Environmental Footprint (PEF) and Organisation Environmental Footprint (OEF) methods*" (European Commission, 2021c).

The EF guidelines act as an "umbrella document", where specific product categories or organizations can refer to and make specific PEF Category Rules (PEFCR) and OEF Category Rules (OEFCR), e.g. the PEFCR for Feed for Food-Producing Animals and the PEFCR for Dairy Products. The individual category rules aim to define a very specific set of rules (e.g. choice of functional unit, requirements for primary data, evaluation of the representativeness of the data used, specific allocation rules and limitations on the use of secondary data), which further favors comparability across products of the same category.

Despite the strict methodological framework, which *inter alia* sets specific requirements on the system boundary, the data quality, the background databases, the presentation of the results and the verification process, some companies have already started implementing the EF methodology them as part of their communication / sustainability strategy (see for example DLG (2021) and Aller Aqua A/S (2021)).

The EF methods and accompanying information (see (European Commission, 2021c)) cannot be summarized into a short but still comprehensive text. This report focuses on selected topics, and the reader is still requested to refer to the official documents for further clarifications.

The text below mostly focuses on the PEF (i.e. EF with focus on products) methodology (European Commission, 2021a), unless otherwise specified. To improve readability, the following sections avoid citing the PEF methodology (European Commission, 2021a) every time that text is extracted from it. It is only mentioned the Section number (e.g. Section 4.4.10.3), which the citation refers to.

Organic agriculture

The current PEF guidelines (European Commission, 2021a) do not explicitly mention neither the word "conventional" nor "organic" in relation to modelling of agricultural process. One possible interpretation may be that the methodology can be applied as it is in both production systems, hence there was no need to make specific references to any type of production system. In support of this interpretation, although with only a few datasets, the current FEFAC/Blonk node (https://eplca.jrc.ec.europa.eu/LCDN/contactListEF.xhtml) contains a few products, namely organic cow milk and organic cotton fiber, attributable to organic agriculture.

Impacts on "Climate change" from "Land use change" (LUC)

Direct LUC (Section 4.4.10.3):

> "A*ll carbon emissions and removals shall be modelled following the modelling guidelines of PAS 2050:2011 (BSI 2011) and the supplementary document PAS2050-1:2012 (BSI 2012) for horticultural products.*"
>
> "*Removals as a direct result of land use change (and not as a result of long-term management practices) do not usually occur, although it is recognized that this could happen in specific circumstances. Examples of direct land use change are the conversion of land used for growing crops to industrial use or conversion from forestland to cropland. All forms of land use change that result in emissions or removals are to be included.*"

Indirect LUC (Section 4.4.10.3):

> "*The PEF method only considers direct land use change, while indirect land use change, due to the lack of an agreed methodology, shall not be taken into account in PEF studies. Indirect land use change may be included under additional environmental information*."

Other methods:

> No other methods are currently allowed by the PEF methods.

Impacts on "Climate change" from C-sinks other than LUC

Different types of carbon-sinks (C-sinks) exist, and the PEF methodology (European Commission, 2021a) addresses some of these types in different sections:

- Temporary and permanent carbon storage and/or delayed emissions

  Section 4.4.10 "*Currently, credits associated with temporary and permanent carbon storage and/or delayed emissions shall not be considered in the calculation of the climate change indicator.*".

  It is however worth noting that "*Developments will be considered in order to keep the method updated with scientific evidence and expert-based consensus*.".

- Offsets

  Section 4.6.1 "*Offsets are GHG reductions used to compensate for (i.e. offset) GHG emissions elsewhere, for example to meet a voluntary or mandatory GHG target or cap. Offsets are calculated relative to a baseline that represents a hypothetical scenario for what emissions would have been in the absence of the mitigation project that generates the offsets*."…"*Offsets shall not be included in the impact assessment of a PEF study, but shall be reported separately as additional environmental information*."

- Soil carbon uptake (accumulation), e.g. from grasslands or improved land management

  Section 4.4.10.3 "*Soil carbon uptake (accumulation) shall be excluded from the results, e.g. from grasslands or improved land management through tilling techniques or other management measures taken related to agricultural land. Soil carbon storage may only be included in the PEF study as additional environmental information and if a proof is provided. If legislation has different modelling requirements for the sector, such as the EU Decision on greenhouse gas accounting from 2013, which indicates carbon stock accounting, it shall be modelled according to the relevant legislation and provided under additional environmental information*."

In other words, potential carbon credits associated with the application of biochar (attributable to the slowly degradable carbon forming the biochar) cannot be accounted according to the current PEF guidelines, yet – methodological developments may be expected.

Soil carbon uptakes shall be excluded from the main results, but they can be included in the supplementary material i) if proof is provided and ii) if required by local legislation.

N balance

"*N emissions shall be calculated from nitrogen applications by the farmer to the field and excluding external sources (e.g. rain deposition)".* As a first approximation, the Tier 1 emissions factors from IPCC (2006) are recommended. However, "*if better data is available, a more comprehensive nitrogen field model may be used in the PEF study, provided*" that i) it covers at least NH_3 to air, N_2O to air, NO_3 to water (leaching from the applied N-products), ii) N is balanced in inputs and outputs and that (iii) the N balance is described in a transparent way.

The potential modelling of interventions that have a significant influence on the N balance, as for example the use of nitrification inhibitors, is not explicitly mentioned in the current version of the methodology.

Fertilizers from residual resources

THE CIRCULAR FOOTPRINT FORMULA (CFF) AND THE "A" PARAMETER

"*The Circular Footprint Formula (CFF) is a method which has been published by the European Commission in its PEF and OEF methodologies which intends to integrate aspects of different end-of-life allocation approaches, in combination with material- and market-specific characteristics (such as material degradation and country-specific recycling rates). The formula splits the benefits and burdens of recycling (material recovery) between the producer using recycled input material and the producer of the product that was recycled. This means that when recycled material is used, a certain amount of the benefits and burdens of the recycling process is attributed to the product that uses this recycled content. Similarly, when material is disposed of, a portion of the benefits and burdens of recycling and energy recovery processes are also attributed to the product. When material is disposed of through landfill or incineration without energy recovery, the burdens are attributed solely to the product."* (PRé Sustainability B.V., 2022)

The parameter "A" in the CFF represents the market situation of a specific material. Low A values (e.g. A = 0.2) are given to materials where the demand of high-quality secondary materials is larger than the production; in practice, low A values give large credits (for the avoided production of primary materials) to the producer, which is encouraged to produce more. The opposite market situation is modelled via high A values (e.g. A = 0.8). A balanced, or unknown, market situation is modelled with a A value of 0.5. Further details about the CFF can be found in Section 4.4.8.1.

MANURE

Section 4.5.1.2 "*Manure exported to another farm shall be considered as one of the following.*

a) Residual (default option): if manure does not have an economic value at the farm gate, it is regarded as residual without allocation of an upstream burden. The emissions related to manure management up to the farm gate are allocated to the other farm outputs where manure is produced.

b) *Co-product: when exported manure has an economic value at the farm gate, an economic allocation of the upstream burden shall be used for manure by using the relative economic value of manure compared to milk and live animals at the farm gate.*
In the case of cattle farms, *"However, biophysical allocation based on IDF rules shall be applied to allocate the remaining emissions between milk and live animals."*

c) *Manure as waste: when manure is treated as waste (e.g. landfilled), the circular footprint formula shall be applied*"

At the animal farm, manure is generally treated as a residual flow, unless it can be demonstrated otherwise. Treating manure as a residual flow means that it carries no upstream burden of the animal production system, which is somewhat inconvenient for the animal farmer (because the emissions from the manure management system are allocated to the animal products), but convenient for the crop farmer (because he/she can apply a fertilizer material that carries no environmental burdens connected to its production).

A general "rule of thumb" for considering manure as a co-product is that the crop farmer pays for the manure a price that exceeds its transportation costs, as also suggested by Helmes et al. (2020) in the "*Hortifootprint Category Rules. Towards a PEFCR for horticultural products*".

DIGESTATE AND COMPOST FROM RESIDUAL RESOURCES

Section 4.4.8.14. "*Compost and anaerobic digestion/ sewage treatment.*

> *Compost, including digestate coming out of the anaerobic digestion, shall be treated in the 'material' part (Equation 3) like recycling with A = 0.5. The energy part of the anaerobic digestion shall be treated as a normal process of energy recovery under the 'energy' part of Equation 3 (CFF)."*
>
> where "A: allocation factor of burdens and credits between supplier and user of recycled materials" (Section 4.4.8.1.)

There are no specific application examples or many default values to use when applying the Circular Footprint Formula in organic fertilizers (differently than other material types - see Part C of Annex II in PEF methodology (European Commission, 2021a)), but the formula shall still be applied. The general principle is that the system gets "somewhat" credited for the avoided production of mineral fertilizers (assuming that the digestate / compost is used instead of mineral fertilizer) and energy, in the case of biogas production from the anaerobic digestion; "somewhat" is factor that depends on local conditions, although some default values can be found in the PEF methodology (e.g. A = 0.5, and B = 0 - Section 4.4.8.14. and Section 4.4.8.3.). No double counting is allowed between one system and the surrounding ones:

- If system X is partly credited for the avoided production of mineral N fertilizers, because of the N contained in the digestate (or compost), then the user this digestate (irrespective of whether he / she is internal or external to system X) will be partly blamed for the production of some mineral N fertilizer – even though the user is only using digestate.

An illustrative example of the CFF, with focus on the anaerobic digestion of biowaste, is presented in Appendix A. As it was mentioned a few sentences above, there are no specific application examples of the CFF in the case of organic fertilizers. The example applies some minor adaptations / interpretations of the CFF in order to apply it.

The illustrative example is based on coarse assumptions, and uses generic emission factors from Agribalyse v3.0.1 (ADEME, 2022) and the ELCD v3.2 database (European Commission, 2015). The example assumes that biowaste is produced within the considered system and it is sent to an anaerobic digestor, producing digestate (which is used within the system considered) and biogas (which is burned onsite to produce heat). The reader should be aware that the results are very sensitive to the values used as input to the formula. The user must update the values to reflect actual conditions (e.g. mass balance at the anaerobic digestor; emission factors describing anaerobic digestor, natural gas combustion and biogas combustion; utilization rates; N contents and plant availability in digestate; classification of the material in input to the anaerobic digestor as waste or co-product…). The illustrative example shows that even if the system gets fully credited for the avoided production of energy via natural gas, the relatively high impacts from the generic anaerobic digestion process make the considered system a net burden to climate change.

Another key aspect / limitation of the illustrative example is that it assumes that the digestate substitutes calcium ammonium nitrate. While this can be true for "conventional agriculture", "organic agriculture" would not use calcium ammonium nitrate, because it is a mineral fertilizer. In "organic agriculture", it could not be claimed that this is the substituted product.

- Section 4.5 states that "*To demonstrate that the direct substitution effect is robust, the user of the PEF method shall prove that: (1) there is a direct, empirically demonstrable substitution effect, AND (2) it is possible to model the substituted product and to subtract the LCI in a directly representative manner: if both conditions are fulfilled, model the substitution effect.*"
  The circular footprint formula in Section 4.4.8.1. is tailored to model the EoL stage, with explicit focus on secondary materials (such as plastic, metals, paper and textile) where there is a direct substitution of primary materials and energy.

It is not possible to give a concrete modelling recommendation within this document (in connection with the substituted product in organic systems), and further clarifications should be taken with the "EF helpdesk".

FERTILIZERS FROM RESIDUAL RESOURCES

Companies producing fertilizers from residual resources (see, for example, the "Øgro" fertilizers produced by Daka Denmark A/S) have their core business in what can be considered, in LCA terms, "end of life" for many residual resources. While no specific reference to these products / processes can be found in the PEF methodology (European Commission, 2021a), companies producing fertilizers from residual resources perform a service comparable to some waste treatment options, such as an anaerobic digestor and a composting plant, which would imply the application of the CFF. Companies producing fertilizers from residual resources are advised to consult the "EF helpdesk" for specific methodological details / clarifications.

Biodiversity

The current EF 3.1 impact assessment method does not account for potential biodiversity impacts. This is because impact assessment methods for biodiversity are still rather immature, and no globally recognized method for LCA exists. Despite this, the EF recognizes biodiversity as an important impact, and allows (under the "additional environmental information") the "*application of additional impact categories that are not included among the EF impact categories, or even additional qualitative descriptions, where impacts may not be linked to the product supply chain in a quantitative manner. Such additional methods should be viewed as complementary to the EF impact categories*". (Section 3.2.4.1)

Furthermore, "*considering the high relevance of biodiversity for many product groups, each PEF study shall explain whether biodiversity is relevant for the product in scope. If that is the case, the user of the PEF method shall include biodiversity indicators under additional environmental information.*" (Section 3.2.4.1). A few possible qualitative / semi-quantitative indicators are currently proposed by the EF methods (see further details in section 3.2.4.1), in the absence of specific category rules that prescribes further requirements – see for example the "PEFCR Feed for food-producing animals" generated during the EF pilot phase, which required the LCA practitioner to include, under the additional environmental information, the endpoint impacts from the "Recipe" impact assessment method.

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