Opportunities of using Exergetic Life Cycle Assessment (ELCA) towards ecological-economic analysis

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Introduction

Livestock farming

- increasingly been studied using Life Cycle Assessment (LCA) with a **main focus on emissions-related impacts**
- many systems have become **high input/ high output systems**

→ **resource-based analysis** very relevant

→ resource consumption assessment by **Exergy Analysis** (see M&M)

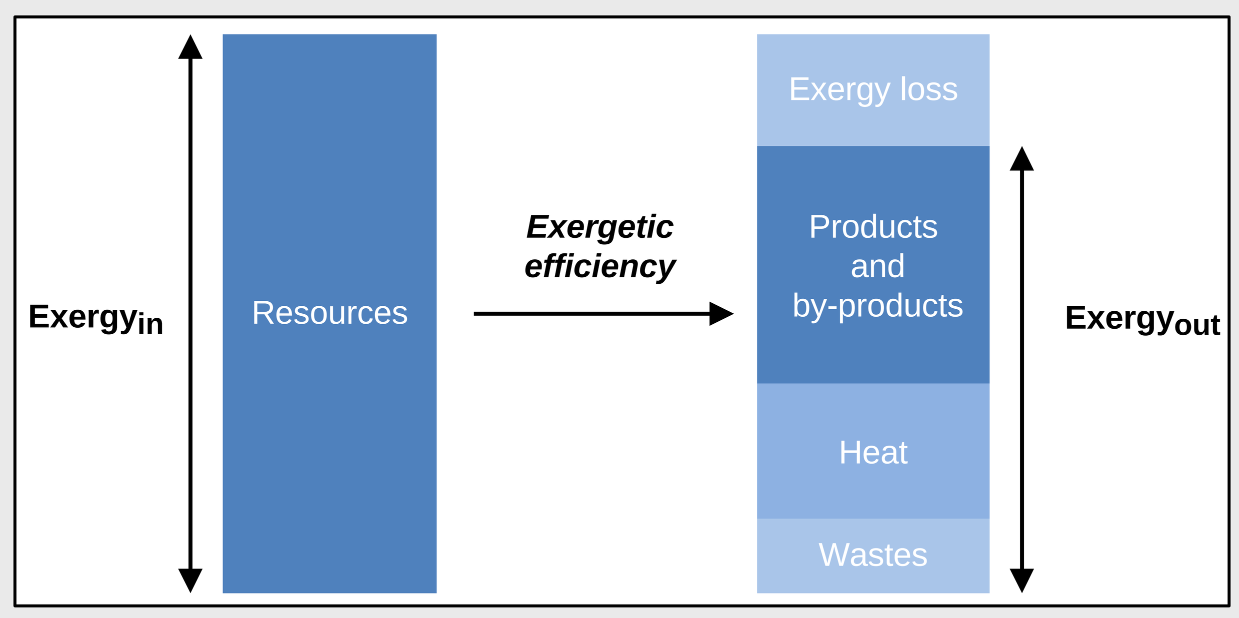
Similar system logic between

- Exergy Analysis (exergy values)
- economic analysis (monetary values)

→ enables an **integrated ecological-economic assessment**

Materials & Methods

Exergy reflects both the quality and the quantity of resources, while **energy** only includes their quantity. Exergy of a resource = *"maximum amount of useful work that can be retrieved from this resource when bringing it into equilibrium with the natural environment through reversible processes"* (Szargut *et al.*, 1988)



Advantages of Exergy Analysis (EA):

- system logic: quantification of inputs and outputs
- one common scale for all types of material and energy flows: joules of exergy
- exergetic efficiencies can be calculated at process level

A life cycle resource footprint can be calculated by conducting an **Exergetic Life Cycle Assessment (ELCA)**.

Impact assessment methods used in our study:

- resource use: *Cumulative Exergy Extraction from the Natural Environment (CEENE)* (Dewulf *et al.*, 2007)
- emissions: *ReCiPe v1.08* (Goedkoop *et al.*, 2013)

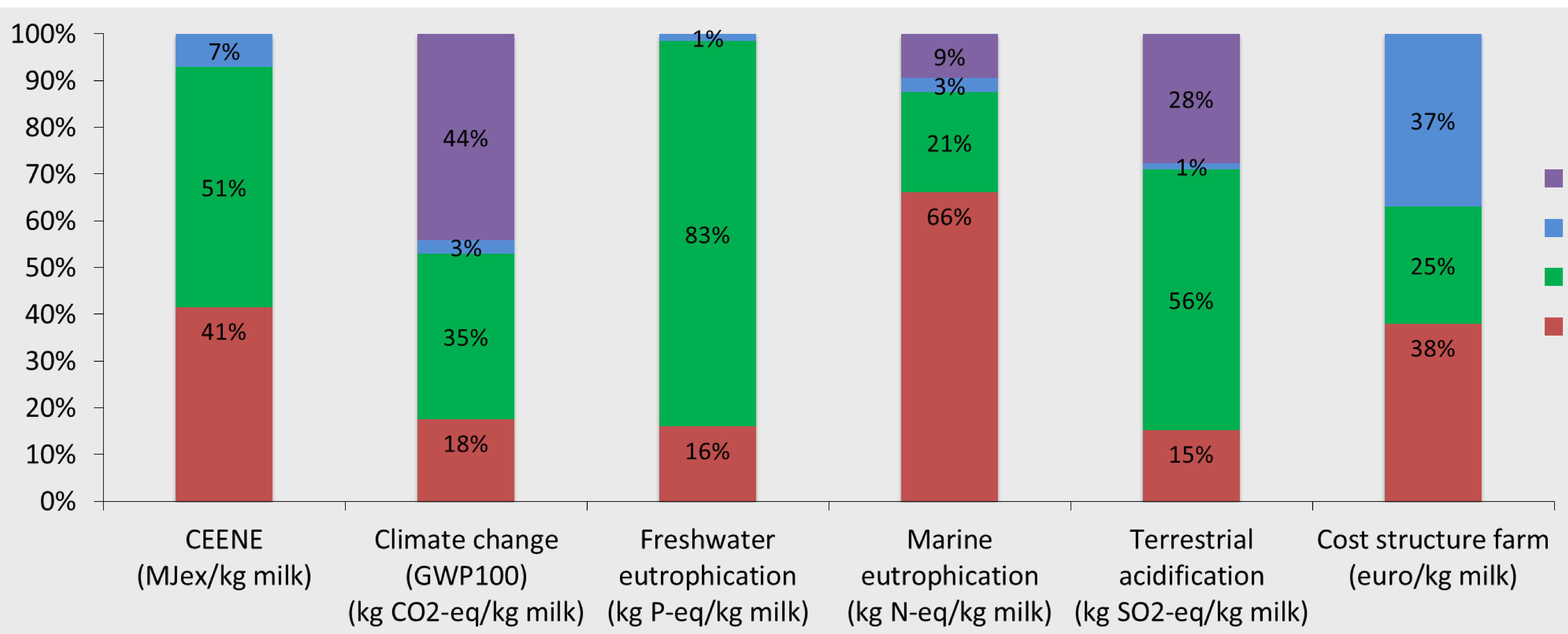
Objectives

Our study aims to

(i) critically analyse the **combined application of a resource-based ELCA and an emissions-based LCA** in a case study of a specialised Flemish dairy farm

(ii) explore the possibilities of **linking ELCA (and LCA) with an economic analysis** to enhance sustainable development of dairy farms

Results



* includes electricity, fuel use for feeding, infrastructure, etc.

Conclusion & Perspectives

- The results show that **main impacts**, both in terms of resource consumption and emissions, can be ascribed to **the total feed supply**. From the preliminary economic analysis, a **similar dominance of feed was seen in the cost structure of milk production**.
- In further research we will concretise which, and how, ecological and economic information should be linked in an **ecological-economic trade-off analysis** to enhance sustainable development of dairy systems.

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