State of the art of the Life Cycle Assessment (LCA) in the wine industry

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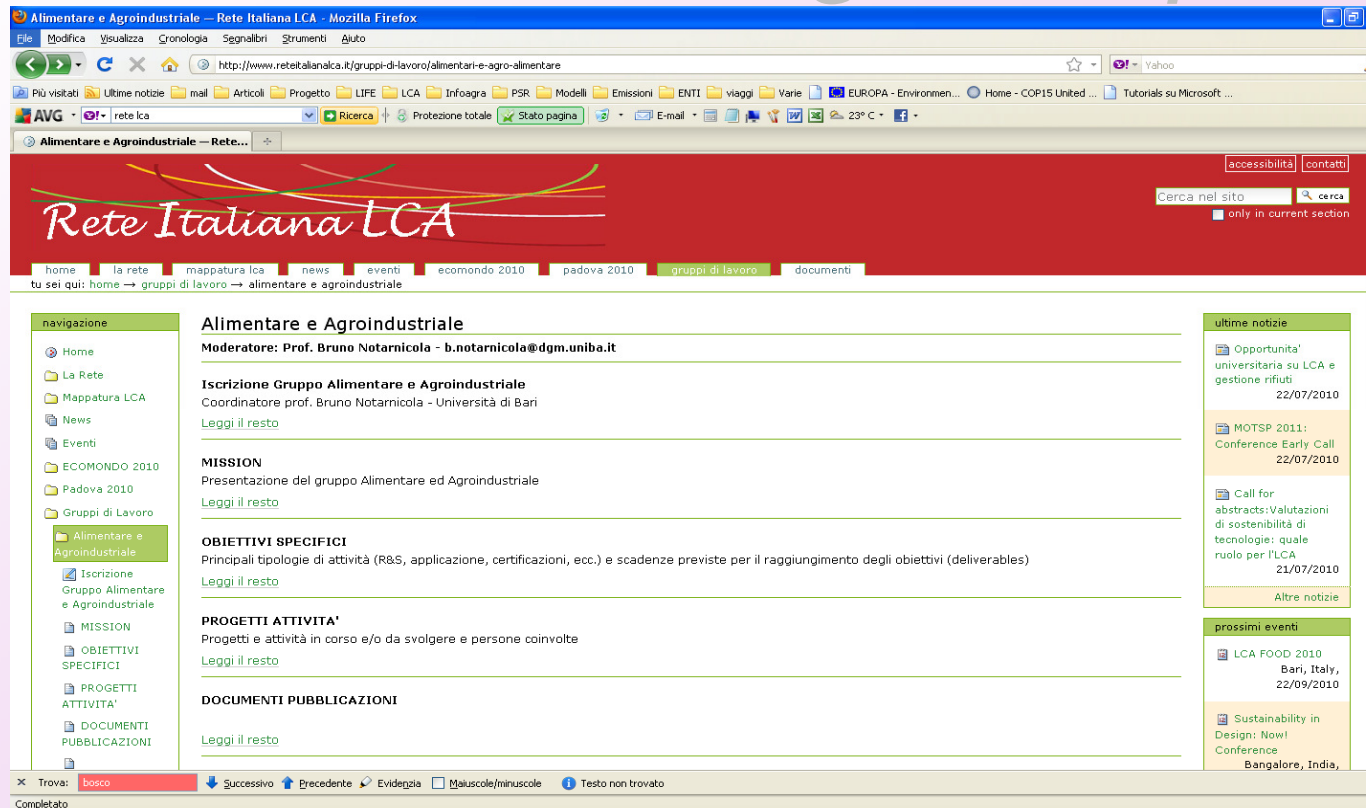[+] Land Lab – Scuola Superiore S. Anna, Pisa, Italy
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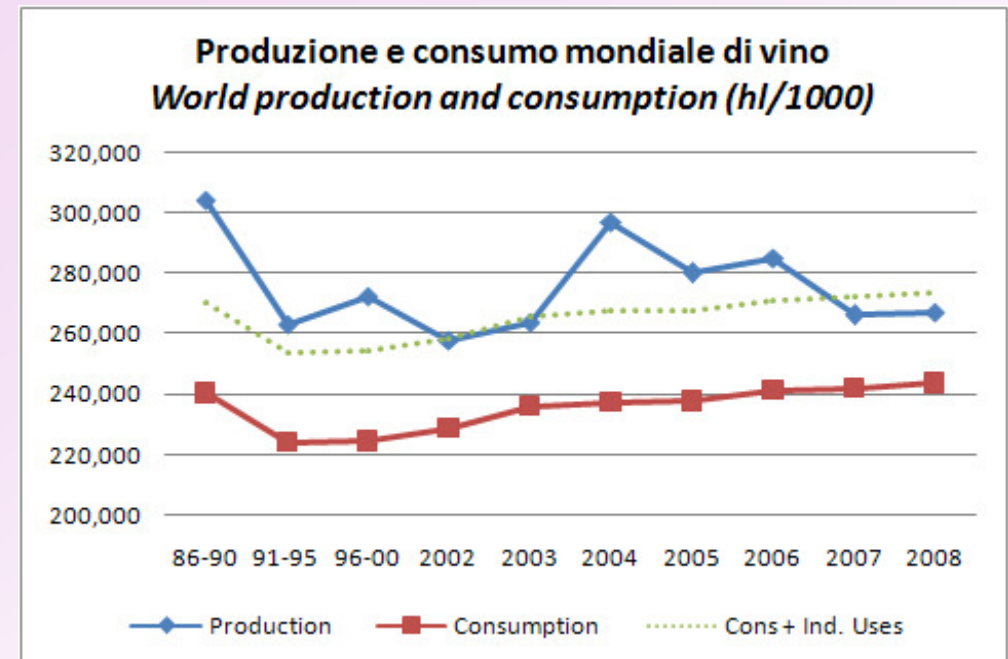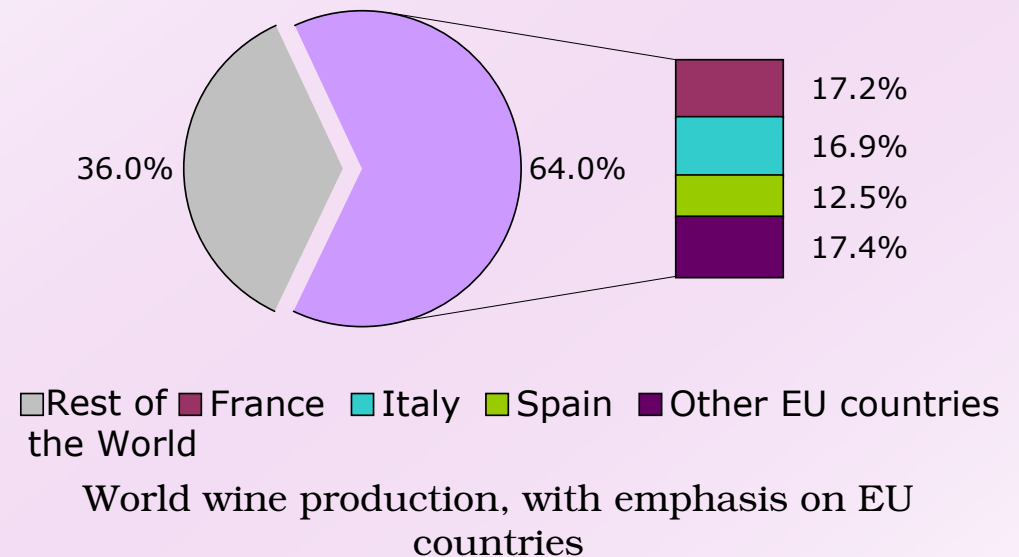
The Working Group

The **Agri-Food Working Group of the LCA Italian Network–Wine and Alcoholic Beverages Subgroup** works with the aim of contributing to:

🖰 identify the environmental critical points of the wine supply-chain and define the essential elements of an LCA study;
🖰 define an optimal set of indicators for the assessment of environmental impacts
🖰 guarantee comparability of results

Wine industry

- In 2008 world wine production was 27.27 Mt, mainly concentrated in Europe (64%).

36.0%   64.0%

17.2%
16.9%
12.5%
17.4%

☐ Rest of the World ■ France ☐ Italy ☐ Spain ■ Other EU countries

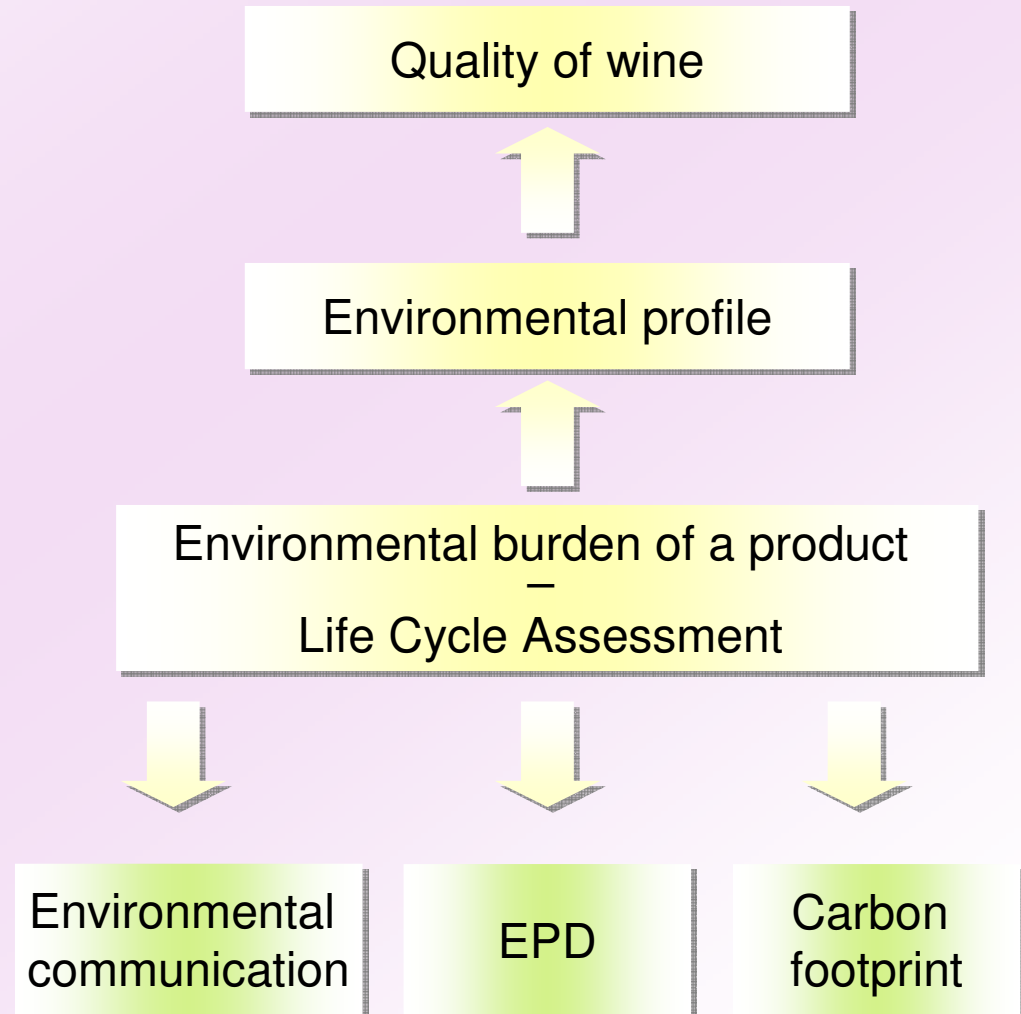World wine production, with emphasis on EU countries

The trend is towards reduced quantity but higher quality: over the last 25 years national wine production has almost halved while designations have more than doubled (FAO, 2008).

Produzione e consumo mondiale di vino
World production and consumption (hl/1000)

320,000
300,000
280,000
260,000
240,000
220,000
200,000

86-90 91-95 96-00 2002 2003 2004 2005 2006 2007 2008

—◆— Production   —■— Consumption   ·········· Cons + Ind. Uses

High quality and environmental profile

- The production trend in Italy is moving towards high quality wines
  - **41 DOCG** (controlled and guaranteed denomination of origin)
  - **36 DOC** (controlled denomination of origin)
 - **120 IGT** (typical geographical indication) wines.

Quality of wine

↑

Environmental profile

↑

Environmental burden of a product –
Life Cycle Assessment

↓   ↓   ↓

Environmental communication

EPD

Carbon footprint

The implementation of LCA to wine

◻ The implementation of LCA to wine industry has several problems common to all agri-food products.
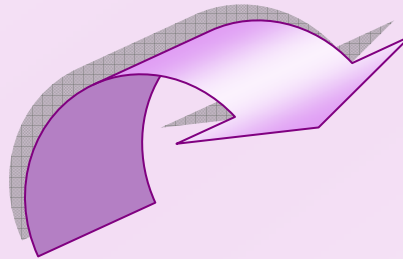
Major difficulties are due to the complexity of this activity where **technology** is as important as **grape quality** or **wine makers skills**.
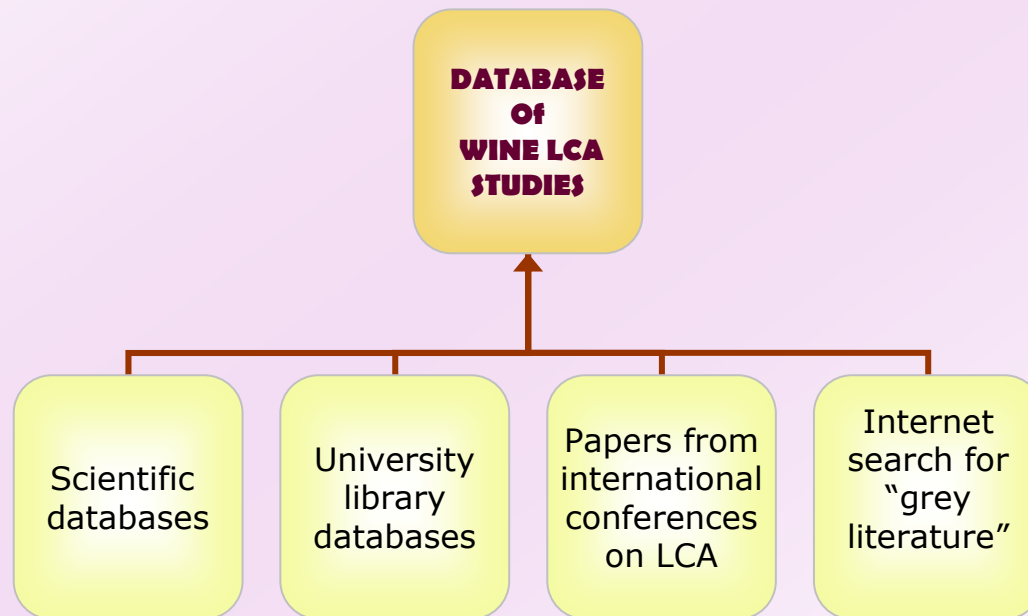
Aims of the study
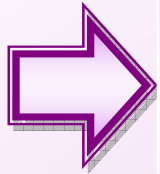
➢highlighting the crucial points of this methodology

➢assessing the need for specific guidelines for the wine industry.

Methodology

The bibliographic sources for database creation

Methodology

Wine and alcoholic beverages subgroup established in the framework of the Agri-Food work group of the Rete Italiana LCA (Italian LCA network)

Authors	Life-cycle-based methodology adopted	Year of the study	Geographic area of reference	Product considered	Distinguishing features of LCA applications in the field						
					Objectives	Functional unit	System boundaries	Data Origin	Environmental impact assessment method	Peculiarities and strong points	Limits and problems

Data sheet for the collection of the elements that characterise LCA studies in the wine-growing sector.
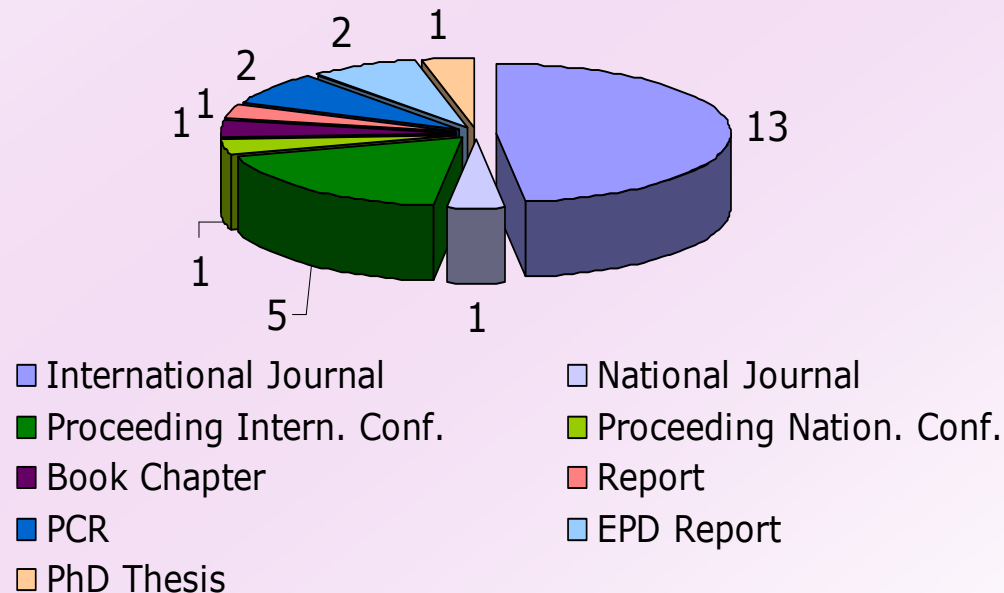
Results

27 LCA studies analysed

Product:

85% wine product | **15%** technical enhancement, Food basket including wine

Source:

Legend:
- ☐ International Journal
- ☐ National Journal
- ☐ Proceeding Intern. Conf.
- ☐ Proceeding Nation. Conf.
- ☐ Book Chapter
- ☐ Report
- ☐ PCR
- ☐ EPD Report
- ☐ PhD Thesis

The works found cover the last decade, specially last years (2008-2009 ~ 60%).

Results

Objectives

- identification of the environmental burdens and the assessment of the potential environmental impact
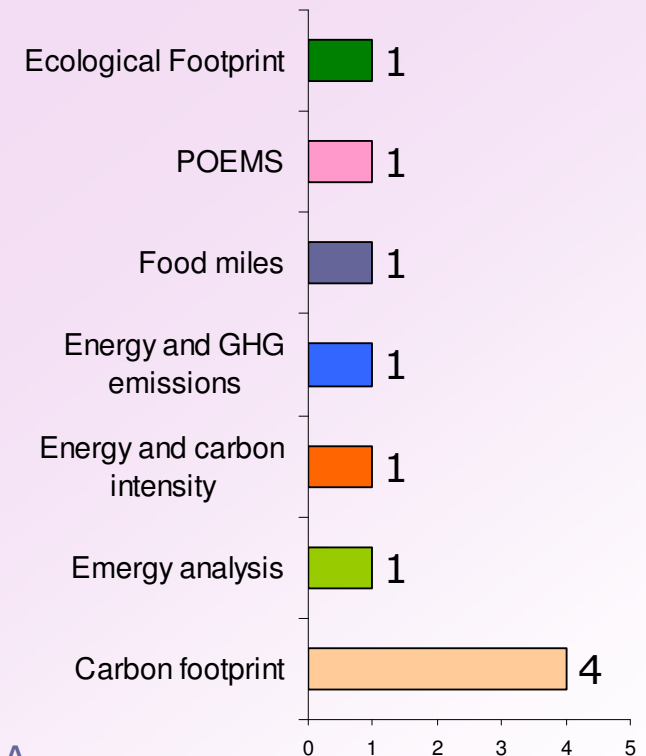
LCA Methodology

- 23 works are case studies and 4 are business related studies.
  - 11 Standard LCAs with explicit reference to ISO 14040
  - 21/27 works a full impact assessment was not performed
  - **other tools** related to LCA utilized

Geographic area of reference

- 3 studies in Italy
- At international level: Spain, France, England, Canada, USA and Australia

OTHER TOOLS RELATED TO LCA:

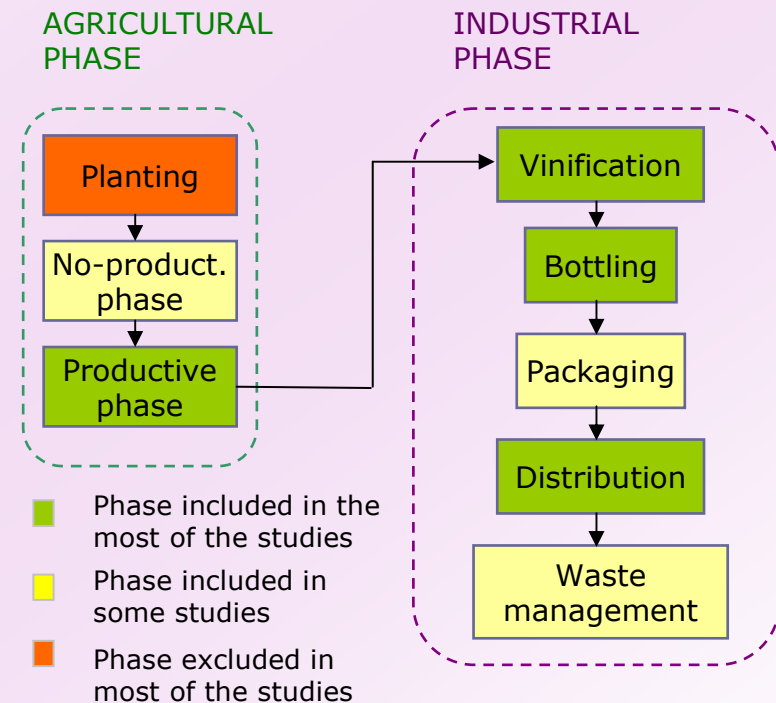| Tool	Value
Ecological Footprint	1
POEMS	1
Food miles	1
Energy and GHG emissions	1
Energy and carbon intensity	1
Emergy analysis	1
Carbon footprint	4

Results

Functional Unit

➢63% studies refer to a standard quantity of wine (usually 750 ml, 1 litre or even 1 t).

➢Only 6 studies refer to the bottle and possibly to the secondary packaging

Data origin

➢Most of the works provide on-site data concerning the **foreground system** collected on site (from producers, wine-growers and oenologists), while data on the **background system** were obtained from literature and databases.

System boundaries

AGRICULTURAL PHASE

INDUSTRIAL PHASE

Planting → No-product. phase → Productive phase → Vinification → Bottling → Packaging → Distribution → Waste management

🟩 Phase included in the most of the studies

🟨 Phase included in some studies

🟧 Phase excluded in most of the studies

- Planting: only 1 study

- 4 studies focus on specific phases (wine-making, coproduct management)

- Use phase was always considered irrelevant

Results

▣ **Environmental impact assessment method**

➢ Many studies only deal with the inventory phase, or the classification and characterization of the impacts, but **the normalization and weighting phases were not implemented**.

➢ **CML 2 method**, introducing additional items (Land use, energy consumption).

➢ EPD: GWP, AP, ODP, POCP, NP (new: water consumption, toxic emissions)

▣ **Peculiarity and strong points**

➢ How to allocate the environmental burdens of the process among the co-products and/or by-products: avoided the expansion of system boundaries

▣ **Limits and problems**

➢ Specific data and characterisation factors for pesticides and fertilisers used in the agricultural phase

➢ End of life of bottles, recovery and recycling processes.

➢ In general the "land use" and "water consumption" categories were not taken into account.

Conclusions

- Great variability in the definition of the functional unit;

- Inclusion or exclusion of packaging;

- Very different approaches in the assessment of the environmental impacts of co-products and the management of allocation processes;

- Greater or lesser importance given to end of life and waste management;

- Extreme variability in the choice of the environmental impact categories analysed.

Thanks for your attention

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Bacco
Caravaggio