

Is LCA-based eco-labelling reasonable? The issue of tropical food products

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ABSTRACT

In the light of near future compulsory LCA based eco-labelling in France, the LCA literature on major tropical food imports was reviewed. About 70 studies covering five food product categories were considered. Observations were similar across these categories of fruits and vegetables, rice, stimulant beverages, vegetable oils and animal products: most assessments are either partial (often one or two impact categories), or lack a comprehensive description of the methodology and data used. In addition to this scarcity of comprehensive LCA studies, methodological weaknesses are generally observed, especially regarding the failure to consider farming systems diversity, the lack of specific methods and data for their inventory (especially field emissions), the absence of crucial environmental indicators for tropical systems such as biodiversity and water use. The state of the art of tropical food product LCAs is too immature to enable a fair assessment of these products in an eco-labelling program. Specific methodological issues and key challenges for research arising from this review are discussed.

Keywords: Eco-labelling, Life cycle assessment, Food, Agriculture, Tropical

1. Introduction

To promote the best consumption patterns towards environmental performance, the French government has recently released a regulation on life cycle assessment (LCA) based eco-labelling for all products, to enter into force by July 2011. National working groups were created to elaborate harmonised guidelines for each product category. One group focuses on food produce. In this arena, the shortcomings of the current application of LCA to food produce are suddenly being discovered and debated amongst stakeholders with uneven understanding of the methodology. Beyond methodological issues, a new area of trouble has emerged: how should imported produce, especially those from tropical or semi-arid regions (rice, cotton, coffee etc.), be assessed? These tropical products can represent a major part of imported commodities to Europe and their market is expanding. France is the 2nd largest rice importer in the European Union (EU) and yearly rice intake per capita in France grew from 4kg to 5kg over the last 20 years. In 2007, France also imported some 700 kt of coffee, cocoa and tea, and half of its fruits consumption and one third of its vegetables. Finally, the EU is among the three largest world importers of palm oil. Moreover, a tremendously increasing demand for oil seed crops is driven by livestock production. Animal products are not much exported from tropical countries to Europe notably due to sanitary barriers. Still, part of the environmental impacts of livestock production in France is due to feed production in tropical countries, especially soybean meal. LCA application to tropical food produce is recent. Most references and models used in LCA studies have so far been developed for temperate regions. What are the data and studies available for LCA of tropical food? Are the methods and models developed in temperate regions adapted or adaptable to tropical commodity chains? In this paper, we review the available literature for major product categories. On this basis, a critical analysis of the scientific relevance of

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using LCA for Eco-labelling of food produce in Europe in the current state of knowledge is proposed and recommendations are made.

2. State of the art for LCA applied to the main tropical food products

For five major tropical product categories, papers were reviewed and are summarised in the below sections. For each product, a reference study was selected and is summarised in table 1.

2.1. Fruits and vegetables

Fourteen LCA studies for fruits and vegetables were selected. Eight papers studied tomato in Mediterranean countries, 3 related to citrus in Spain (Sanjuan *et al.*, 2005) and Italy. Medina *et al.* (2006) proposed a first scoping study on tomato in the tropics. In Brazil, CETEA contributed to frame the LCA of oranges for juice by producing a comprehensive assessment of economic flows at farm level (Coltro *et al.*, 2009) and by developing a simple methodology for their inventory (Mourad *et al.*, 2007). Tomato in Mediterranean passive greenhouse systems showed most references (Antón *et al.*, 2005). Generally speaking, direct emissions at field level were estimated through generic emission factors or general inventory calculation methods for agricultural products. Only the IRTA team in Cabrils (Spain) produced specific methods and data for assessing greenhouse systems with LCA especially regarding nutrient emissions, toxicity and land use assessment. In the majority of studies reviewed, water use and biodiversity were not assessed due to a lack of consensual method.

2.2. Rice

While there is abundant literature on the assessment of greenhouse gas emissions from irrigated paddy fields, few studies applied the LCA methodology for assessing potential environmental impacts of rice production in Asia, where most production takes place. Most published research essentially focused on Global Warming Potential (Mishima *et al.*, 2005; Harada *et al.*, 2007; Hokazono *et al.*, 2009) or even only on greenhouse gas (GHG) emissions per se. More indicator-inclusive research have been performed in Thailand by Yossapol and Nadsatoporn (2008), Kasmaprapuet *et al.* (2009), assessing other impact categories. Facing current paucity of studies, LCA-based labelling of rice or the mere comparison of impacts are further hindered by discrepancies between studies, in terms of system boundaries, functional units (mass of milled or un-milled rice), impact categories, and even reference units as per category. Further, methods used regarding GHG emissions remain often unspecified or not local-based. Also, water use remains commonly unaddressed. Finally, average production systems under consideration grossly overlook the actual diversity of field and farm situations.

2.3. Stimulant beverages

The LCA studies for coffee and cocoa used similar system boundaries from plantation to consumption, while the quality of inventory data varied from fine detail (Coltro *et al.*, 2006; Ntiamoah & Afrane, 2008; Humbert *et al.*, 2009), to relying mostly on literature and database (Salomone, 2003; Flysjo & Ohlsson 2006). The key challenge of using LCA for eco-labelling of coffee and cocoa products resides in accounting for the diversity of producing countries spanning Latin America, Africa and Asia, cultivation systems: shaded, organic (Coltro *et al.* 2006), and transformation technologies. The three LCA studies of coffee identified cultivation and consumption as the most impacting phases of the life cycle, respectively due to fertilizer use and related GHG emissions, and due to energy use and waste when brewing coffee. Consequently, these studies could be used as a first proxy for eco-labelling of coffee. However, since coffee and cocoa marketing tends to rely on environmental/fair-trade certifications, the development of an eco-label that differentiates products by country of origin, cultivation system and

type of use (instant, drip-filter, etc.) will be useful in the long term, for which more detailed studies appear necessary.

2.4. Vegetable oils

Eighteen LCA-based studies were reviewed for tropical vegetable oils. Among them, palm oil is clearly the main depicted commodity chain with 14 references (Yusoff and Hansen, 2007; Schmidt, 2010). Indeed, palm oil is largely dominating the world market of vegetable oils. Moreover, interest has arisen in using palm oil for biofuel purposes. Thus most palm oil LCA (9 out of 14 studies) are only focused on energy consumption and/or greenhouse gas emission indicators. Palm oil production comes along with several co-products and the allocation rules applied are very diverse, with a potentially high influence on LCA results. Inventory data is generally site-specific for agricultural practices or transformation processes but comes from international databases for emission mechanisms and background processes. International round tables exist that have led to define consensual good management practices for sustainable oil production (RSPO, RTRS). A co-development of these qualitative guidelines together with a quantitative assessment through consistent LCA is needed to reach the eco-labelling target.

2.5. Animal products

Reviewed studies were conducted in Asia for pork (Dai and Kuo, 2008), beef (Ogino *et al.*, 2007) and milk (van Kernebeek and Gerber, 2008), in Oceania for milk (Basset-Mens *et al.*, 2009) and South America for poultry (Spies *et al.*, 2002). No Africa-specific studies were found. The majority of studies are “cradle-to-farm-gate” LCAs. An exception is the recent report of FAO (2010) who considers milk production and processing for main regions and farming systems of the world. Studies based on local data and mechanistic models are scarce (Basset-Mens *et al.*, 2009). They mainly refer to management manuals and/or international standards (Ogino *et al.*, 2007). Global warming is assessed by all, whereas water use and biodiversity were never considered. Key challenges in applying LCA for eco-labelling tropical animal products reside in the provision of reliable local data and in some methodological adaptations needed. Tropical livestock systems are mainly low-input, manual and mixed systems. They provide services for crop activities (animal draught and organic fertiliser). Consequently system boundary must be enlarged.

3. Discussion and conclusions

Overall, among the 70 papers reviewed in this study (not all cited due to size constraints), most were either presenting partial LCA (with one or two indicators), or lacked a comprehensive description of the methodology and data used especially in the case of proceedings papers. Although, reference studies were selected and could provide first proxies for most indicators selected in the French eco-labelling scheme (Table 1), our first general conclusion from this review is the scarcity of comprehensive LCA studies for tropical agricultural products. A second important observation relates to the methodological limitations and weaknesses of the available studies, especially regarding the failure to consider farming systems diversity, the lack of specific methods and data for their inventory (especially field emissions), the absence of several crucial environmental indicators for tropical systems such as biodiversity and water use. On the basis of the two previous statements, we consider the state of the art of tropical food product LCAs as too immature to enable a fair assessment of these products and its use in an eco-labelling program.

Many tropical farming systems deeply differ from farming systems in temperate regions, from social, economic, cultural and environmental perspectives. They often show an extreme diversity of farming situations with many being low-input and manual systems. They use preferentially natural and on-farm produced resources. Furthermore, they often interact or compete with a still pristine environment compared to our temperate habitats. In most farming regions in tropical countries, the competition for land and water poses the challenge of biodiversity preservation in crucial terms. Moreover, with very specific conditions of soil and climate (and maybe more acute vulnerability), the knowledge on the interaction between farming systems in the tropics and the environment seems more dispersed and scarce. Specific methodological issues and key challenges for research arise from these specificities.

At a mid-term horizon, to produce “classical” LCA studies (consensual indicators) for a range of typical products from the Tropics, the following aspects should be given emphasis:

- A protocol for designing and characterizing typical farming systems at a given scale should be developed
- System boundaries should be enlarged to include human and animal labour as key sources of energy. Harmonised assumptions must be set up for the definition of temporal system boundaries in regions subject to land conversion;
- Best available knowledge on direct field emissions from farming systems in tropical conditions should be explored and included into more reliable and specific LCI data;
- Some local initiatives for developing background processes inventory databases for tropical countries and supply chains should be supported;
- Water use should be included systematically according to up-to-date method from the UNEP-SETAC initiative.

Long-term propositions relate to:

- The development of adapted characterisation models and factors for regional impacts such as eutrophication, acidification and toxicity;
- The development of a consensual method for biodiversity assessment.

All these actions will not be possible without the strong involvement of technical and scientific partners in the tropics. For a consistent and quick development of LCA for tropical countries, a global and active scientific network and partnership is needed between North and South countries.

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