

Sustainability analysis of a bean stew using Environmental LCA and Life Cycle Cost Assessment

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Abstract

This investigation aims to investigate the sustainability of an industrially produced bean stew, as a representative example of the ready-made food industry. The analysis covers the environmental and economic dimensions of the products, which were evaluated using Life Cycle Assessment (LCA) and Life Cycle Costing (LCC), respectively. Key results have shown that most of the environmental impacts and economic costs of this product are attributable to the ingredients, primarily those of animal origin.

Keywords: LCA, LCC, cooked food, sustainability, bean stew

1. Introduction

Due to consumer demand and pressure from public administrations, the food, agriculture and farming sectors are increasingly interested to show that their products are sustainable (EC, 2018; Fusi et al., 2016, Zufia, 2008). This means not only the manufacturing stage but also the production of raw materials and ingredients, packaging, transport and distribution, etc. This paper describes an investigation into the life cycle sustainability of an industrially produced bean stew.

2. Methods

Goal and scope: the aim of this study is to evaluate the environmental and economic performance of an industrially produced ready-made food product (bean stew) using LCA and LCC. The methodological basis of both studies are based on ISO 14040-4:2006 while specific methodological decisions were made considering Product Category Rule UN CPC 23995 for sauces, mixed condiments and mustard (Environdec, 2018). The product investigated is a bean stew (commercial name Fabada Asturiana) made and commercialized by a local producer in Asturias (Spain), who provided very complete specific material, energy and economic inventories for the product. The Functional Unit employed in the analysis was 1 kg of stew ready to eat by a final consumer. The life cycle of the product was structured in three phases: upstream (production of raw materials and ingredients, including packaging and transport), core (activities within the food plant, including packaging of final product) and downstream (distribution, retailing, consumption and

end-of-life of packaging material). The environmental impacts considered in the investigation include global warming, acidification, eutrophication and photochemical smog. Generic inventory data was obtained from ELCD, ecoinvent y Agri-food.

Inventory: Complete material and economic inventories were available for the ingredients, packaging, transport, distribution and food processing (including energy use, cleaning, waste materials, wastewater, equipment and infrastructures). The ingredients employed to produce one batch (800 kg) of stew include white beans (155 kg), salt cured pork belly (80 kg), blood sausage (40 kg), spicy sausage (40 kg), sunflower oil (3 kg), potato starch (8 kg), salt (1 kg), spices (curcuma, white pepper, sweet paprika, paprika oleoresin, saffron) (0.61 kg), all this topped up with water (472 kg).

Impact assessment: the environmental impact assessment methodology was ILCD 2011 Midpoint +v1.10. To be consistent with the environmental assessment, no discount rate was used in the LCC.

3. Interpretation of results

As shown in **Table 1**, the bean stew caused a carbon footprint of 2.87 kg CO₂ eq/FU and its life cycle costing was estimated at 2.11 €/FU. Most of the impact in the category of global warming (62.5 %) was attributable to the core stage (production, processing, packing and transport of ingredients). The ingredients dominates impact generation on most other environmental (54.2 % photochemical smog, 87.2 % acidification, 94.0 % eutrophication) and economic (42.2 %) categories. This is so primarily due to strong contribution from animal products (spicy sausage, blood sausage and bacon), as shown in **Figure 2**. The life cycle phase referred to as *core*, which comprises processes carried out within the food factory, contributed to 23.9 % of the carbon emissions and 32.2 % of the costs of the system. This is primarily attributable to the fabrication of the steel can and, to a lower extent, energy used (electricity and natural gas). The *downstream* life cycle phase, which comprises processes occurring once the product has left the food plant, is responsible for the remaining life cycle carbon emissions (13.61 %) and costs (25.7 %).

4. Conclusions

The environmental performance of an industrially produced bean stew is determined primarily by its ingredients, and more specifically by those of animal

origin (pork belly, blood sausage and spicy sausage). This trend is also evident, although less marked, in its life cycle economic performance.

Table 1. Characterized environmental and economic impacts of the bean stew (referred to 1 kg)

Impact category	Units	TOTAL	UPSTR	CORE	DOWNST.
Climate change	kg CO2 eq	2.88E+00	1.80E+00	6.86E-01	4.02E-01
Photochemical ozone formation	kg NMVOC eq	6.66E-03	3.59E-03	2.05E-03	1.02E-03
Acidification	molc H+ eq	3.84E-02	3.34E-02	3.66E-03	1.33E-03
Terrestrial eutrophication	molc N eq	1.50E-01	1.40E-01	5.45E-03	3.68E-03
Economic cost	€	2.1122	0.8904	0.6791	0.5425

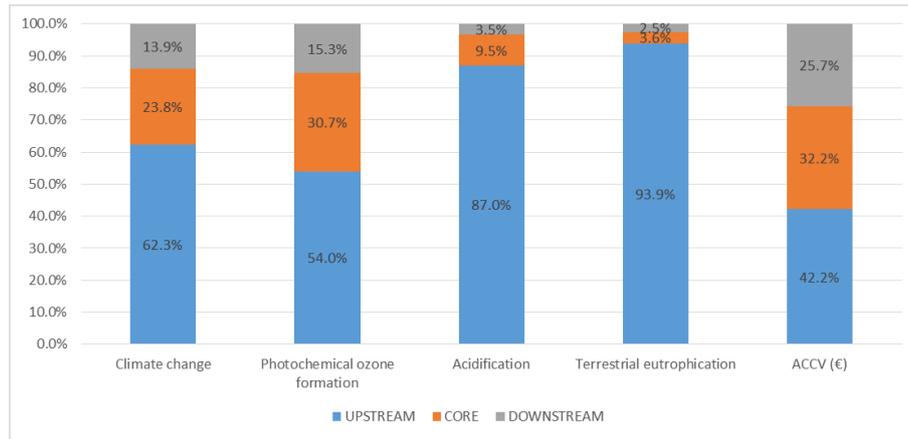


Figure 1. Distribution of characterized environmental and economic impacts among the life cycle stages of the bean stew

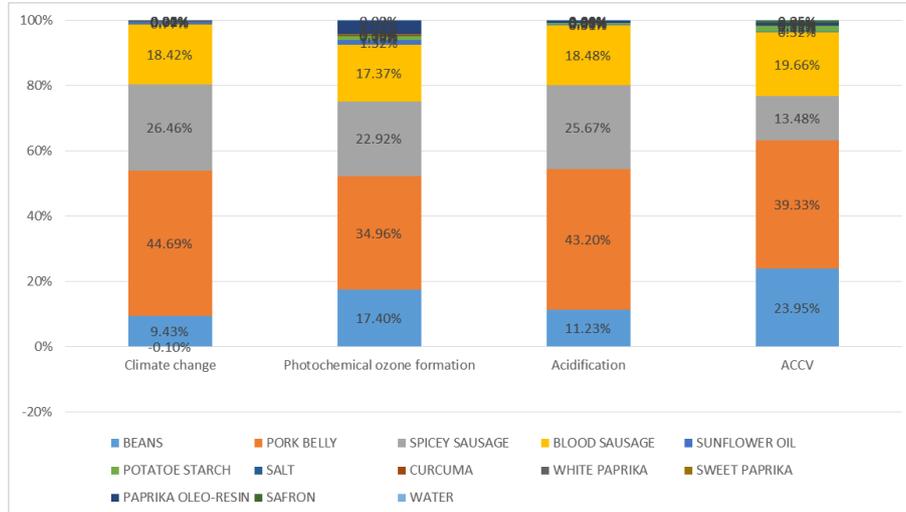


Figure 2. Contribution of ingredients to the environmental and economic cost of the bean stew

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