



FROM LAB TO PLATE:

life cycle assessment of herring and lingonberry co-product valorization

BACKGROUND

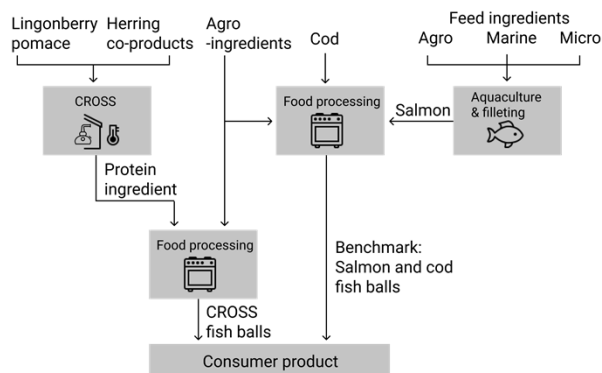
Food industry side streams can be a source of valuable raw materials, e.g., high-quality proteins from fish filleting co-products, and natural antioxidants from fruit pomace.

pH-shifting is a food processing technique that allows the solubilization and extraction of proteins.

Cross-processing fish co-products and a helper (e.g., lingonberry pomace), inhibits lipid oxidation during processing.

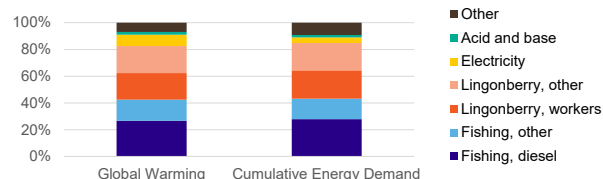
METHOD

We carried out a life cycle assessment of a pH-shift method for cross-processing herring heads and back bones with lingonberry pomace (CROSS). We modeled the resulting protein ingredient as input to a fish ball and compared that with a benchmark fish ball.

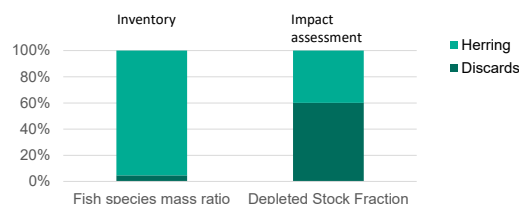


We upscaled primary laboratory data for the cross-process following Piccinno et al. (2016). Life cycle inventory data for salmon production was based on Winther et al. (2020), including feed composed of agricultural, micro-ingredients, and 14 different fish species. We also included fishery discards following Pérez Roda (2019). Among other impact indicators we used the depleted stock fraction proposed by Hélias et al. (2018) to characterize impacts on marine resources.

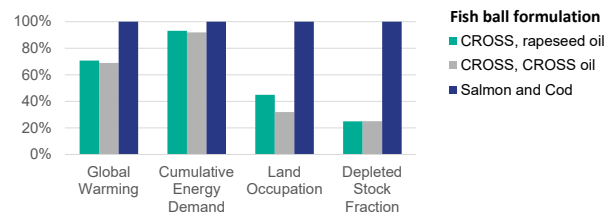
RESULTS



Protein ingredient: fuel consumption for fishing and transport of berry-picking workers accounted for at least 46 % of the potential contributions to global warming and cumulative energy demand.



Protein ingredient: despite a low discard rate for herring fisheries, discards dominated the impact of depleted stock fraction category.



Fish ball comparison: fish balls produced with the cross-processed protein ingredient perform better than the benchmark option in all investigated categories. Using oils extracted during cross-processing in the fish ball formulation could reduce land use impacts of the final product and improve its nutritional profile.

REFERENCES

- Hélias, A., Langlois, J. & Fréon, P. Fisheries in life cycle assessment: Operational factors for biotic resources depletion. *Fish Fish.* 19, 951–963 (2018).
- Pérez Roda, M. A. (ed) et al. A third assessment of global marine fisheries discards. *FAO Fisheries and Aquaculture Technical Paper No. 633 vol. 633* (2019).
- Piccinno, F., Hirschler, R., Seeger, S. & Som, C. From laboratory to industrial scale: a scale-up framework for chemical processes in life cycle assessment studies. *J. Clean. Prod.* 135, 1085–1097 (2016).
- Winther, U., Hognes, E. S., Jafarzadeh, S. & Ziegler, F. Greenhouse gas emissions of Norwegian seafood products in 2017. Report No. 2019:01505 (2020).

