LCA methodology from analysis to actions: some Barilla's examples of improvement projects

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Abstract The life cycle approach is implemented by Barilla in the decision making process to identify processes requiring improvement in order to meet in-line sustainable business strategies. This work illustrated the main improvement projects that Barilla performed in its analyses of Life Cycle Assessment results relevant to dry durum wheat semolina pasta. Projects were undertaken for each phase, including the system boundaries (dry durum wheat pasta, milling, pasta production, packaging production, product transport and household cooking). Results obtained from each phase shall be used to improve processes management along the product chain. An example of improvement action concerns the updating of crop guidelines in relevance to the need of greater sustainability of durum wheat cultivation.

1 Introduction

Barilla's development policy strongly pursues the research of business strategy closely linked to sustainability, measuring continual improvements in the areas of environmental footprinting, energy efficiency and water management by means of Key Performance Indicators (KPI).

Environmental related issues are examined through Life Cycle Assessment (LCA) methodology to evaluate each activity along the product chain.

These analyses have two aims: on one hand the identification of hot spots along the product chain with consequential improvement projects, on the other hand the integration of communication policies with reliable environmental information.

2 Life Cycle Assessment of dry durum wheat semolina pasta

One of the first analyses performed by Barilla focused on the evaluation of durum wheat pasta; and delved deeply into every phase of the entire chain (durum wheat cultivation, milling, pasta production, packaging production, product transport and household cooking).
A specific analysis was launched for each phase to identify actions able to improve activity management along the entire chain.
Results (see Figure 1) relevant to the durum wheat semolina pasta LCA were used in the Environmental Product Declaration (EPD) [1] following the scheme provided by the International EPD System [2]. the reliability of the environmental information is assured by a third-party verification.
The following paragraphs describe each phase at issue with relevant results in terms of environment and improvement management.

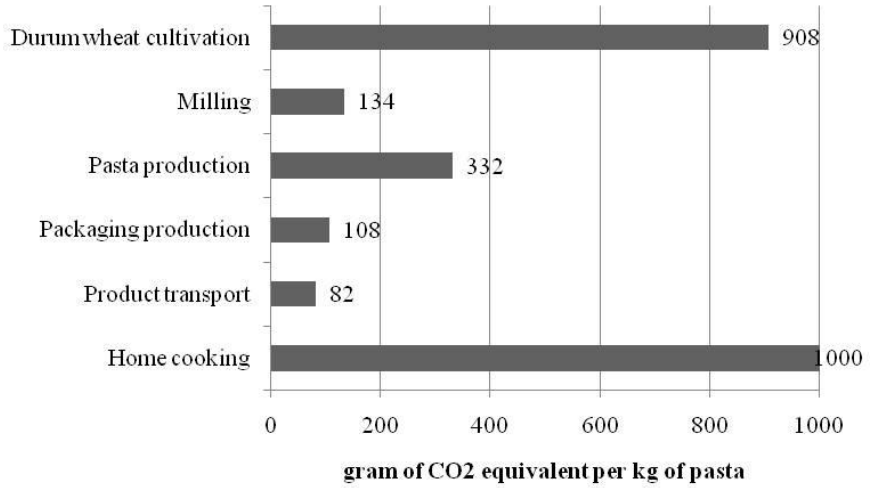

Fig.1: Greenhouse gases emissions of 1 kg of dry durum wheat semolina pasta (2008 data)

3 Durum wheat cultivation

Durum wheat cultivation, as reported in figure 1, is one of the phases that most contributes to pasta environmental performance. As a result, Barilla has launched a specific project for the implementation of more sustainable cropping systems for the production of the most important raw material in pats production: durum

wheat. The aim was to analyse and compare different cropping systems for durum wheat cultivation.

Several Mediterranean four-year crop rotation systems, which includes Durum wheat, were examined from a life cycle perspective; the systems analyzed are typical of different Italian regions.

The system boundaries include various fundamental elements: crop rotation, tillage activities, crop yields, fertilizer, herbicide and pesticide use; including relative emission to air and water.

Cropping system environmental performances were analyzed through LCA wiht several indicators in the form of Carbon Footprint, Water Footprint and Ecological Footprint. The results obtained were, finally, integrated with specific economic and agronomic indicators, in order to provide guidance on the "sustainability" and "feasibility" of the cropping systems analysed [3].

The parameters used to quantify the environmental indicators of the different cropping systems are divided into:

1) Environmental indicators: carbon footprint (CF), water footprint (WF), ecological footprint (EF);
2) Agronomic indicators: nitrogen index, DON (deoxynivalenol mycotoxin) index
3) Economic indicators: net income

Given the non-comparability of the various performance indicators and the complexity of results interpretation, an aggregated "scoring point system" was devised in order to identify the more sustainable crop systems considered by the study: the environmental results obtained from the LCA were combined with the agronomic and economic analysis to express the overall efficiency of the crop systems analysed.

Consideration of the results obtained by crop rotation comparison provides an estimate of predictable improvements achievable by implementing cropping systems characterized by greater sustainability and feasibility, a comparison was drawn between this system and a simplistic current real framework in terms of: carbon footprint reduction, net income increase, and farmland saving referred to Barilla's Durum wheat need per region[1] (Table 1).

Tab.1: Main improvements achievable with the implementation of the most sustainable and feasible cropping systems compared to a simplified current real framework for each area

[1] 26% comes from Northern Italy, 38% from Central Italy, 15% from Southern Italy and the remaining 21% from France, USA, Canada, Mexico, Turkey, Spain, Greece, Australia (Data 2008)

AREA (Barilla's 2008 supply	Current most diffused situation	Alternative cropping system	Predictable improvements			
			Indicator	UF	Referred to 1 t of Durum Wheat	Referred to 4 year rotation 1 ha
North Italy (26%)	Industrial (Hi) (Soy, Durum wheat, Maize, Wheat)	Dive(Soy, durum wheat, rapeseed, maize)	Carbon footprint	Kg CO2eq	-90	-3,570
			Net Income	€	28	1.420
			Farmland	ha	0	n.a.
Centre Italy (38%)	Cereals (Hi) (3 years of Durum wheat, Sorghum)	Proteic (Li) (Proteic pea, Durum wheat)	Carbon footprint	Kg CO2eq	-390	-3,670
			Net Income	€	116	1.120
			Farmland	ha	0	n.a.
South Italy (15%)	One-crop (durum wheat)	Fodder (Li) (Oats and Vetch, durum wheat)	Carbon footprint	Kg CO2eq	-270	-3,770
			Net Income	€	107	1.110
			Farmland	ha	-0,1	n.a.

The aggregated analysis led to the identification of the Durum wheat crop systems that showed greater sustainability in comparison with the scenarios most commonly diffused.

Possible improvements over the current situation in Northern Italy are not significant; and investments for this area are not justified. Forecast improvements over the most widespread cropping methods in Central Italy may yield excellent results, while Southern Italy may be stage to environmental and economic benefits; however, Barilla currently purchases only 15% of its Durum wheat from this area.

Lastly, the study demonstrates that “sustainability” is a feasible concept that finds solid application in the agricultural sector: the best durum wheat crop systems identified demonstrate that agronomic and environmental improvements can lead to an increase in a farmer's net income.

3.1 Milling and pasta production

The milling and pasta production phases lend minor contributions to environmental performance when compared to durum wheat cultivation. Despite this fact, a series of energy saving projects have been performed (electronic

control system for the boilers, installation of Oil Free variable rate compressor, the partial replacement with high efficiency motors).
Aside from the projects mentioned above, two of the three Italian pasta plants have adopted cogeneration/trigeneration power generation.
The Pedrignano[2] cogeneration plant began full-capacity operation in February 2009; and construction of the trigeneration plant in the Caserta[3] factory was completed in July 2009.
The cogeneration plant gave rise to a 13% reduction compared to 2008 in GWP emissions per unit of finished product at the Pedrignano factory.

3.2 Packaging production

Environmental performance of packaging production does not have a strong impact along the whole pasta chain. Regardless of this fact, the LCA approach was also applied to packaging materials in order to first check their environmental performance and then compare alternatives on an equi-functional basis.
According to the huge amount of information available over years, Barilla's focus shifted from ex-post analyses to further focus on a dynamic approach which allowed preliminary comparison of packaging alternatives. The general concept revolved around the availability of a restricted set of LCA indicators for each material and process at issue in order to preliminarily pinpoint the environmental benefits of innovative solutions, which will later be fully illustrated through specific data collection and LCA.
In pursuit of the goal, a first LCA calculation tool was developed in 2004 and then refined and enhanced with more specific data as it became available (continuously collected).
The tool makes use of a database accredited through the Barilla EPD system[4].
Packaging materials data is available with a set of predefined processes for shaping and coupling in order to best define the current system, which also includes supply transport. A specific feature also allows an ad hoc analysis of the benefits related to more efficient storage procedures onboard delivery vehicles.

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[2] Pedrignano is Barilla headquarter in Italy, it comprises a durum wheat mill and a pasta plant

[3] Caserta is one of Barilla's Italian pasta plants, along with Pedrignano and Foggia

[4] During 2010 year, Barilla implemented and certified the EPD Process System with the aim to certify and publish in an easy and reliable way the LCA results of most of its products. For more information see www.environdec.com.

One of the first examples of calculation tool application is the preliminary evaluation of environmental burdens concerning two solutions of spaghetti packaging: cardboard box versus flowpack.
Results are based on a cradle-to-gate approach; and comparison is made in relation to the quantity of material necessary for 1 kg of packaged pasta. System boundaries account for: primary packaging material production, tertiary packaging material production, shaping process for tertiary material and ancillary materials.
Results are expressed in terms of carbon footprint, water footprint and ecological footprint. The main highlights of this application are the following:

- the flowpack has a higher environmental burden per kg of packaging produced if compared with cardboard boxes
- the flowpack burden related to 1 kg of spaghetti is lower than that of cardboard boxes for all indicators analysed (-3% carbon footprint; -46% water footprint and -28% ecological footprint) because the flowpack has a lower mass (-84%) compared to the box.

4 Product transport

A project has been launched to evaluate the environmental performances of the logistic network. The goals of the project are the following:

1) Individuation and analysis of a series of Key Performance Indicators (KPI) related to transport activities and to warehouse used for the product storage before its transport to final customer
2) Evaluation of logistic improvement projects performed from 2006 to now from an environmental point of view

The project is still operative and preliminary results are summarized as follows:

1) Transport emissions have decreased since 2008 thanks to the annual replacement of old vehicles;
2) Emissions per kilogram of product transported have decreased since 2008 to 2010 thanks to an increase in transport efficiency (e.g. optimization of vehicle saturation);
3) Projects for the improvement of the logistic network have contributed to reduce emissions of carbon dioxide equivalent; an example of such project implemented for a specific route has saved 800 tons of carbon dioxide equivalent

4.1 Household cooking phase

Like durum wheat cultivation, the household cooking phase also contributes to environmental performances. This fact has prompted Barilla to carry out a project aimed at reducing the amount of water required to cook pasta, while keeping quality standards untouched.

Initial results reported in Figure 1 (1,000 grams of carbon dioxide equivalent per 1 kg of pasta) are updated in the latest issue of the EPD (data relevant to 2009) accounting for the hypotheses based in the ongoing project [4].

The LCA indicator monitored in this type of projects is the carbon dioxide equivalent emissions (Global Warming Potential - GWP_{100}).

The main hypotheses considered are the following:

- household cooking could adopt gas or electrical ranges; in the case of power, the GWP varies per country producing site-specific results (see figure 2);
- quantity of water recommended per 100 grams of pasta: 1 litre;
- evaluation of necessary energy is made independent from energy required to heat a specific pot.

Preliminary results (figure 2) reveal that using less water prevents a certain quantity of carbon dioxide equivalent; for example, using 0.5 litres of water (instead of 1 litre) per 100 grams of pasta prevents about 30 grams of carbon dioxide equivalent.

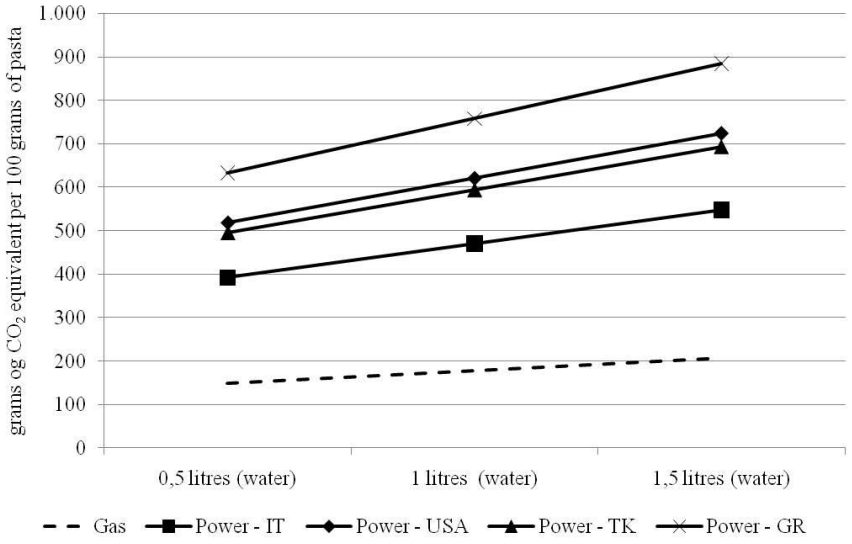

Fig.2: GWP_{100} of 100 grams of pasta cooked at home with different quantities of water (0.5 - 1 - 1.5 litres) using different types of energy mix

5 Conclusion

In its definition of improvement programs, Barilla also accounts for results of LCA evaluation. The company aims to improve both process management and environmental performances of the whole chain.
The next update of the crop guidelines, suggested by Barilla, shall also implement the qualitative results of the cropping system project, given that these findings should be tested and confirmed through in-field experimentations.
Cogeneration plants and energy saving projects allow Barilla to improve its environmental performance and cut expenses.
The use of a calculation tool to determine the environmental performances of packaging materials permits the preliminary identification of environmental benefits linked to innovative solutions, which shall undergo extensive analysis for future implementation.
The project concerning product transport will help optimize the logistic network through the use of specific KPI.
Lastly, the household cooking phase is not directly controlled by Barilla, rather it depends on consumer behaviour. Barilla could provide cooking recommendations that exploit project results through informative campaigns.

6 References

[1] Barilla, *Environmental Product Declaration of dry durum wheat semolina pasta*, 19/08/2009.

[2] International EPD Consortium, *General Program Instructions (EPD)*, ver.1 of 29/02/2008.

[3] Luca Ruini, Paolo Cabrini, Roberto Ranieri, Fabrizio Boeri, Marco Montani, Pierluigi Meriggi, *Economic, Agronomic and Environmental integrated analysis of durum wheat cultivation cropping system*, LCA food 2010 proceedings, Volume 1.

[4] Barilla, *Environmental Product Declaration of durum wheat semolina dried pasta (brand Barilla)*, available at http://www.environdec.com/en/Detail/?Epd=7699, 10/03/2011.