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Feed eco-design: how to make a good decision? Part 2- rebound effects of eco-feed production

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Abstract

This study takes place in a context where the feed manufacturers have access to eco-labeling databases which allow them to do eco-design and produce feeds with less environmental impacts. First results of eco-feed show substitutions between feedstuffs compared to standard feed. Therefore, the objective of this study is to identify the rebound effects of the production of eco-feed for pigs if the practice becomes widespread in France. A mind map was built with 5 experts to identify in a qualitative way the panel of different consequences. We then focused on the one concerning the change of crop rotations to produce eco-feed. We chose a virtual territory dedicated to produce the feedstuffs for a pig farm and assessed the environmental impacts by LCA using different functional units and perimeters. The situation with the production of eco-feeds can appeared better or worse compared to the production of standard feeds. This work underlines the complexity of eco-design and the limit to do it with data from attributional LCA. It is necessary to complete the databases by information to make the users aware of the rebounds effects invisible during the eco-design process.

Keywords: *environmental impacts, Life cycle assessment, feed, formulation, crop rotations, regional scale*

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1. Introduction

Are the environmental data concerning feed ingredients adapted to eco-design for feed manufacturers? The question is of interest because eco-labeling leads to the production of several databases on environmental impacts of agricultural products which are now available for economic stakeholders. ECOALIM dataset, included in AGRIBALYSE® database, is one of them and concerns the environmental impacts of 150 different feedstuffs (Wilfart et al., 2016) with average national data. Feed manufacturers can use them in formulation in order to produce eco-feeds. Garcia-Launay et al. (2016) have tested it for pig's fattening feeds and found more incorporation of wheat co-products and pea and less maize and sunflower meal, compared to the formulas of standards feeds. If the practice becomes widespread in France, what will be the final environmental consequences? To help answering this question, the objective of this study was to identify the rebound effects of the production of eco-feed.

2. Material and methods

First, we identified in a qualitative way the rebound effects of the production of eco-feed if the practice was widespread in France by the feed manufacturers. The goal of this first step was to achieve to a general mind map figuring most of the incidences as widely as possible (not only in France) on economic, environmental and social aspects. Five experts of animal feed and feedstuffs

production were questioned individually in order to fill the mind map. The results were shared between the experts in order to achieve to a share vision.

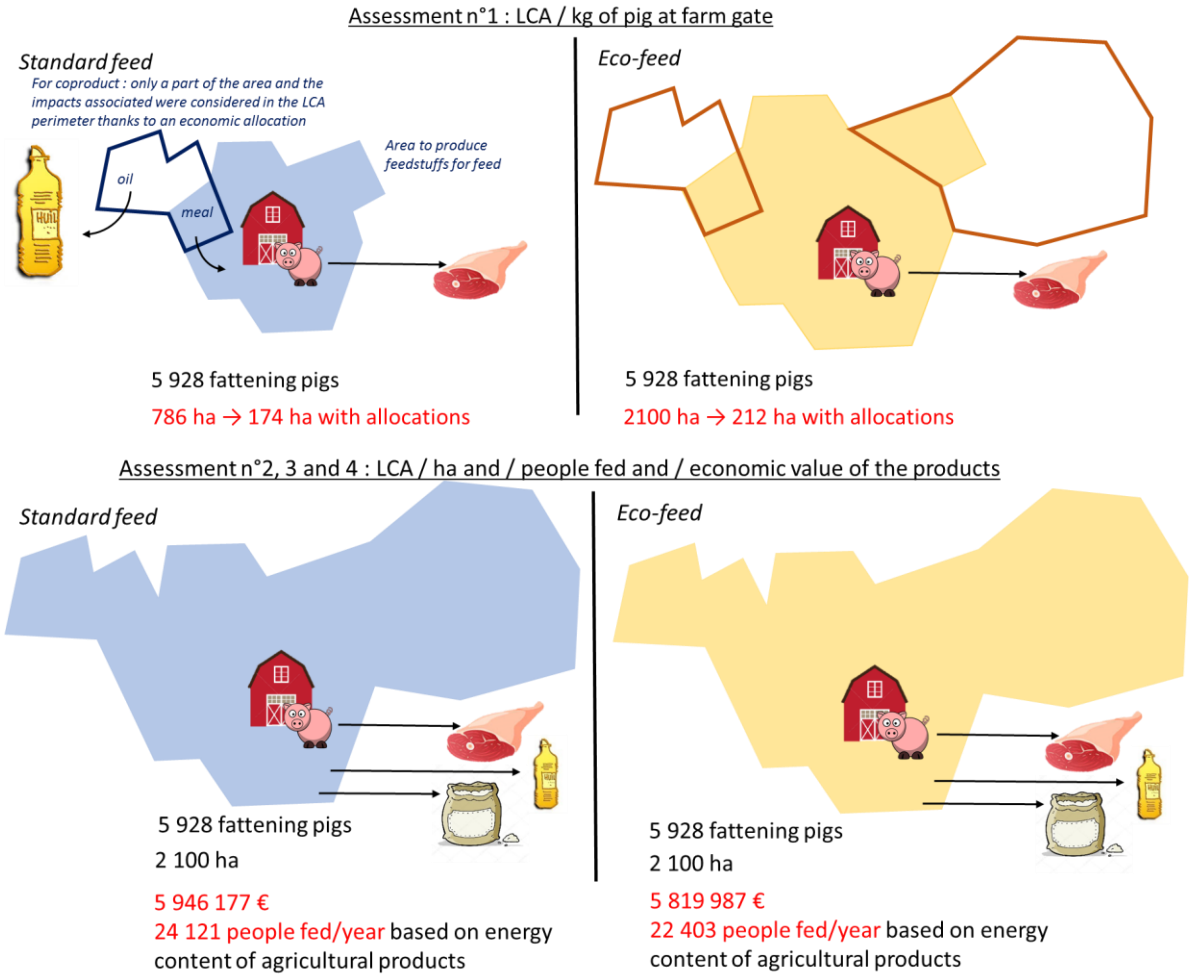

Figure 1: System boundaries and functional units to assess the incidence of the production of eco-feed on a territory

For a quantitative approach of the rebound effects, we focus on the change of practices induced by the production of eco-feeds on a "closed" territory. By "closed", we mean a self-sufficient territory to produce all the feedstuffs for the annual production of almost 6000 fattening pigs. This virtual approach makes it possible to overcome the complex global scale and forces the change of practices locally. We considered pedoclimatic conditions of the region Pays de la Loire in France and we defined crop rotations respecting agronomic rules and providing all the feedstuffs needed by pigs. We measured quantitatively the environmental impacts of the production of eco-feeds by LCA for the impacts phosphorous consumption (PC), energy consumption (EC), climate change (CC), acidification (AC), eutrophication (EU) and land occupation (LO). To do so and to measure most of the incidences, we considered different functional units and perimeters (figure 1): the kilogram of pig produced on the territory, the average hectare of the territory, the economic value produced on the territory, the number of people fed with the food produced on the territory by considering the energy content. For the assessment per kilogram of pig, an economic allocation of impacts was used between coproducts for pigs and other coproducts for other activities (for instance rapeseed with meal for animal feed and oil used in human food). For each simulation, we compared a situation with the production of standard feeds to a new one with the production of eco-feeds.

3. Results and discussion

The mind map allowed to list numerous rebounds effects linked to the production of eco-feeds (the figure 2 is a simplified version summarizing the different parts). Some play worldwide with the economic aspects of supply and demand, other at the level of the production chains of feedstuffs with reorganization, specialization and contractualisation, and other at regional scale with the modification of crop rotations. This last incidence leads to a modification of environmental fluxes which brings to change the initial environmental impacts of feedstuffs in the database when eco-feed are implemented at large scale.

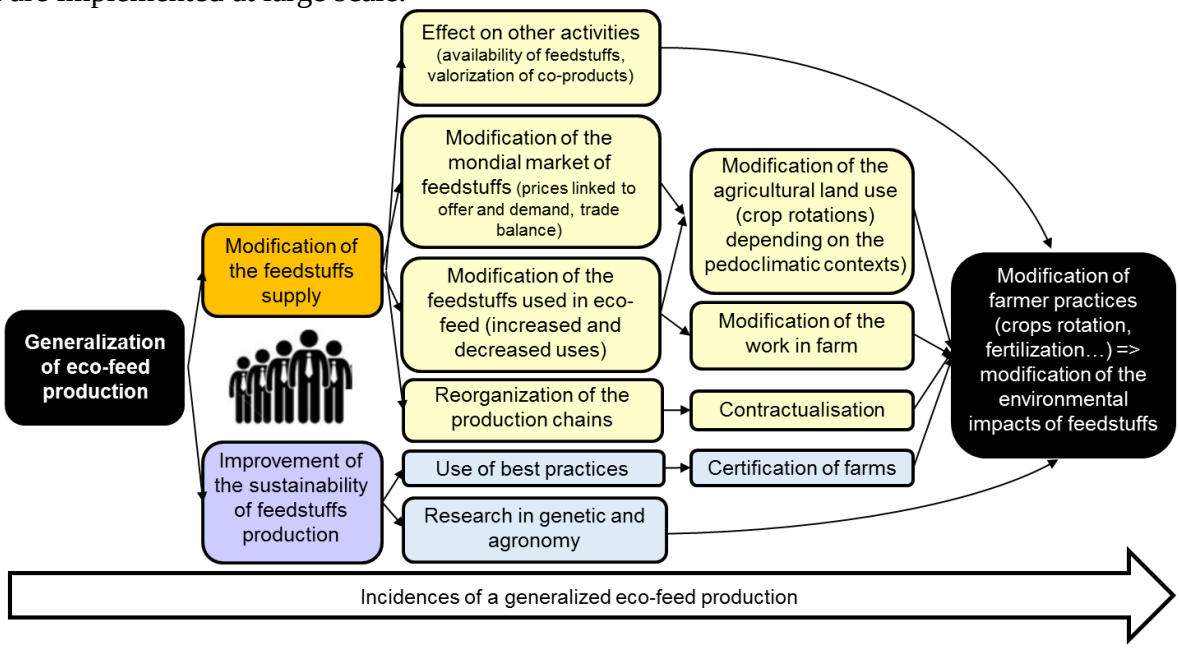

Figure 2: Simplified mind map of the incidences seen by experts related to the production of eco-feed

The simulations performed at small regional scale gave contrasted LCA results (figure 3). The situation with the production of eco-feeds can appear better or worse depending on the functional unit. It is mainly better at the scale of the kilogram of pig except for phosphorous consumption because the crops rotations of the territory changes the phosphorous fertilization compared the average practices considered in the ECOALIM database (with average national practices). Per hectare the assessment gives less impacts with eco-feed. The situation with eco-feed is worse when we consider the results per people fed because the territory feed less people than in the standard situation. Per economic value produced the situation can be improved ou degraded depending on the impact. The results could seemed no significant (several differences < 5%). This is due to a dilution effect. Indeed, a larger territory is requested to produce eco-feed compared to standard feed and we chose to have the same territory for the standard situation and the eco-feed situation. This is linked to the need of wheat coproduct for the eco-feed. The wheat is produced in a crop rotation with other crops (rapeseed and barley) which are not used for pig production.

The different functional units show different aspects of the question as shown by Basset-Mens et van der Werf (2005) and Dourmad et al. (2014) who presents as well contrasted LCA result per kg of product and per hectare. Even if it makes the decision harder, those elements are required to be aware of the different consequences. The results of the mind map question about the updating of the database and the use of the data in attributional LCA which doesn't make visible the rebounds effects. Van Zanten et al. (2017) tested both attributional LCA and consequential LCA to assess different protein sources in pig feed and obtained different results. However, consequential LCA can't be a routine practice in eco-labeling because it's complex to do and there is a lot of

assumptions linked to it (Schmidt, 2008; Chen et al., 2012).

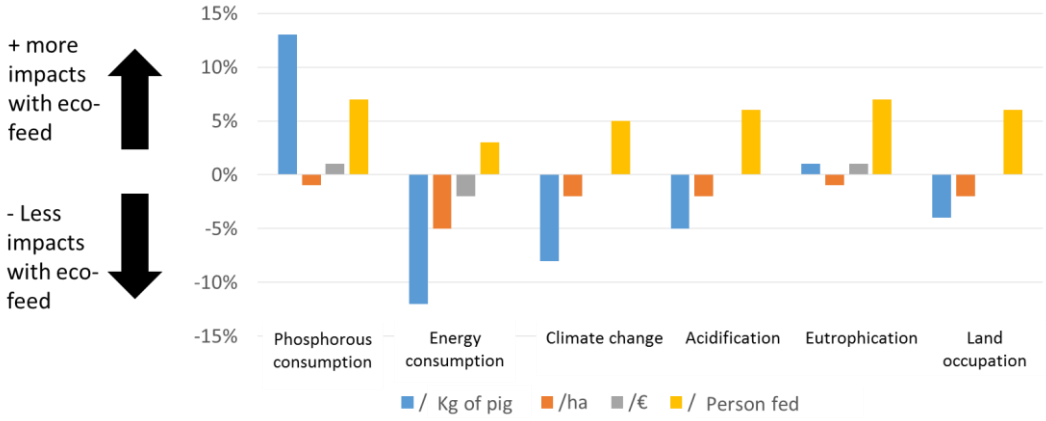

Figure 3: LCA results for eco-feed in comparison to standard feed

4. Conclusions

This work underlines the complexity of eco-design and its consequences by considering the rebound effects. The database production was only the first step. Research and development should bring results of simulations to final users of environmental data in order to make them aware of the rebounds effects which are not visible during the eco-design process with data obtained by attributional LCA.

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