SEA2LAND

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Life cycle assessment (LCA) of bio-based fertilizers from fisheries and aquaculture sidestreams

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Introduction

Fertilizer:

- EU strongly depends on fertilizer imports
- Mineral fertilizer have large environmental impacts (during production and application)

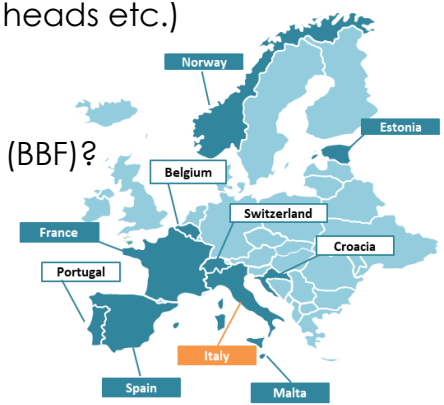
Fisheries:

- Worldwide fish consumption strongly increasing
- In the EU, around 2.3 million tonnes of fish sidestreams generated yearly (viscera, heads etc.)

Horizon2020 Sea2Land project:

- How can fish sidestreams be sustainably valorized to produce biobased fertilizers (BBF)?
- How sustainable are biobased fertilizers compared to mineral/organic fertilizers?
- 7 demonstration pilots in 6 case-study regions

  →LCA of Italian case-study presented here.



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Methods – Life Cycle Approach (LCA) approach

- **Aims:**
  - **Pilot scale: Identify hotspots** to optimize environmental performance of BFF production
  - **Industrial scale**: Analyse relevant changes in environmental impacts for an **upscaled** production
  - **Compare** environmental performance of BFF with other fertilizers.

- **Approach of cradle to factory gate LCA:**

  - **Upscaling**: changes in processes, changes in inputs and wastes, size scaling, external factors (framework of van der Hulst et al., 2020)
  - **Function unit:** Environmental impact of **1 kg fertilizer produced**
  - **Impact assessment:** Indicators from ImpactWorld+

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Adriatic pilot case study (cf. Andreola et al., 2023)

Fish waste

Mollusc waste

Energy, Machinery, Buildings, Transport

Emissions, waste

Mincing

Crushing and separation

Li ing agent

LCA system boundary

ALCALASE PURE 4.0

Enzy atic hydrolysis trifugation

Pyrolysis

Today's focus

Packaging

Concentration

Composting

Protein Hydrolysate

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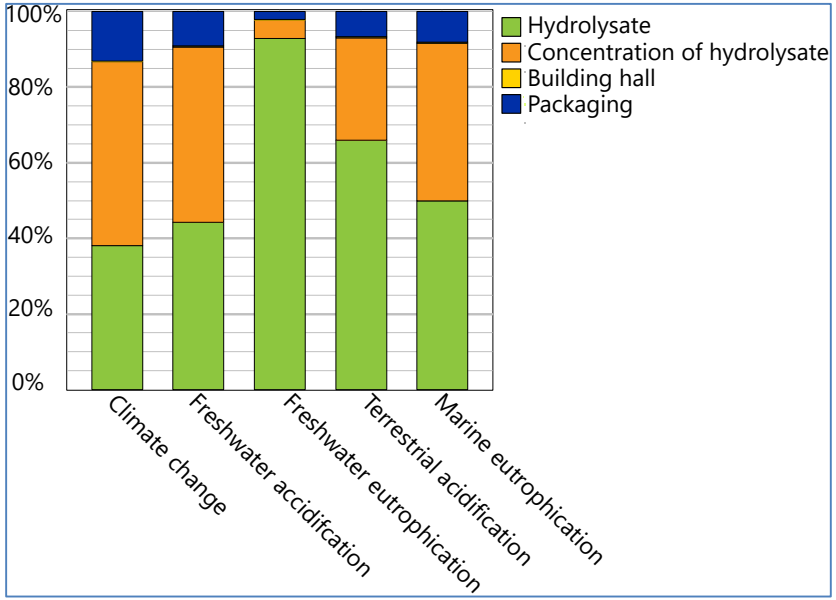
Packaging

Biochar- Compost Composite

Preliminary results: Pilot scale: identify hotspots for optimization

- **Enzymes** in enzymatic hydrolysis: growth-substrate starch
  → high eutrophication and climate warming potential.
- **Concentration step** after enzymatic hydrolysis (Andreola et al., 2023)
- **Packaging** (polyethylene, manufacturing)



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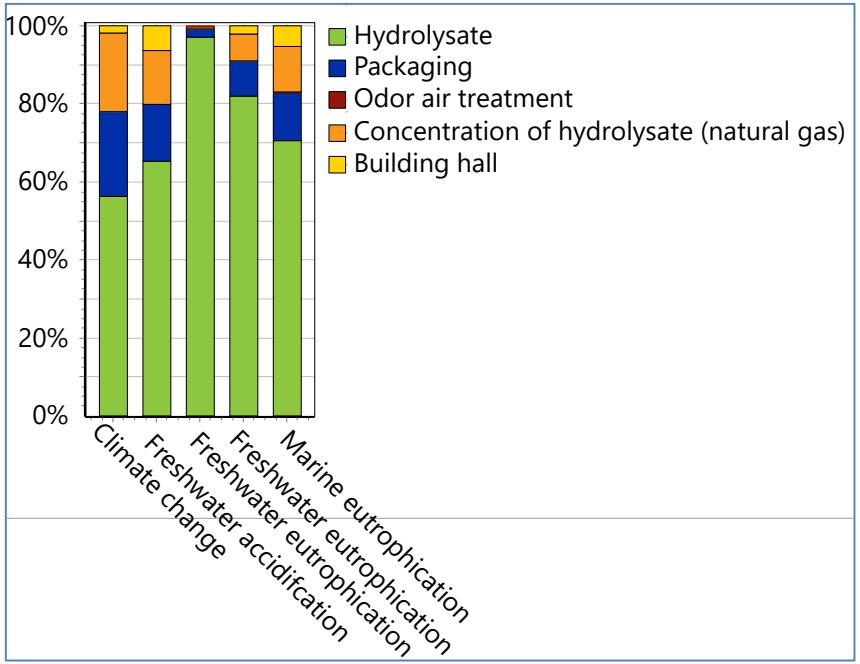
Preliminary results: Prospective LCA: Upscaling to industrial scale

- **Concentration:** Substantial reduction in environmental impacts (electricity → gas) → Higher energy efficiency and less SO_2 and NO_x -Emissions
- **40% reduction** of GWP100: From 2.0 to 1.2 kg CO_2 eq / kg protein hydrolysate.
- **New odor treatment** in industrial plant not relevant for environmental impacts.



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Discussion and Conclusions

- **Pilot production:** most of the data directly from pilot case studies → high certainty
- **Industrial production**: expected future changes difficult to quantify →higher uncertainty
- General, main uncertainties introduced by assumptions: **Price of BBF and burden-free assumption for sidestreams.**

Outlook

- **Comparison** of BBF from the 6 case studies with other fertilizers: do BFF have lower environmental impacts as mineral or organic fertilizers?
- **LCA of fertilizer application:** Environmental impact of 1 kg crop produced (cradle to farm gate LCA), analysed with FarmLCA tool.

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