

# Preface

This book stems from a joint effort of some members of the Italian Network of LCA, who are particularly interested in Life Cycle Assessment (LCA) of agri-food product systems, with the aim of thoroughly and critically evaluating the state of the art of food LCA and its application to some particular food chains.

The Italian Network of LCA was launched in 2006 as an initiative of the “Italian National Agency for New Technologies, Energy and Sustainable Economic Development” (ENEA) with the aim of creating a network useful for the exchange, in Italy, of information, methodologies and good practices on the state-of-the art and on the prospects of the LCA methodology.

Six years later, during the VI Conference of the Italian Network of LCA hosted in Bari (Italy) in June 2012, a step forward was taken and the Network became a scientific Association founded by ENEA, the Politecnico di Milano, the Universities of Bari, Palermo, Chieti-Pescara, and Padova, and the “Interuniversity Consortium Chemical Reactivity and Catalysis (CIRCC)”. Nowadays, membership association is open to all physical persons interested in the promotion of the development of the LCA methodology within the Italian territory.

The main aims of the Association of the Italian Network of LCA are: promoting the exchange of information and good practices on the state-of-the art and prospects of LCA studies in Italy; promoting the dissemination of the LCA methodology at national level; stimulating the interaction between the parties that deal with LCA and encouraging the process of networking among various stakeholders for the implementation of projects at national and international level; finally, the Association supports the life-cycle approach and the LCA methodology among the institutional bodies. Among the Association’s activities, apart from the annual conference, are those of the information services (website, newsletter and mailing list) and of the “Working Groups” (WG).

In particular, along the years, nine WGs have been created: Food and Agri-industrial; Energy and Sustainable Technologies; Construction sector; Chemical products and processes; Tourist services; Management and waste treatment; Wood furniture; Automotive & Electric-Electronic; Development and Improvement of LCA methodology; Research and Exchange Board of experience (DIRE). Some of these WGs have been (and still are) involved in the definition of databases and methodological

approaches mostly applicable to the specificities of the Italian territory and economy.

As far as the “Food and Agri-industrial” WG is concerned, it was constituted in 2008 with the aim of increasing the specific knowledge regarding the application of the LCA methodology to the Italian food and agro-industrial sector and also with the aim of spreading its use for the improvement of the environmental performances of the involved supply chains. The WG is made up of five sub-working groups which study some of the most important food supply chains, namely wine, olive oil, cereals and derived products, meat and fruit.

Among the past activities developed by this WG, the LCAFood 2010– VII international conference on “Life Cycle Assessment in the Agri-food sector” (hosted in Bari in September 2010) is worthy of mention.

This book represents another challenge undertaken by the “Food and Agro-industrial” WG aiming at highlighting, in an as much as possible exhausting manner, environmental hotspots, methodological issues and best practices for the agri-food sector from a life cycle perspective. Its writing has involved several Life Cycle Assessment (LCA) researchers and practitioners (from both private and public Italian organisations) with the aim of creating some practical guidelines for the LCA community and the main actors of the agro-food chains (e.g. farmers, manufacturing companies, consumers, etc.). The book is focussed, in particular, on some of the most relevant and productive agri-food supply chains within the European context, namely: olive oil, wine, cereal and derived products, livestock and derived edible products, and fruit.

In fact, since the end of the 1990’s, researchers have scientifically highlighted the fact that most food chains are not sustainable from an environmental perspective due to the impacts occurring in different phases of their life cycle. So, in order to address these relevant issues, several European policies related to sustainable production and consumption began to be promoted with the aim, among others, of quantifying environmental performances of agri-food products. In particular, in 2003, the so-called Strategy for Sustainable Production and Consumption (SPC) was launched aiming at reducing the environmental, social, and economic impact of products and services throughout their entire life cycle. The concept of SPC can be applied to all the existing products sold and bought on the market and hence also to food and drink products. These products in particular play a fundamental role in the everyday life of consumers, whose demand for high quality food has increased in the last few years. In a similar manner to other products, their production and consumption (from farm to fork and end of life) have environmental implications; nevertheless, because of specific aspects related to health, nutrition, well-being, cultural identity, and lifestyle, they need to be considered and treated differently from all other products. In the same period, the Directorate General Joint Research Centre/Institute for Prospective Technology Studies (DG JRC/IPTS) launched a project called Environmental Impacts of Products (EIPRO) in an attempt to identify those products with the most relevant environmental impacts throughout their life cycle, from cradle to grave, taking into account the full food production and distribution chain from farm to fork. Among its results, the report, published in 2006,

highlighted that the food and drink sector accounts for 20–30 % of the environmental impact of private consumption. Subsequently, in 2007, the Strategic Research Agenda (SRA) (2007–2020) of the European Technology Platform (ETP) Food for Life was published defining sustainable food production as the most important challenge that facing the European food industry.

Sustainability tools and, in particular, LCA have been applied for more than 20 years to agricultural and food systems for finding more sustainable ways of food production and consumption and as a means of supporting environmental decision-making via the identification of the environmental impacts throughout the systems' life cycles.

One of the reasons for the growing consideration of the academic community for aspects regarding food LCA is the fact that methodological issues (for example, the definition of the functional unit, difficulties in data collection, pesticides and their exposure, fertiliser dispersion models, impact categories of land use and water use) are different from the typical ones arising from industrial product LCAs. Until now such topics have been tackled with many different approaches that do not represent standardised methods, hence much has to be done to build a consistent, practical and life cycle science based approach to product level sustainability information reporting for all food, beverage, and agriculture products.

This book has been written with the intention of contributing to the identification of practical recommendations to these still open key issues, adding value to the international discourse. It consists of six chapters.

The first chapter has been designed to be propaedeutic to the subsequent ones, providing the reader an as exhaustive as possible overview of the key concerns, applications, and methodological uncertainties of agri-food life cycle assessment (LCA). It comprises: a review of the main international initiatives, eco-labels and declarations, and footprints together with some of the most important LCA initiatives developed by the main stakeholders of the agri-food chains; a general synopsis of the main methodological issues strictly linked to the application of the LCA methodology to the agri-food sector; a state of the art of the major existing international LCI databases and of the national and international initiatives currently under development; finally, an overview of the main dietary issues in the sense that in the context of food sustainability the importance of consumer behaviour and, in particular, dietary behaviour is becoming increasingly recognised, together with the product and its production chain.

On the contrary, each of the other five chapters focuses deeply and critically on one of the chosen agri-food supply chains. Even if each one is developed in its own different way, they are built on a common framework consisting of:

- an as comprehensive as possible state-of-the art of all the international LCA case studies developed on a specific agri-food sector, which represents a building block and a starting point for the subsequent steps;
- the identification of the main environmental hotspots and of the still open methodological issues specifically related to each sector;

- a critical analysis of these key points for identifying and developing practical guidelines to overcome these issues.

These “lessons learnt” are intended to be a support for LCA practitioners and for all the involved stakeholders when developing an LCA study in the agri-food sector.

Specifically, regarding Chaps. 2–6:

- the second chapter focuses on the olive oil industry, one of the most significant sectors within the European Union. The related production process is characterised by a variety of different practices and techniques for both the agricultural and processing phases, causing several adverse effects on the environment. After a description of the international state of the art of LCA implementation in this specific sector, a brief description of other life cycle thinking methodologies and tools (such as simplified LCA, footprint labels and Environmental Product Declarations) is given by the authors. Then, the methodological problems connected with the application of LCA in the olive oil production sector are analysed in depth, starting from a critical comparative analysis of the applicative LCA case studies in the olive oil production supply chain. Finally, guidelines for the application of LCA in the olive oil production sector are proposed.
- the third chapter regards the wine sector; a critical review of LCA case studies is presented by the authors in order to compile a list of scientifically-sound environmental improvements suggested by published LCAs. Next it identifies: the critical environmental issues of wine production and the essential elements that an LCA case study in the sector should consider; optimal sets of indicators and methodologies for the evaluation of the environmental impacts of wine; finally, best practices for environmental improvement in the wine sector are presented;
- the fourth chapter is focussed on cereal and derived products, vital for the production of commodities of worldwide importance that entail particular environmental hot spots originating from their widespread use and from their particular nature. After a brief introduction to the sector and supply chain, the chapter reviews some of the current cereal-based life cycle thinking literature, with a particular emphasis on LCA. Next, an analysis of the LCA methodological issues emerging from the literature review is carried out. The following section discusses some practices and approaches that should be considered when performing cereal-based LCAs in order to achieve the best possible results. Conclusions are drawn in the final part of the chapter and some indications are given of the main hot spots in the cereal supply chain.
- the fifth chapter regards livestock and derived edible products; like the olive oil industry, it is one of the most significant sectors from an economic perspective in Europe representing more than 40% of the economic value of EU primary productions. This sector consists of a huge diversity of processes and techniques depending on the animal species and the final products. Because of these differences, livestock productions are associated with several adverse effects on the environment, especially in the breeding phases and feeding composition and management. In this chapter, after an overview of the structural and economic characteristics of the most significant livestock supply chain and its main

environmental problems, a description of the international state of the art of LCA implementations for livestock is given. Methodological problems connected with the application of LCA are investigated, starting with the critical analysis of international papers and the few Italian papers in the scientific literature. Finally, the best practices regarding LCA methodology implementation are proposed, in order to improve results and manage the methodological problems identified.

- finally, the sixth chapter focusses on fruit products, generally considered to be some of the less environmentally damaging foods in western diets. In fact studies investigating the carbon footprint of different food choices have reported that fruit is the category with the least environmental impact. However, these studies use data from environmental assessments of generic fruit production, which take no account of specific issues within orchard systems and fruit supply chains. Indeed, modern food production is very diverse, with high levels of specialisation and complexity. This chapter starts with an overview about the fruit industry in Europe and the main environmental burdens related to fruit production. Then, life cycle thinking methodologies and approaches in the sector are presented reporting a state of the art of international LCA practices and other life cycle methodologies and tools for product environmental assessment. Finally, based on the results of the critical analysis of international experiences, methodological problems concerned with the application of LCA to the sector are described and lessons learnt and practical guidelines are proposed.

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The Editors

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