

# Life Cycle Assessment (LCA) to capture indirect effects of crop diversification - how to consider the multiple functions of diversified cropping systems?

## Problem

It is unclear whether multifunctional diversified cropping systems are more sustainable than the reference systems that they replace. Comparisons need to define a common basis to take into account the multiple functions of the systems being compared.

## Solution

Expanding system boundaries to define a common functional unit reflecting energy supply to the end user using substitutional LCA ensures comparable results and highlights trade-offs between environmental impacts.

## Benefits

Farmers and actors of the value chain can quantify and communicate on the sustainability performance of their products in comparison with a benchmark.

## Practical recommendation

- Map the system: describe all physical and energy flows for every step of the value chain, including use of all co-products. This means asking farmers about their cropping practices, asking retailers about crop destination and processing (food, feed, fuel?). E.g. Energy supply from food, feed and energy crops from diversified rotations (Figure 1)

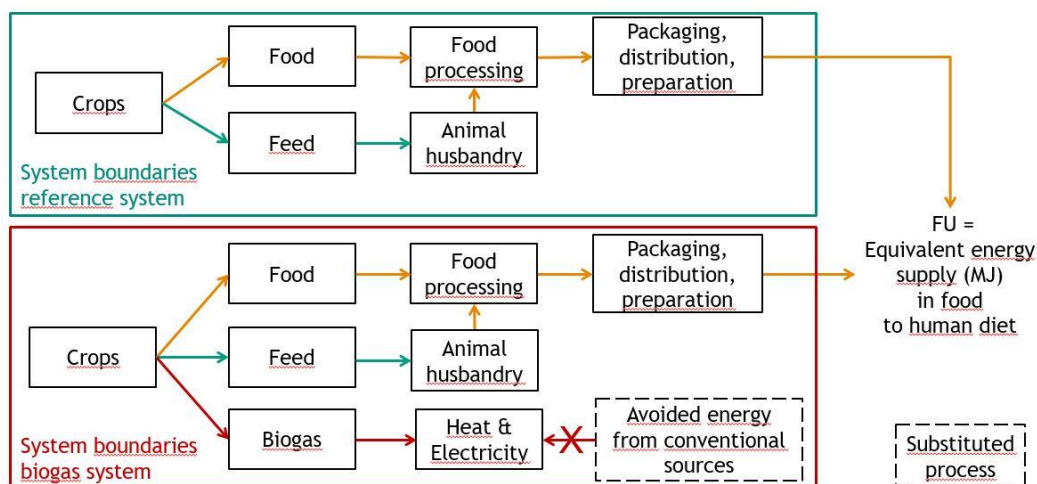
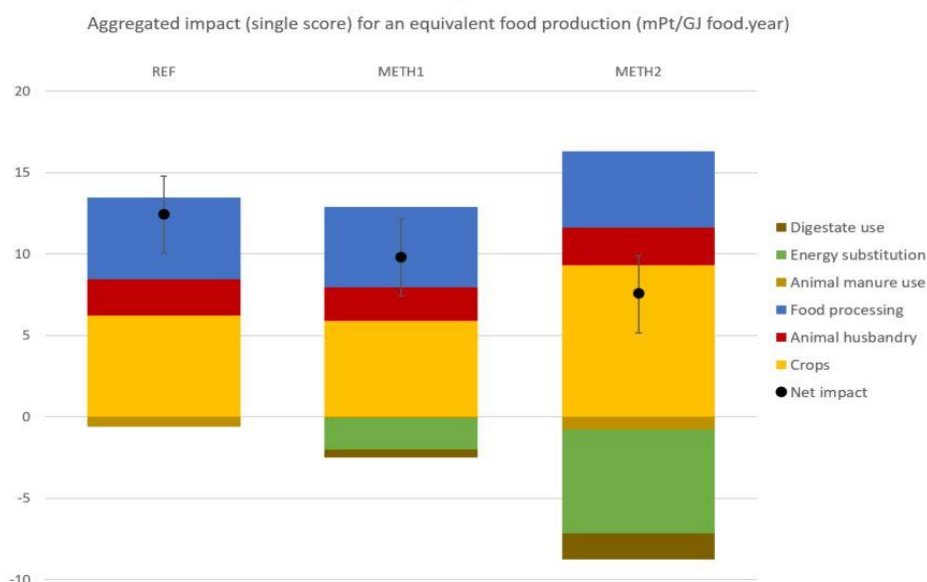


Figure 1: System boundaries of the reference and diversified systems (FU: functional unit, impacts of processes with dotted lines are subtracted from the results)

- Define a benchmark: Which reference system will you be comparing against? E.g. Classical rotation delivering food and feed crops only
- Collect data for crop production (cropping practices, inputs, outputs), animal husbandry (can be generic data if specific data is not known), processing (idem) and distribution (packaging and transports) for all systems using, if required, databases for the unknown or generic data
- LCA practitioner calculates impacts and highlights hotspots and potential improvements. E.g Diversified systems with energy crops show lower global warming potential than the reference rotation for an equivalent supply of energy to humans (Figure 2)
- Communication on the sustainability of the product can be made, targeting actors of the value chain and final consumers



**Figure 2: Process contribution to the overall impact (i.e. all environmental impacts aggregated into a single score according to Sala et al. 2018) of the production of 1 GJ of dietary energy from the three compared systems (REF: reference; METH1 and METH2: diversified systems with energy crops for biogas production); mPt = 10<sup>-3</sup> Points; whiskers represent the confidence interval of the population at p=0.05**

## Further information

### Further readings

- Earles, J., Halog, A., 2011. Consequential life cycle assessment: a review. *Int. J. Life Cycle Assess.* 16, 445-453
- Sala S, Cerutti AK, Pant R (2018) Development of a weighting approach for the Environmental Footprint, Publications Office of the European Union, Luxembourg, ISBN 978-92-79-68041-0
- Van Stappen F, Mathot M, Decruyenaere V, Lories A, Delcour A, Planchon V, Goffart JP & Stilmant D 2016. Consequential environmental life cycle assessment of a farm-scale biogas plant. *Journal of Environmental Management*; 175: 20-32
- Weidema, B., Frees, N., Nielsen, A.-M., 1999. Marginal production technologies for life cycle inventories. *Int. J. Life Cycle Assess.* 4, 48-56.
- DiverIMPACTS Practice abstract on accounting for co-product use in LCAs

### Weblinks

- <https://syppre.fr/>

## About this practice abstract and DiverIMPACTS

#### Publisher:

Walloon Agricultural Research Centre (CRA-W), Belgium

Authors: Florence Van Stappen

Permalink: <https://zenodo.org/record/6581198>

This practice abstract was elaborated in the DiverIMPACTS project, based on the EIP AGRI practice abstract format. It was tested in Champagne, France (Case study 13 of DiverIMPACTS)

DiverIMPACTS: The project is running from June 2017 to May 2022.

The overall goal of DiverIMPACTS - Diversification through Rotation, Intercropping, Multiple Cropping, Promoted with Actors and value-Chains towards Sustainability - is to achieve the full potential of diversification of cropping systems for improved productivity, delivery of ecosystem services and resource-efficient and sustainable value chains.

Project website: [www.diverimpacts.net](http://www.diverimpacts.net)

© 2022