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USING LIFE CYCLE ASSESSMENT TO ASSESS AND IMPROVE THE ENVIRONMENTAL PERFORMANCE OF ORGANIC PRODUCTION SYSTEMS

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Abstract: Life cycle assessment (LCA) is an international method that allows an estimation of a set of environmental impacts of products. A growing number of studies have used LCA to assess environmental impacts of agricultural products, but available LCA data mainly concern conventional agriculture. The ACV-Bio project has created LCA data for arable crops, grassland, forages, grapes, cattle, sheep, pigs and poultry in France. For most products, contrasting production systems were assessed to explore a diversity of organic systems. The web-based MEANS-InOut software was used to facilitate and streamline the generation of LCA data, and their external review by independent experts. Impact values were calculated for nine indicators. The InOut software was enhanced to allow assessment of intercrops and cropping systems, which are important elements of organic systems and of agro-ecological systems in general. Eco-design scenarios of pig and grape production systems allowed impact reductions of 0 - 22%, depending on the impact considered.

Introduction: Many consider organic agriculture as a model for improving the sustainability of agricultural systems. Compared to conventional agriculture, organic generally uses fewer inputs per unit of land occupied; consequently, its environmental impacts per unit of land are usually lower. However, as organic yields are usually lower, when impacts are expressed per unit of product, organic products may have similar, higher or lower impacts than conventional ones.

Life Cycle Assessment (LCA) is an internationally standardised method that quantifies all relevant emissions and consumed resources and the related environmental and resource depletion issues that are associated with any products. LCA takes into account the product's full life cycle: from the extraction of resources, through production, use, and recycling, up to the disposal of remaining waste. A growing number of studies have used LCA to assess environmental impacts of organic systems, but at the level of a country such as France, LCA data available are far from sufficient to capture a diversity of products and production systems.

The French AGRIBALYSE life cycle inventory (LCI) database contains LCIs for 113 products at the farm gate, 13 of which are organic products (Koch and Salou, 2016). For conventional agriculture, it contains several LCIs yielding a same product (e.g. milk), in an attempt to capture a diversity of French production systems. Recently, demand for LCI data of organic products has increased. To create such data, the “ACV-Bio” project was funded by ADEME (the French environment agency), the French Ministry of Ecology and the project partners. The project enables organic stakeholders to assess their systems and to identify potential ways to reduce their environmental impacts. Assessment of organic practices and systems can also be part of a more general approach to eco-design agricultural systems, as these practices and systems can be used in the wider context of agroecology. This paper presents the ACV-Bio project, its methodology and some results in terms of eco-conception.

Material and methods: LCI and LCA data of French organic products at the farm gate were created. For most products, several variants representing contrasting production systems, were assessed to explore a diversity of organic systems (Table 1). The project partners used the web-based MEANS-InOut software (Auberger et al., 2018) to facilitate and streamline generation of LCIs and their external review by independent experts. MEANS-InOut provides forms to guide detailed data collection for production systems at the level of individual fields and animal production units.

LCA was conducted according to AGRIBALYSE methodology (Koch and Salou, 2016). Impact indicators were calculated according to ILCD recommendations except for biodiversity impact, which was adapted according to Knudsen et al. (2017).

Results:

3.1 Methodological challenges

Most AGRIBALYSE LCI data for conventional agriculture represent average data for French products. We did not create such average data for two reasons. First, as organic systems do not use synthetic fertilisers and pesticides, they depend more than conventional systems on ecological processes that vary according to local soil and climate conditions. As a result, organic systems have more diverse farm structures, farming practices and resulting agronomic performances than conventional systems. Secondly, despite its rapid growth organic still represents a modest percentage of overall agriculture, data characterising it are scarcer than for conventional systems. The project therefore created LCIs of several production systems for a given product according to data availability. Average French data were not proposed.

LCA studies do not routinely assess impacts of farming systems on biodiversity due to a lack of appropriate assessment methods. Assessing impacts of organic products without considering biodiversity is problematic, because organic systems generally have higher species richness at the field level than conventional systems (Knudsen et al., 2017). The project therefore specifically considers impact on biodiversity.

Cropping systems are a series of crops grown on the same field, either following each other, or sharing the same field (intercropping). In organic systems, more than in conventional ones, cropping system design is an important tool to optimise agronomic performance. LCA generally focusses on one crop, which presents a limitation, because the performance of one crop often depends on other crops in a given cropping system. An approach in which the entire cropping system is assessed is preferable. Furthermore, intercropping is more common in organic agriculture, as it improves nitrogen availability, favours weed control, reduces pests and diseases and provides lodging resistance. The AGRIBALYSE® methodology and the MEANS-InOut software were therefore adapted to allow creation of LCIs of cropping systems.

3.2 Some specific characteristics of organic agriculture

According to the project's steering committee, organic agriculture tends to occur more frequently in less-favoured areas that have below-average yield potential. A study of variables predisposing farmers to convert to organic in the Germany confirms this observation. When comparing AGRIBALYSE conventional and organic LCIs, this could bias the results in favour of conventional. We therefore documented yield potential in the metadata of LCIs of organic crops.

Conventional pigs are generally fed concentrated feed only, whereas organic pigs may have access to fresh or conserved grass or other forages. Including forages in pig diets contributes to their energy and protein needs, may improve their health and may reduce aggressive behaviour. Therefore MEANS-InOut software was adapted to allow the incorporation of forages in pig diets.

3.3 Eco-design

We present here eco-design scenarios for pig and grape production.

In France, organic soybean used in concentrate feed for pigs is generally imported from India or China. In an organic pig production system containing 7% of soybean cake in the overall feed intake, sourcing organic soybeans from France rather than India reduced impacts of live pigs at the farm gate by 2 – 22% (Figure 1: Effect of the sourcing of organic soybeans for feed on impacts of organic pigs at the farm gate).

In organic grape production, the soil between the rows of vines can be tilled to control weeds. Introducing a permanent grass cover between the rows strongly reduces nitrate leaching and soil erosion. An eco-designed scenario, combining such grass cover with the use of a tractor equipped with a fuel-efficient gearbox allowed an impact reduction of 0 – 20% relative to the baseline scenario (Figure 2: Effect of an eco-designed scenario (inter-row grass cover and fuel-efficient tractor) on impacts of organic grapes at the farm gate).

Table 1. Products and number of variants (in brackets) per product in the ACV-Bio project.

Product category	Products and number of variants
Sole crops	Barley (6), faba bean (6), grain maize (3), oat (1), rapeseed (1), soybean (5), sunflower (5), triticale (3), sorghum (1), wheat (18)
Intercrops	Faba bean-wheat (3), pea-triticale (3), pea-wheat (3), pea-barley (2), faba bean- barley (2)
Grassland/forages	Cereal-legume intercrop harvested as silage (1), grassland (12), alfalfa (5), ryegrass-clover (1), silage maize (1)

Grapes	Grapes for Protected Designation of Origin white wines (PDO) from Alsace (2) and Loire Valley (3)
Ruminants	Beef cattle (5), cow milk (4), lamb (3)
Pig and poultry	Broiler (2), egg (2), pig (4)

Discussion: The ACV-Bio project allowed the adaptation of AGRIBALYSE methodology and MEANS InOut software to the specific characteristics of organic agriculture. A wide-ranging set of LCI and LCA data of products of organic agriculture was created. LCI will be available in the AGRIBALYSE database in SimaPro and OpenLCA softwares and LCA results will be published in a data paper. These data have shown that LCA can support the eco-design of organic production systems.

References: Auberger J, Malnoë C et al., 2018. MEANS-InOut: user-friendly software to generate LCIs of farming systems. LCA Food 2018 conference proceedings, Bangkok, Thailand.

Knudsen MT, Hermansen JE et al., 2017.. Sci. Tot. Environ. 580: 358-366.

Koch P, Salou T, 2016. AGRIBALYSE: Methodology – Version 1.3. ADEME, Angers, France.

Figure 1:

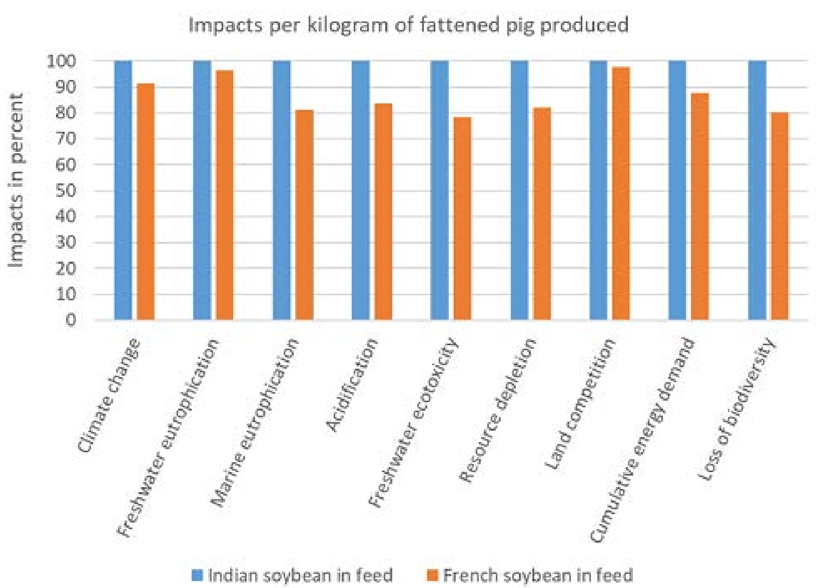
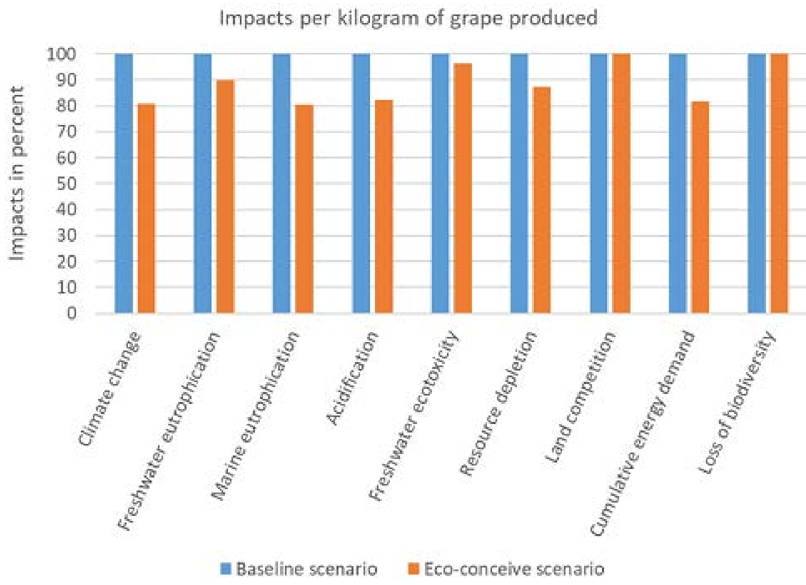


Figure 2:



Disclosure of Interest: None Declared

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