SAFE Workshop

Critical challenges of sustainable freshwater aquaculture production

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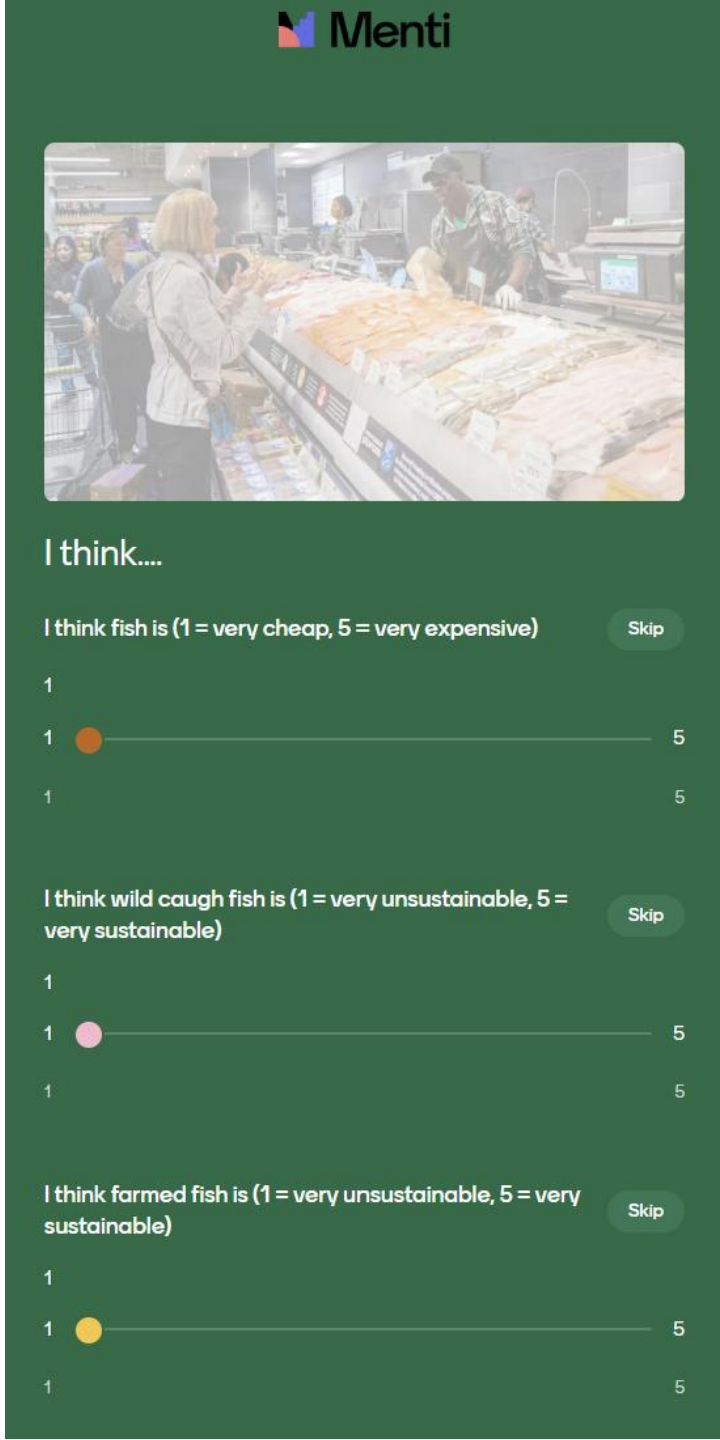
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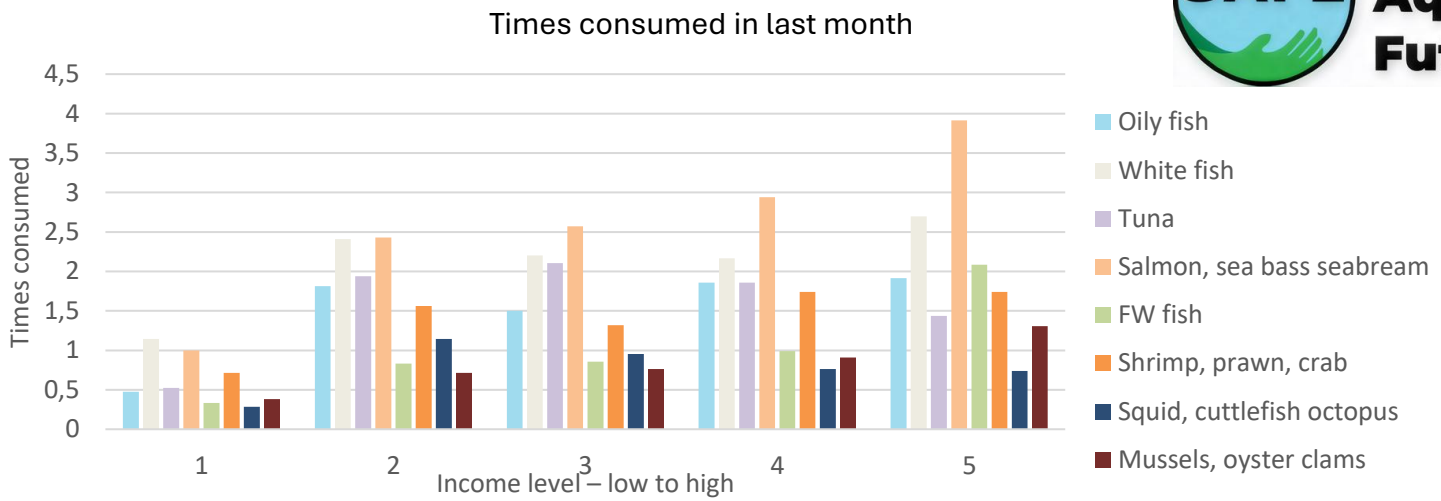
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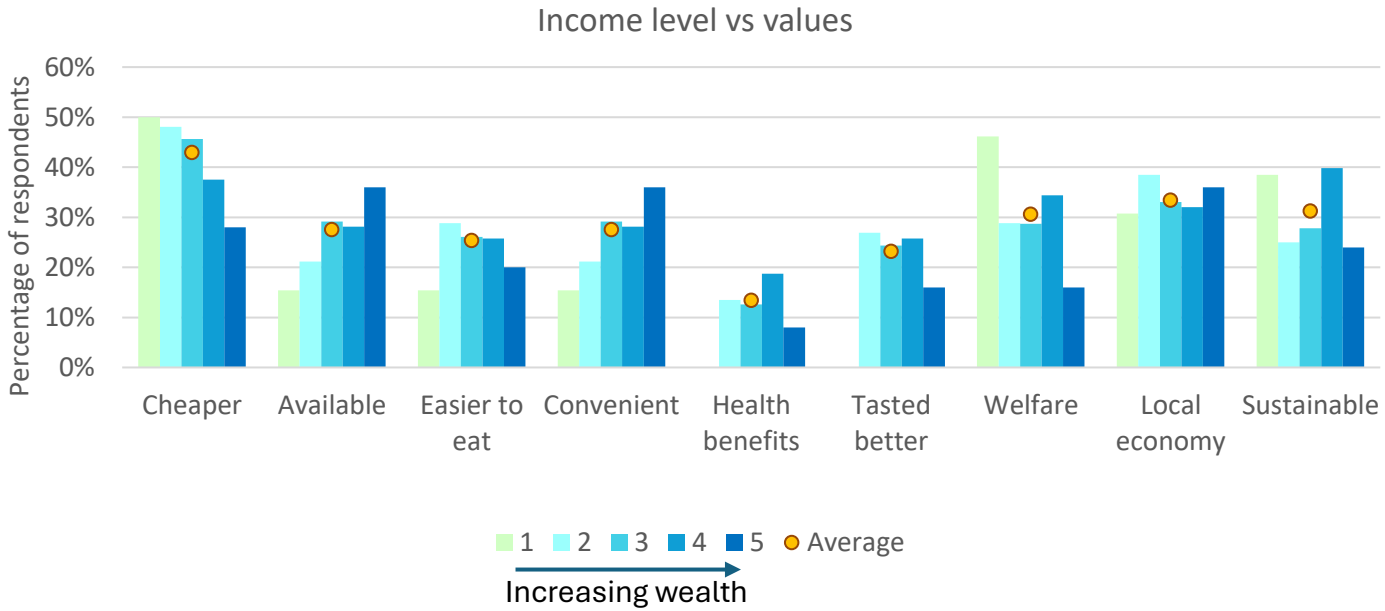
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What seafood do European consumers eat?

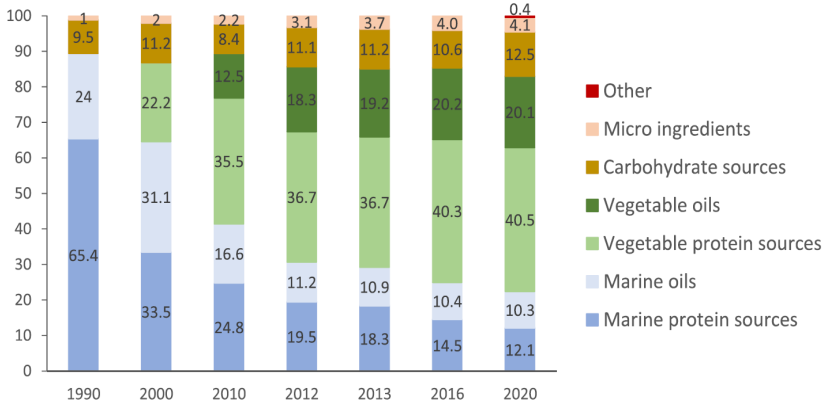
- Lower income level respondents eat considerably less seafood than others
- Over 90% of European respondents thought seafood was “somewhat” or “very” expensive
- Over 40% of respondents said they would buy more seafood if it was cheaper
- Consumers want locally produced seafood that is affordable, sustainable, and convenient
- How competitive is freshwater fish production compared to other “seafood”?

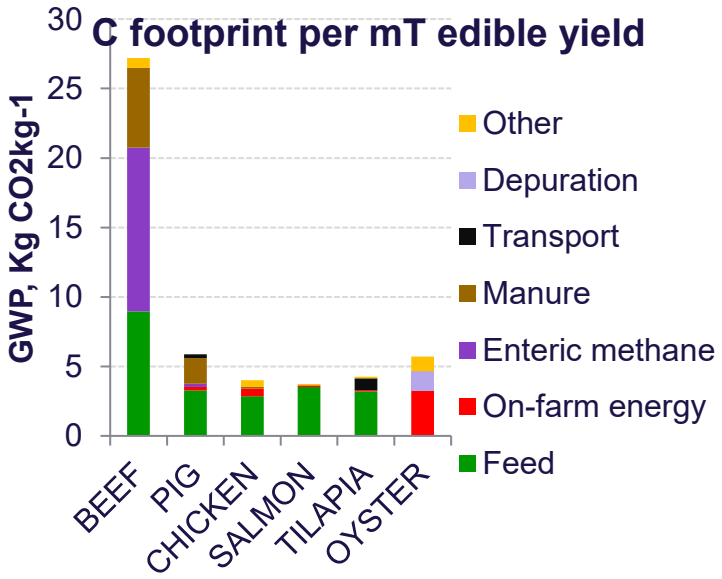




Two challenges in aquaculture sustainability

- Sustainable feed (C1)





- Waste and efficiency (C2)





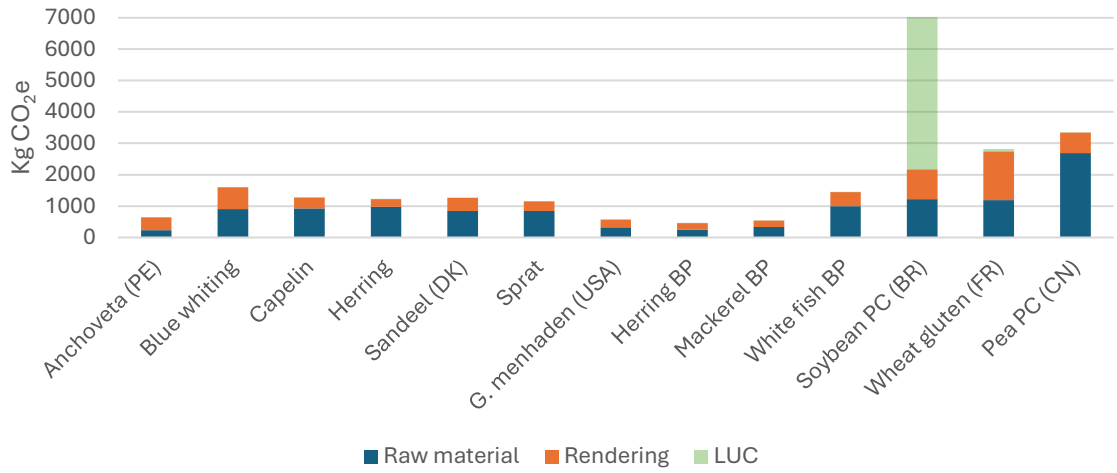
- Two of the biggest challenges in aquaculture

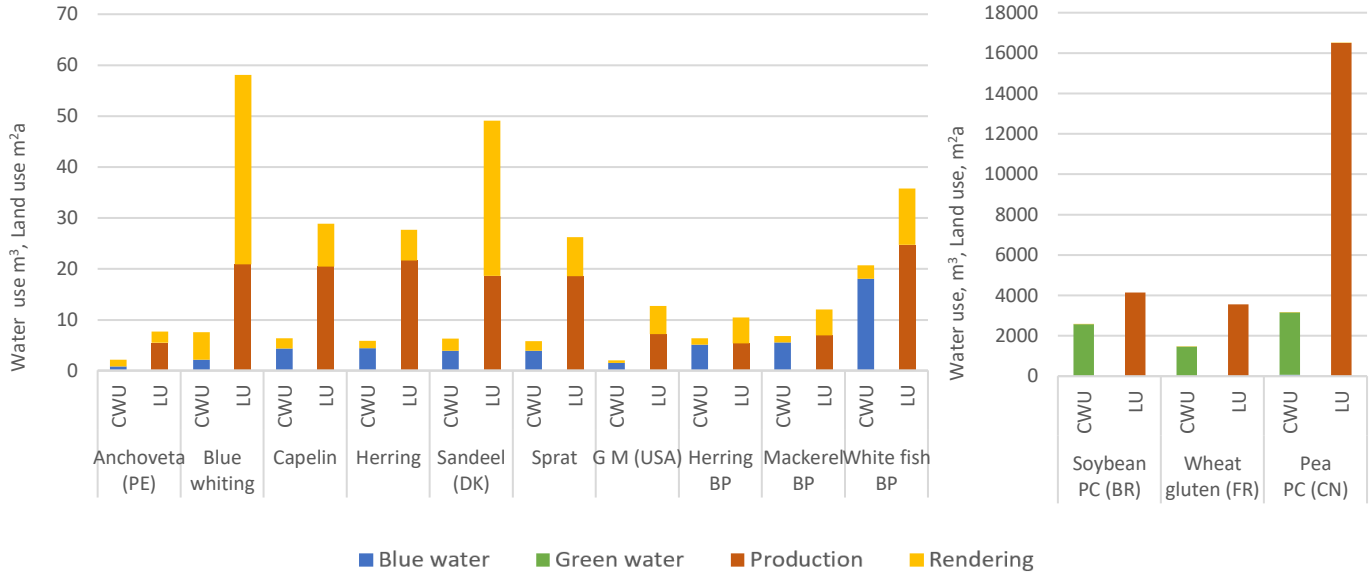
- Producing sustainable feed:-
  - Nutritional composition
  - Consistent quantity and quality
  - Costs
  - Environmental impact

- Improving waste management
  - Solid and dissolved waste
  - Nutrient efficiency

Challenge 1 – Sustainable feed

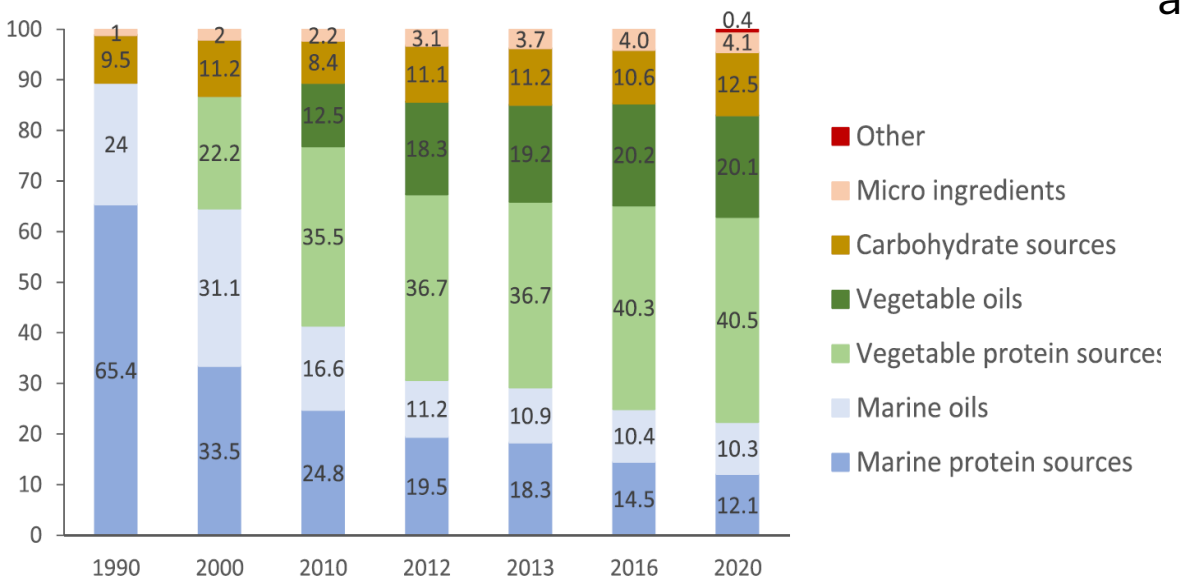
- Marine ingredients are highly nutritious and digestible
- They provide essential omega-3 fatty acids to consumers
- They have low C, land and water footprints
- … but they are limited in supply
- Are the subject of negative press in the media and from NGOs
- Are a key target for replacement





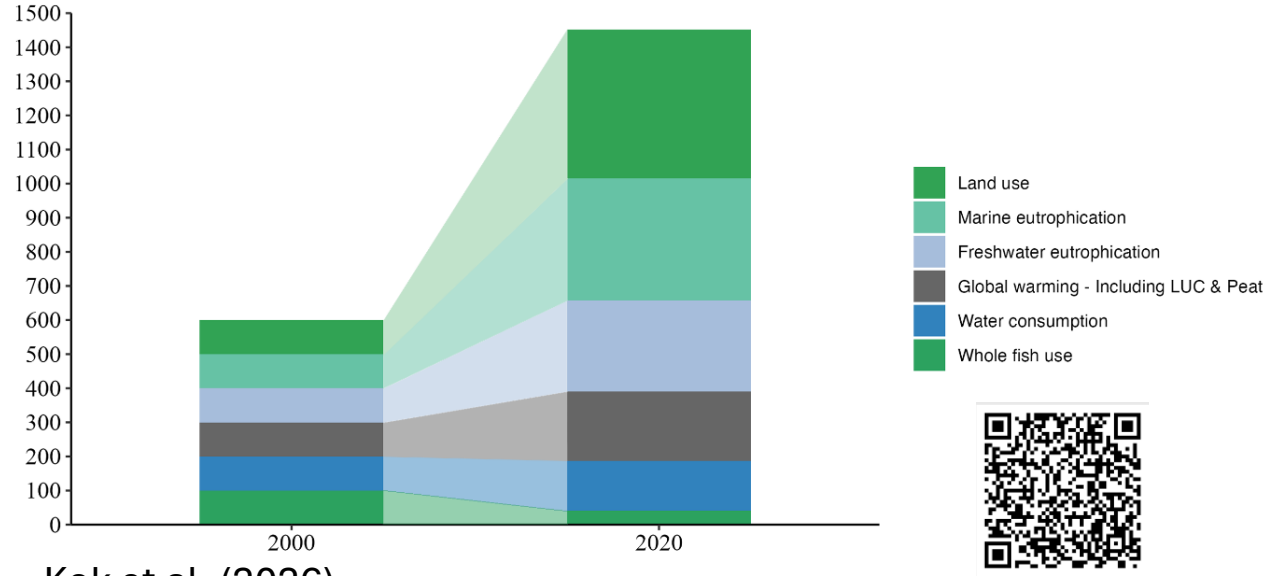
Changes in global impacts over time

Ingredient inclusions in Norwegian salmon diets



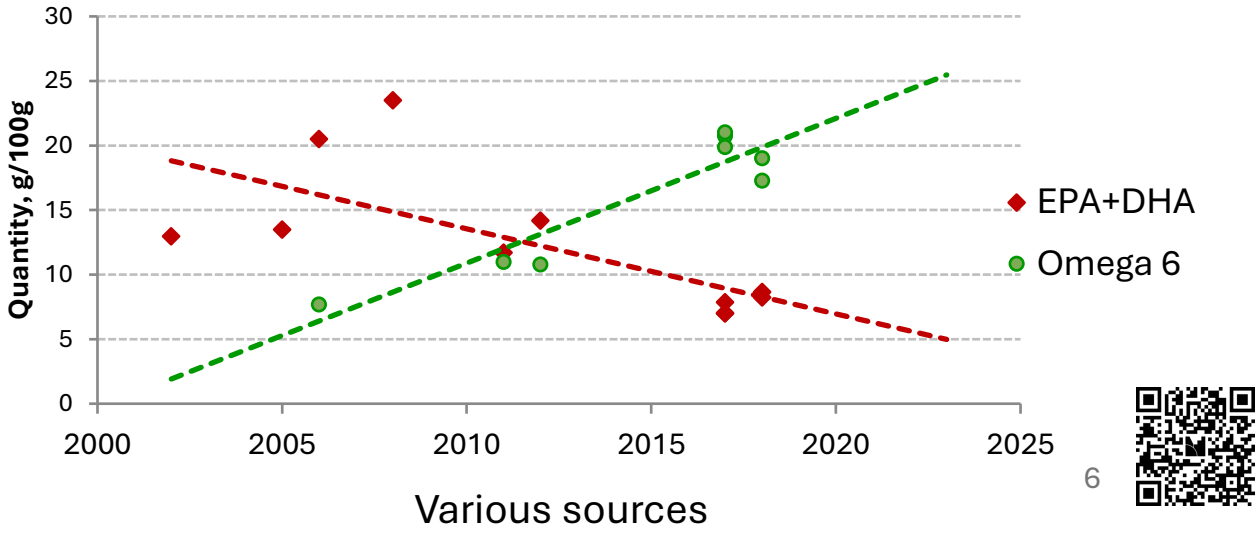
Aas et al. (2022)

Changes in average environmental impact for feed for European aquaculture species per kg fish produced.



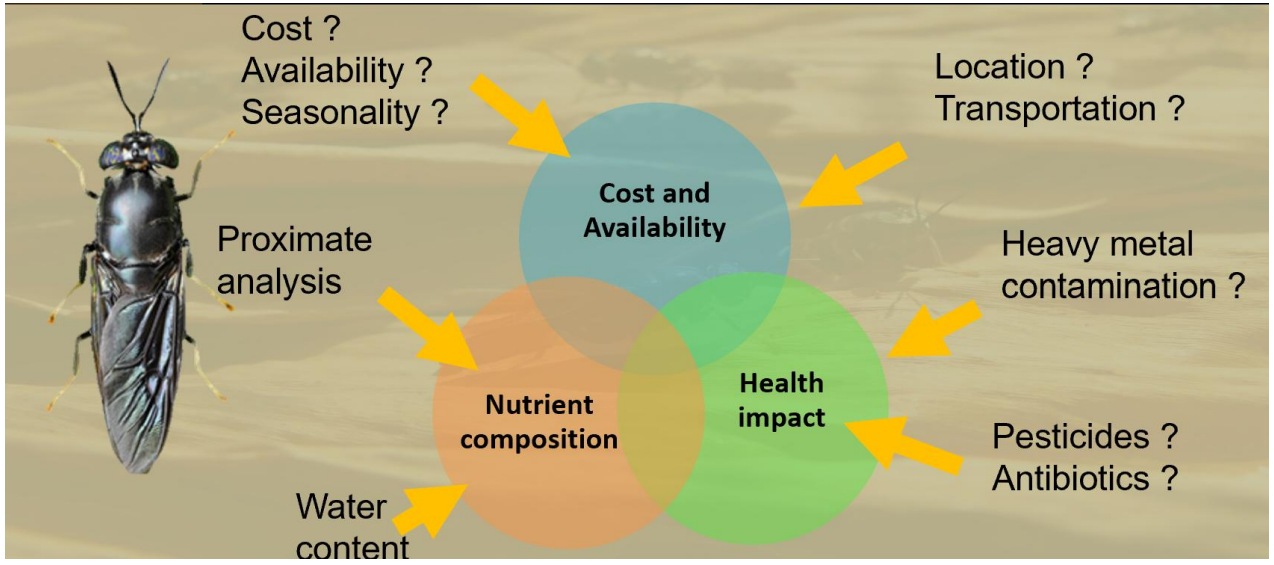
Kok et al. (2026)

- 2000 – 2020 European aquaculture has approximately doubled
- Overall use of forage fish has dropped
- …but other environmental impacts have increased
- Welfare impacts are also a concern
- Omega 3 levels in salmon have dropped
- Can we maintain performance and health outcomes and reduce impacts?



The challenge for alternative ingredients

- Circular economy ingredients sound great but have a lot of challenges
- Risk averse legislation restricts use of raw materials (animal by-products – effluent)
- Often energy intensive to produce and process
- Higher costs and higher environmental impact?
- Consumer acceptance?
- How can we make production more efficient?



Considerations for black soldier fly larval meal production


Coming soon to a fish counter near you, the salmon that's truly fowl...

INGREDIENTS: Salmon, chicken guts, blood, bones and feathers

Backlash over plan to feed farmed favourite on 'avian protein' to save money



Challenge 2 – Reduce and mitigate waste

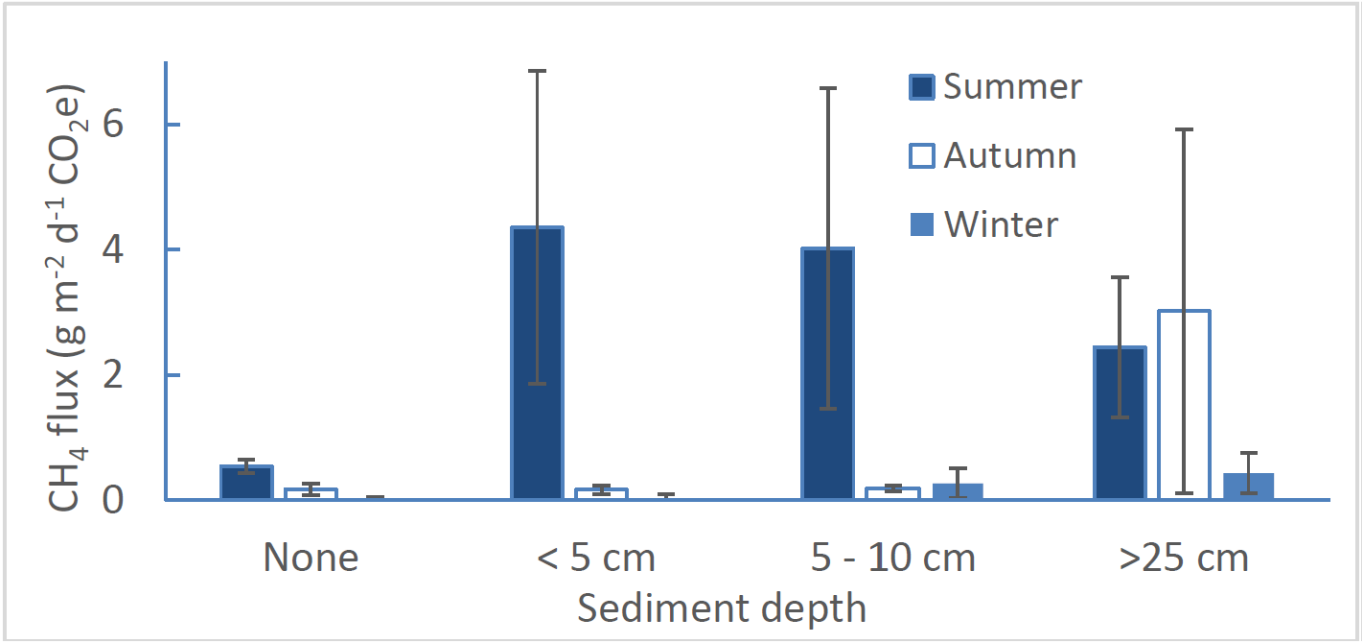
- FW aquaculture produces a lot of dissolved and solid waste
- Can cause major eutrophication problems
- Potentially major source of greenhouse gases (GHGs) if unmanaged
- RAS systems are expensive and not feasible for all species
- Collection of sludge and effluent from RAS is easy but utilisation barriers remain

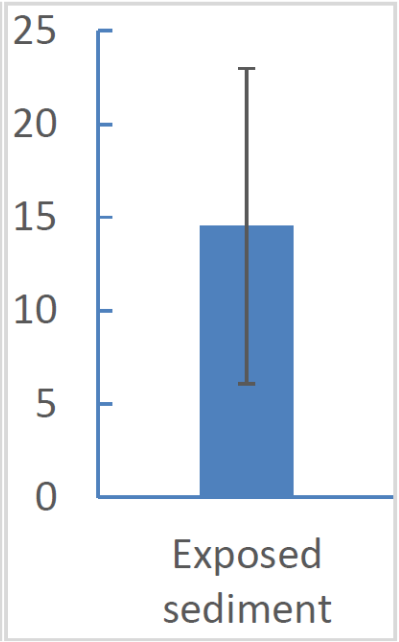


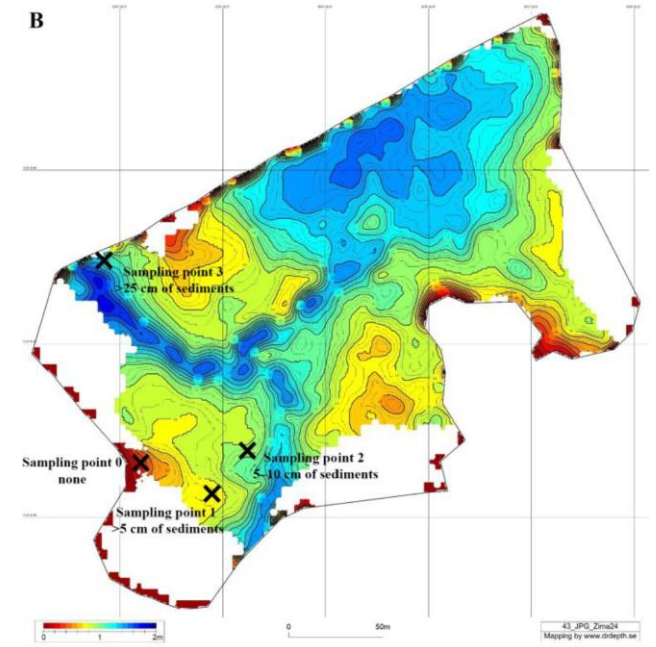


Sludge management

- GHG emissions in ponds are seasonal
- Dependent on depth of sediment and exposure
- Can sediment be collected and used effectively?
- … to mitigate impact with low costs, or even profit?







Sediment thickness, carp ponds

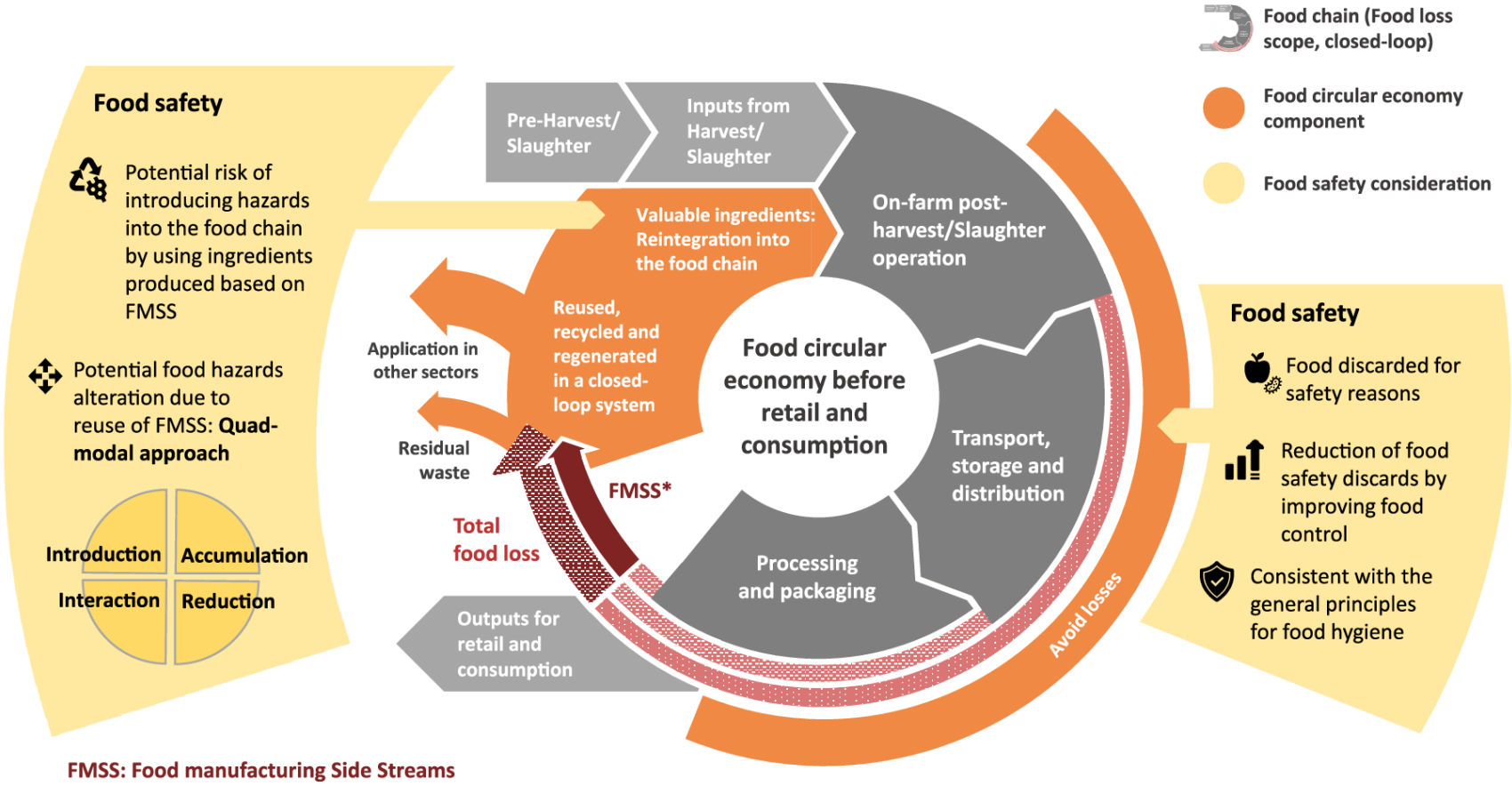
Can collection of waste be cost effective?

- Some ponds are very large
- Collection, storage and transport is difficult and expensive
- High water content – needs to be reduced
- Low value with limited options for utilisation
- Legislation on use of sludge can be restrictive
- Inconsistent effluent quality and quantity



Seafood in a conundrum to be “sustainable”, maintain high welfare and reduce costs

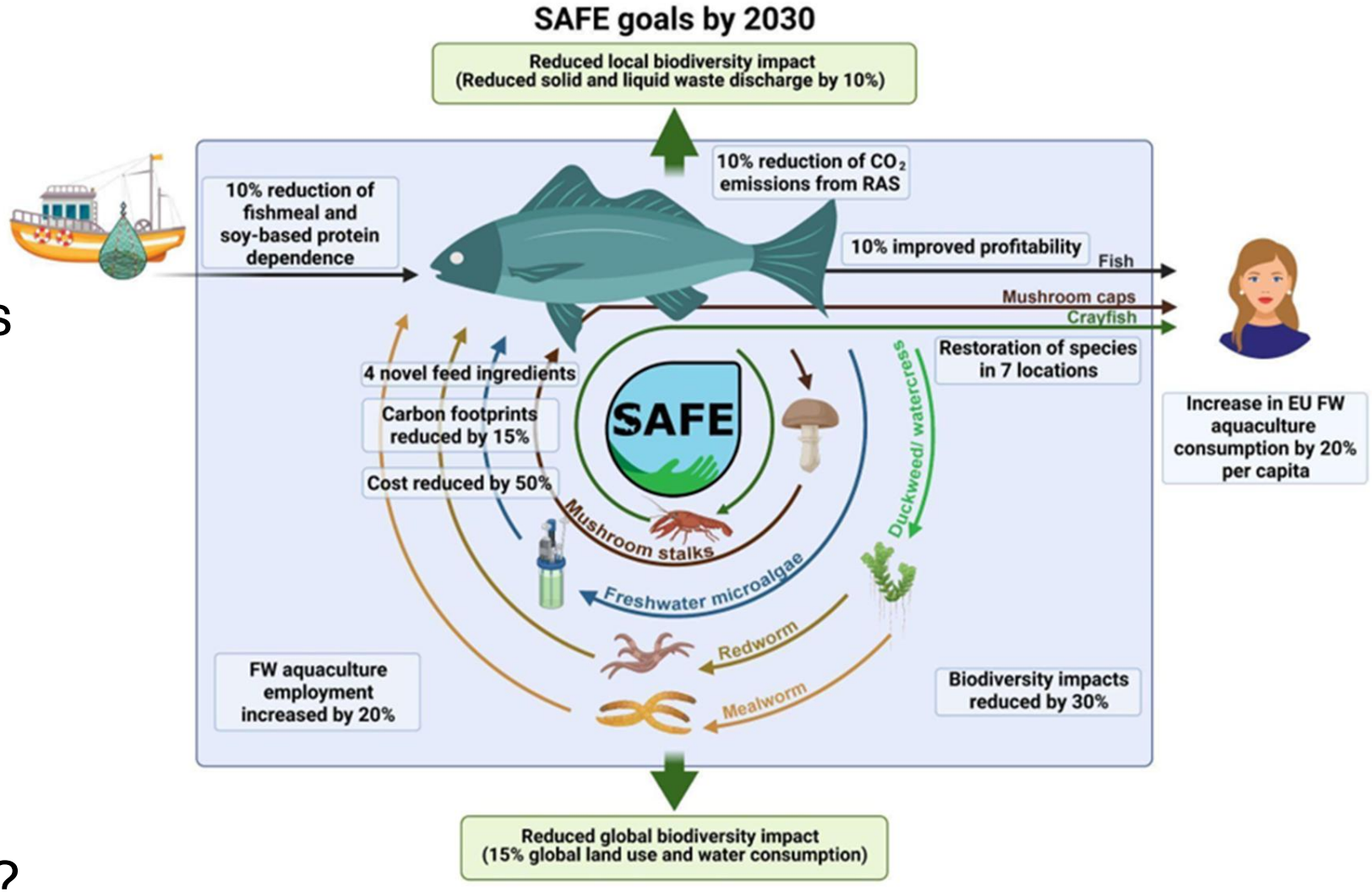
- Does legislation encourage circularity?
- What other barriers are there?
  - Food safety and contaminants
  - Colocation and transport costs
  - Storage and spoilage
  - Scaling and consistency
- Do these create further “unacceptable” costs?



Yeo et al (2024) https://doi.org/10.1038/s41538-024-00309-3

Summary

- Reducing impacts by incorporating waste more effectively seems like common sense
- But the reality is more complex
- SAFE tried to identify and overcome hurdles
- Did we succeed?
- What needs to change?



☑ Reducing carbon footprint – “Net Zero”
☑ Reducing biodiversity impacts
☑ Boosting production, profits and employment through engagement in the “circular economy”
☑ Achieving United Nations Sustainable Development Goals

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