

# Linking PCF, LCA and ecodesign – A practical approach for the food sector

Philippe Schiesser<sup>1</sup>, Ricardo Teixeira<sup>2</sup>, Anne Himeno<sup>2</sup>, Andrew Southwood<sup>2</sup>

## Abstract

Product Carbon Footprint (PCF) and Life Cycle Assessment (LCA) for food and agriculture products is becoming more mainstream as more companies adopt and integrate the process. On the one hand, food products have one of the largest shares of carbon emissions. On the other hand, primary production sectors feel the effects of climate change before any others, in price and availability of inputs, in soil and water quality, and in yields. In response, PCF studies are progressively being integrated in companies' day-to-day activities. Reducing the footprint of products can, however, be costly. First, assessing the impacts of products can be time and resource consuming. For this reason, it's important to start simple and use screening tools providing insights on hotspots and chain management.

In this paper, we discuss how PCF and LCA are being used by companies in the agri-food sector to turn the issue of sustainability around. Instead of being a cost-inducing burden, sustainability can be a profit-driving activity for business. To support this conclusion, we present different improvement scenarios studied for an agri-food company. We show how LCA-oriented changes in ingredients, packaging and energy use in food products can provide companies with win-win improvements to their operations.

## 1. Introduction

Product Carbon Footprint (PCF) for food and agriculture products is rapidly becoming a reality. Product labeling, using LCA, is starting to take off, as shown by recent initiatives by retailers (Clare/Little 2011) and the labeling program set by the French government (ADEME 2011). France is developing policies that could make PCF compulsory from 2012, and AFNOR (2009a) has selected Life Cycle Assessment (LCA) as the standard method for calculations. The Food Working Group (GT1) of AFNOR has also mentioned lately that other indicators should be added to labels. Those indicators, besides carbon, should be biodiversity, ecotoxicity and water use/footprint, for example. A correct indicator for each impact is also under discussion (AFNOR 2009a). The packaging working group, on the other hand, proposes to follow ILCD handbook indications (JRC 2010) and CML indicators (AFNOR 2009b).

As the true impact of food products and agricultural practices measured in PCF is increasingly disclosed in labels or otherwise, consumers become empowered to make informed choices. Sustainability may become as important as ensuring nutritional balances. This is a new reality to which companies must, sooner or later, adapt.

Still, while product labeling has its strengths, there is still a long way before it becomes a widely accepted and recognizable reality. Experience with nutritional labels has been positive (Drichoutis 2006). Labels inform and educate consumers. However, some authors argue that the message is hard to come through. There is not even a clear picture of how nutritional idea should be displayed.

---

<sup>1</sup> Ecoeff, 2 à 20 avenue Salvador Allende, 93106 Montreuil, France.

<sup>2</sup> Bluehorse Associates, 12 rue Soyer, 92200 Neuilly-sur-Seine, France.

email: ricardo.teixeira@bluehorseassociates.com, Internet: [http:// http://www.bluehorseassociates.com/](http://http://www.bluehorseassociates.com/).

For example, Hagen (2010) uses information and behavioral economics to argue that a “traffic light” model, displaying red, yellow, and green lights to depict nutrient levels in a particular food group, is more advantageous than explicitly indicating daily values for each dietary component (e.g. calories, protein), without using any type of color code. Even though the author admits that existing studies do not prove which approach is better at promoting healthy purchasing habits, in most cases it holds that consumers are only able to assimilate a limited amount of information when making purchase decisions. For that reason, in order to have a direct impact even in consumers who are not interested in dietary information, the code acts like a subconscious device leading distracted consumers to the “right” option.

This idea is, however, hard to transpose to environmental labeling. The “traffic light” approach implies a pre-existing definition of what is high, medium and low impact per product. It is unclear how that could happen. The approach of showing “traffic lights” in products in relation to other products in the same sector would also be controversial – it could commercially favor certain products over others (even though that could ignite competition and environmental improvements in “red light” products). As for showing absolute numbers, that could be even less informing than in the case of nutrition – for nutrition there is the reference daily intake, for which there is no consensual equivalent in environmental indicators.

Besides, many authors cast doubt on whether mainstream consumers would change consumption habits due to environmental information. Borin and Cerf (2011) quote Bouds (2009) while referring “the increasing confusion among consumers about the veracity of green marketing promises”. They found that “consumer perception of product quality, value, and purchase intentions does not differ significantly between products with positive environmental messages and those without any message”, except when explanation as to why one product has a lower impact than another is clearly presented. This is, however, contradictory with Hagen’s (2010) idea that consumers can take up limited information when purchasing.

Nevertheless, it should be referred that the objective of eco-labeling is not only allow consumers to make informed choices. As hinted by Czarnezki (2011), it is expected that, if and when consumers shift their consumption choices, the norms of food production will then incorporate those preferences. Or, an equivalent formulation of the idea, companies will adapt to the labeling scheme and, so that they do not lose market share, they will also change their production methods.

It is this idea that we explore in the present paper. The proliferation of many schemes and methodologies is still a threat to underpinning the right metrics to be involved in compulsory labels, and there is still dispute as to which type of label enhances consumer awareness the most (if any). But there is another side to labeling efforts – inducing best environmental practices in producers. While that is not yet done via labeling, it can be done by using the exact same tool that provides data for labels. It turns out that PCF and LCA can be very useful to companies even if they purely internal to companies, and are not communicated. LCA provides insight on life cycle management, and if integrated early in product design it can be a managing tool instead of metrics.

In this paper, we propose that, while the focus of PCF has been reporting, communicating impacts should only be a last stage of applying LCA to PCF. LCA can and should, first and foremost, be used by companies to optimize environmentally and economically their processing chain. When a scheme is put into practice to externalize the results of companies’ efforts, they will be better prepared to face the challenge.

Next we tackle the issue of why environmental impacts and life cycle costs are closely related. Then, we discuss how companies can both reduce impacts and increase revenue using PCF, and which IT tools to use. Finally, we present an example to illustrate this point.

## 2. PCF as a management and eco-design tool

As we mention in the Introduction, product environmental footprint, and particularly PCF, will be likely driving agri-food companies' sustainable business strategy in the future. To discuss how companies can meet this challenge using PCF/LCA for internal purposes, next we discuss the following issues:

- Why companies should internalize environmental impacts in their production chain optimization;
- How companies can use sustainability to drive profit;
- Who, or which types of companies should advance more rapidly in this procedure;
- Where should sustainable action be focused (in which life cycle stage);
- Example of application by a food company.

In this discussion, we present the experience gathered by Bluehorse Associates, a sustainability metrics company, while working together with Carbonostics users. Carbonostics is a lifecycle management tool designed to pinpoint the hotspots of any food product or menu along three key criteria: cost + carbon + nutrition, and it was developed by Bluehorse Associates.

### 2.1 Why agri-food companies?

PCF is particularly important for food and agriculture companies, since food products have high impacts throughout their lifecycle, and particularly during the agricultural stage. The connection between the food and agriculture sector and climate change is twofold. On the one hand, food products have one of the largest shares in carbon emissions (Tukker 2005). On the other hand, primary production sectors feel the effects of climate change before any others, in price and availability of inputs, in soil and water quality, and in yields (Friedrich/Scanlon 2008). For this reason, in the agri-food sector, environmental assets work like production factors.

However, completing PCFs and taking action may be expensive for companies, and end up being seen as a liability.

First, assessing the impacts of products can be time and resource consuming. LCA, the most suited method to calculate impacts over the whole life cycle of the product, can take months just to collect the data required. Most available tools for LCA are also costly and hard to use. Due to the complexity of the life cycles, with multiple inputs and high variability on outputs due to external conditions (e.g. grain yield), the agri-food sector is one of the most challenging for LCA practitioners. There are many products to analyze, conflicting methodologies, and mostly a sense that collecting primary data is difficult and very time-consuming (Teixeira/Pax 2011).

Second, the most common strategies to reduce the footprint (after calculations are done) may increase production costs. Food and agriculture companies are oftentimes SMEs who deal with low margins, and cannot afford to squeeze profits. Reducing the footprint of products can, thus, be costly, if it is done only for marketing purposes.

This threat can, however, be turned into an opportunity if companies use LCA to turn the issue of sustainability around. Instead of being a cost-inducing burden, sustainability can be a profit-driving business. To this end, companies must make changes and adaptations to their business model that yield positive environmental results before any regulations force them to.

While this conclusion is already understood by most food companies, who know why they should do it, there is still confusion on how to do it. That is our next topic.

### 2.2 How is sustainability better used?

As we mentioned in the Introduction, compulsory labeling for food products and enhanced regulations for producers are an inevitable trend. While most companies prefer to stand and wait, it is possible to move

early and collect the benefits now. In order to do so, the challenges identified previously must be met. Namely, companies must know how to turn PCF into a management tool, thus using sustainability for purposes beyond marketing.

In order to do so, companies must begin by choosing a method for calculations. While a standard unified method is still lacking (it will hopefully be the last stage of the labeling program in France, for example), each company must turn to solutions on the market. Many methods and IT tools are available for PCF/LCA, but there are several methodological doubts (choose simplified LCA or fully ISO-compliant methods) and questions on data (how much primary data to use, quality of secondary data). LCA/PCF tools that are fully compliant with ISO standards are more costly (in time and resources), but more suited for reporting. ISO-compliant tools can be very complex and LCA work is usually outsourced if there is no in-house LCA expertise. Simplified tools provide insights to improve management more efficiently. If well chosen, some may be used in-house even if previous expertise is absent.

For this reason, a compromise solution is for companies without LCA experience in LCA and/or short in resources (the majority in the sector) to start simple and begin by using screening tools. This is the first part of the iterative approach to LCA that is recommended by the ILCD Handbook (JRC 2010) and the British standard PAS 2050 (BSI 2008), among others. Screening tools provide insights on hotspots and chain management in a shorter time frame than full LCA tools, and so they can be integrated in the design of new products. LCA can thus become an eco-design tool – instead of making calculations downstream, which are mainly useful for reporting, since the formulas for established products are more rigid, if calculations are made upstream then they can be useful to develop sustainable products right from the start.

Many tools are available today that allow this (Teixeira et al 2011). An ideal tool should include more than one sustainability criterion (for example, PCF and life cycle costs). Multicriteria allow practitioners to make tradeoffs between traditional managing objectives (maximizing cost, creating healthy products) and new ones (decreasing PCF). That way, practitioners may run scenarios for different formulations of their products and come up with win-win options that decrease costs and improve revenue while at the same time emitting less carbon.

Then, as a second step, as companies begin to integrate LCA and eco-design in their production chain, so they can evolve to more complex tools and models (e.g. full-LCA tools, environmental multicriteria) that provide a full grip on their activities.

### **2.3 Who should integrate sustainability into management?**

Sustainability is often seen as either a big company business or a niche market. Companies capable of investing in sustainability, such as Danone or Nestlé, have turned to developing internal tools that meet their specific needs. But, as we already showed, all companies should and can integrate sustainability in their product design process.

There are three main reasons why this principle is true for SMEs and not only large companies. The first one has to do with regulations. Compulsory labeling will mainstream companies and SMEs to turn to sustainability as well. Larger companies with more resources can adapt more quickly to new regulations. SMEs, on the other hand, may find it difficult to immediately answer a mandatory PCF scheme if no previous work is done beforehand. So, simplified LCA can be, if nothing else, preventive. The second reason is commercial. First movers may get a commercial edge in a highly competitive market if they are perceived as being legitimately “green”. The third reason is operational. LCA can be used by SMEs to get a grip on cost and carbon hotspots throughout their product life cycles, thus empowering companies to make better choices when choosing suppliers or determining practices. SMEs have lower control over their supply chain than larger companies, so that adaptation can take longer, which is one more reason to start early and adopt PCF/LCA as management tools instead of just reporting instruments.

Again, it is important to stress that even smaller companies not only should but also can do this. Simplified tools and methodologies can overcome the first barriers, which are data availability and lack of expertise and resources. There is enough data available with the level of detail needed for this purpose (Teixeira 2011). There are also enough IT solutions (Teixeira et al 2011).

## 2.4 Where should companies act?

It could be argued that, even without making specific studies, companies can start simple by adopting some well-known sustainability measures. However, that comes at a risk of inefficiently misusing resources. It is important that measures tackle hotspots and not the life cycle stages with lower environmental impacts. The reason why PCF is so important is that companies often assume that their hotspots are packaging and/or energy use because those are hot topics, when for food companies it is often the production of ingredients that carries most of the burden. This is true for PCF and even more in other environmental indicators such as biodiversity or water use/footprint.

As noticed by Himeno (2011), packaging is “often treated as a stand-alone product” instead of part of the food product system, i.e. disregarding its functions to “protect and to distribute the product and to educate and inform consumers”. In fact, “without packaging food turns bad, fragile products may get broken, distribution becomes hazardous, and the entire supply chain becomes inefficient”. Sustainable packaging design should also decrease the total environmental impact of packaged goods. Packaging eco-design optimizes food preservation and reduces food waste by creating the optimal sized and shaped pack for each product (Himeno 2011).

Since the impact of ingredients is often higher than that of packaging products, decreasing food wastes may be more efficient than optimizing packaging materials. Some of the waste is unavoidable (e.g. chicken bones, potato peel, egg shell) and some is reused as a by-product (e.g. for animal feed and pet food or to produce energy or fertilizers). But another fraction of waste is partially or totally avoidable (e.g. confusion on use-by dates, food thrown away at home and in restaurants). At the manufacturing stage, food waste was estimated at almost 35 million tons per year in the EU27 (70kg per capita) (Himeno, 2011). It is clear that LCA can help companies decrease wastes in the food chain.

Sourcing locally, which is another example, is also oftentimes referred as having environmental benefits because it saves shipping. This would be true if the comparison is between two products with similar production methods (as we will see in our example). It is not necessarily true if the comparison is between, for example, an ingredient shipped from overseas that was produced following integrated production norms and a local ingredient produced with highly intensive techniques. In that case, the impacts of the two products and the distance and means of transportation must be assessed case by case.

As a general procedure, it is important to eliminate all assumptions. Each company should attend to its own specific case, and take action based on PCFs done internally, not common practice. Only specific PCFs can show where hotspots are and which measures are more efficient.

## 2.5 Example

In this section, we present an illustration of what we mentioned before. In this example, different improvement scenarios were studied for an undisclosed agri-food company, namely a juice producing company. The study was done by Ecoeff, a LCA and eco-design consultancy in France.

This study follows a life cycle thinking logic. LCA were performed on four products, and the CO<sub>2</sub> emissions of four business units of the company (in France, Belgium and Spain) were also determined by LCA. Crosstalk of both series of results gives a clear idea of important impacts and draws the improve-

ment path for the company. This study included more environmental indicators, but here we show results for PCF.

Some results are shown in Table 1. Four of the examples studied to improve the environmental performance of the juice sector were:

- 10-20% of primary packaging reduction;
- 15-20% of sugar reduction;
- 90% of local ingredients in the recipe;
- 12% of renewable energy use.

Combining these four improvements (named “combined scenario” in Table 1), we obtain a general decrease of 4-11% in all impacts. Note that for each of the business units at least one measure is not possible. The impacts of reducing 15-20% of primary packaging decreased overall impacts by 5 to 16% less than reducing sugar or sourcing locally. This means that changes in the recipe have a higher potential for improvement than changes in packaging, which also underscores how important it is to start doing LCA at product design level.

Nevertheless, the first three of these strategies are cost-reducing as well, and so they are win-win sustainability measures. A simplified assessment of PCF for these products would enable a similar company to obtain business value from LCA.

| Product     | GWP100 reduction in different improvement scenarios |                           |                       |                      |                   |
|-------------|---|---------------------------|-----------------------|----------------------|-------------------|
|             | 10-20% of primary packaging reduction               | 15-20% of sugar reduction | 90% local ingredients | 12% renewable energy | Combined scenario |
| A (France)  | +   | +                         | +                     | ND                   | 11% reduction     |
| B (France)  | +   | +                         | ND                    | ND                   | 4% reduction      |
| C (Belgium) | +   | +                         | NA                    | ND                   | 8% reduction      |
| B (Spain)   | +   | NA                        | NA                    | +                    | 9% reduction      |

Table 1

Global Warming Potential (GWP100) reductions obtained in the different improvement scenarios studied, relative to current production scenario

+: environmentally positive impact (emissions reduction in GWP100 indicator in relation to current scenario)

NA: not applicable

ND: not determined.

### 3. Conclusions

In this paper, we discussed how PCF and LCA can be used by companies in the agri-food sector to integrate sustainability, through LCA and PCF, into their day-to-day operations. While the environmental impacts of agriculture are relatively high, it is also the sector where the effects of environmental degradation are directly felt.

The present increase in PCF and product-level LCA, while motivated by political pressure and retailer initiatives, can be turned into an opportunity instead of a burden, particularly by food and agriculture SMEs deal with low margins, and cannot afford to squeeze profits. Even though product labelling will very likely become compulsory, results from PCF studies can and should be used by companies to find

opportunities for cost-savings and environmental improvements that will ultimately benefit the company. There is enough data and IT to do this efficiently even when companies do not possess in-house expertise, by employing simplified screening tools for a start. Instead of echoing assumption on where hotspots lie in the supply chain, simple PCF studies can easily pinpoint specific win-win measures.

In this paper we show precisely one of those cases. In a study done by Ecoeff for a juice company, the combined effect of three cost-saving improvements (20% primary packaging reduction, 20% sugar reduction, use of 90% local ingredients, use of 12% renewable energy) was responsible for 4-11% of the current environmental impact of the product. Most of those optimization measures also saved costs and decreased waste.

France is now undergoing an experimentation period that may culminate with a policy to make PCF compulsory from 2012. AFNOR Groupe, a French standardization organization, has selected multi-indicator LCA as the standard method for this type of calculation. Examples such as this study will help shape future developments, but as most practitioners recognize today, insights and management improvements that companies can draw from LCA studies are, at the moment, more important than reporting final absolute results.

Throughout the study, it became clear that the main challenge for companies and consultants or IT solutions suppliers, is to catch the right impacts (what to measure besides carbon, and how to measure it), and to create simplified but accurate tools that overcome the limited resources that companies have.

## Bibliography

- ADEME (2011): Affichage environnemental des produits de grande consommation ("Environmental labeling of large consumption products", in English), available from: <http://affichage-environnemental.afnor.org/> (accessed 16.04.11)
- AFNOR (2009a): Affichage environnemental - GT1 N009 (2009-05-29), Paris
- AFNOR (2009b) Affichage environnemental – GT Emballage N004 (2009-01-26), Paris
- Borin, N. and Cerf, D.C. (2011): Consumer effects of environmental impact in product labeling, *Journal of Consumer Marketing*, No. 28/1, pp. 76–86
- Bounds, G. (2009): As eco-seals proliferate, so do doubts, *Wall Street Journal*, April 2, p. D1
- Bluehorse Associates (2011): Carbonostics v2.5, Paris, available at: <http://www.carbonostics.com/>
- BSI (2008): PAS 2050:2008 Specification for the assessment of the life cycle greenhouse gas emissions of goods and services, British Standards Institution, London
- Clare, H. and Little, M. (2011): Breaking the link between consumption and emissions: improving corporate environmental performance through carbon footprinting, *Proceedings of the 17th SETAC Europe LCA Case Studies Symposium*, 28 February – 1 March, Budapest
- Czarnecki, J. (2011): The Future of Eco-Labeling: Organic, Carbon Footprint, and Environmental Life-Cycle Analysis, *Vermont Law School Legal Studies Research Paper Series*, Research Paper No. 11-01
- Drichoutis, A.C. et al (2006): Consumers' use of nutritional labels: a review of research studies and issues, *Academy of Marketing Science Review*, No. 9, pp. 1-26
- Friedrich, T. and Scanlon, K. (2008): *Managing Soil Carbon to Mitigate Climate Change: A Sound Investment in Ecosystem Services (A Framework for Action)*, Food and Agriculture Organization of the United Nations, Rome
- Hagen, K. (2010): *Nutritional Information: Traffic Light Labelling is the Best Way to Reach Consumers*, DIW Weekly Report No. 19.
- Himeno, A. (2011): *Food Waste and the Myth of Packaging Impact*, Bluehorse Associates, Paris, available from: <http://www.bluehorseassociates.com/>

- JRC (2010): ILCD Handbook: General guide for Life Cycle Assessment - Detailed guidance. Institute for Environment and Sustainability, Joint Research Centre, European Commission, Ispra
- Teixeira, R. and Pax, S. (2011): An Update of the Life-cycle Assessment Practitioner Survey - Summary of General Results and Focus on the Agri-food Sector, submitted to: Journal of Industrial Ecology (currently under peer-review)
- Teixeira, R. (2011): Secondary databases for agri-food products LCA: How much detail is optimal?, in: Proceedings of the EnviroInfo 2011 Conference, Ispra
- Teixeira, R. et al (2011): A review of tools used for PCF and LCA in the agri-food sector, in: Proceedings of the EnviroInfo 2011 Conference, Ispra
- Tukker, A. et al (2005): Environmental impact of products (EIPRO): Analysis of the life cycle environmental impacts related to the total final consumption of the EU25, IPTS/ESTO, European Commission Joint Research Centre, Brussels