2024

FOODIMAR

FOODIMAR PROJECT

Environmental Aspects of By-product Valorisation

Federal Ministry of Education and Research

FORMAS

fwo Research Foundation Flanders Opening new horizons

JÜLICH Forschungszentrum

Co-funded by the European Union

Innovationsfonden

The Research Council of Norway

TÜBİTAK

Sustainable Blue Economy Partnership

SUBMARINER Network

- Established 2013
- Not-for-profit
- Located in Germany

- Innovative and sustainable use of marine resources
- Protect the marine environment
- Sustainable economic development

SUBMARINER NETWORK

FOODIMAR

Contents

Environmental impacts of improper by-product disposal

- The seafood industry is globally significant, providing essential nutrition and livelihoods for billions of people.
- During processing, up to 50% of fish weight becomes by-products.
- Processing and production by-products
- Improper disposal can pose substantial environmental challenges.
- The lack of proper management leads to pollution, threatens ecosystems, and poses risks to human health.

Food and Agriculture Organization (FAO). (2020). The State of World Fisheries and Aquaculture 2020. Rome: FAO.

Environmental impacts of improper by-product disposal

Impacts on water:

- Excess nutrients such as nitrogen and phosphorus, causing eutrophication.
- Pathogens from fish waste.
- Chemical contaminants.

Biodiversity loss:

- Waste dumping can harm marine and terrestrial habitats
  - Altering habitat structure
  - Smothering benthic communities
  - Bioaccumulation of toxins

Neves RAF, Nascimento SM, Santos LN. Harmful algal blooms and shellfish in the marine environment: an overview of the main molluscan responses, toxin dynamics, and risks for human health. Environ Sci Pollut Res Int. 2021 Oct;28(40):55846-55868

Environmental impacts of improper by-product disposal

Impacts on soil:

- Accumulation of fisheries waste in landfills.
- Soil quality
  - Altering soil pH, porosity, and water-holding capacity
  - Impacts on soil microbial enzymatic activities
- Heavy metals and other pollutants can persist in soil

Environmental impacts of improper by-product disposal

Impacts on air:

- Decomposition of fish waste releases gases such as ammonia and hydrogen sulfide.
- Exposure to these gases can lead to respiratory issues and other health problems.
- The breakdown of organic waste emits greenhouse gases, e.g., methane and carbon dioxide, contributing to climate change.

Schiffman, S. S., & Williams, C. M. (2005). Science of odor as a potential health issue. Journal of Environmental Quality, 34, 129-138.

Strategies for minimizing waste and maximizing resource recovery

1. Waste minimization and proper sorting

Effective waste minimization starts with proper sorting and logistics of by-products.

Proper sorting:

- Implement on-site separation during processing to prevent contamination[1].

- **Efficient logistics**:
  - Maintain a cold chain to preserve by-product quality[2].

[1] Rustad, T., Storrø, I., & Slizyte, R. (2011). Possibilities for the utilization of marine by-products. *International Journal of Food Science & Technology*, 46.

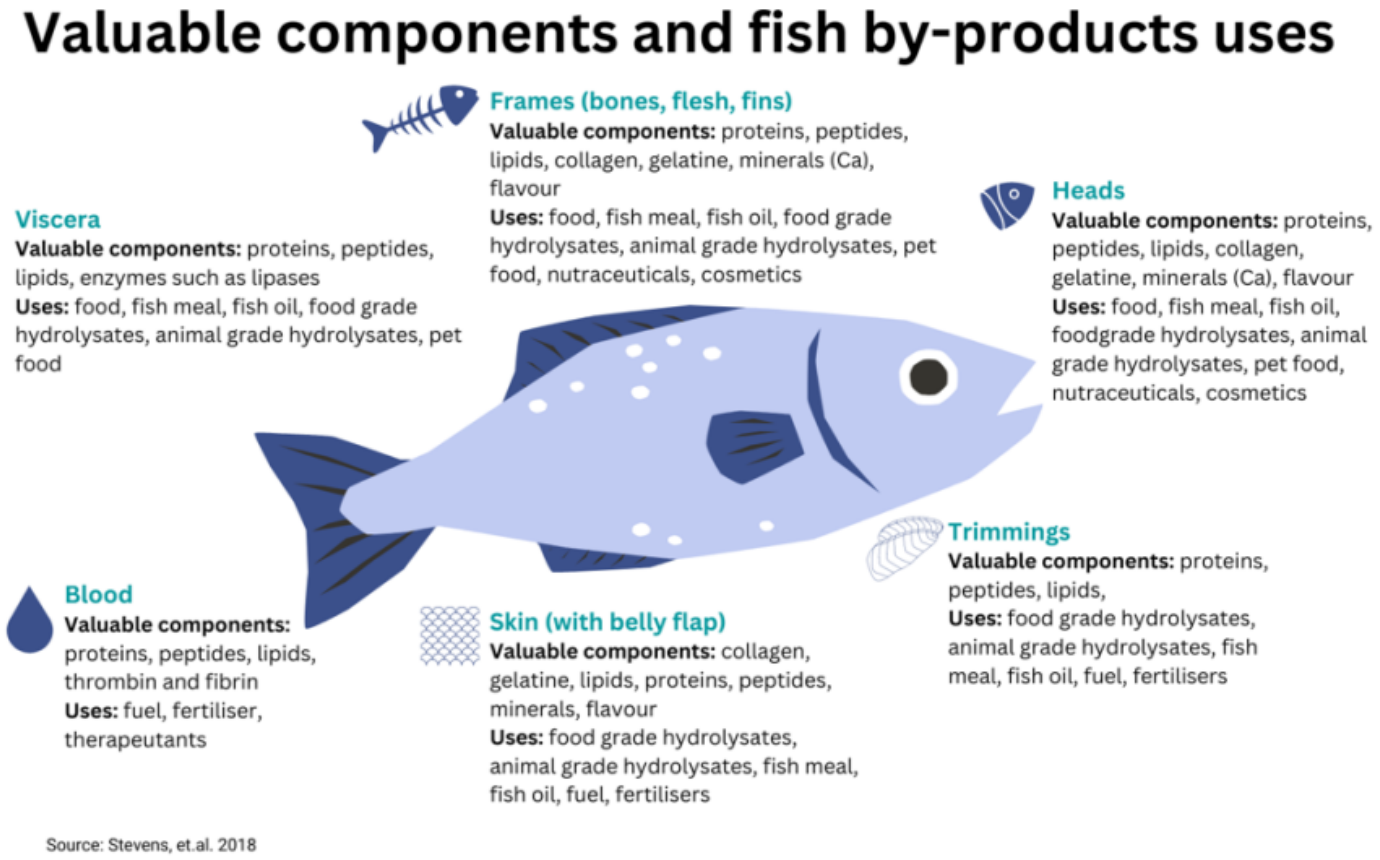
[2] Arvanitoyannis, I.S. and Kassaveti, A., 2008. Fish industry waste: treatments, environmental impacts, current and potential uses. International journal of food science & technology, 43,726-745.

Strategies for minimizing waste and maximizing resource recovery

2. By-product valorization

Transforming side-streams into valuable products could reduce environmental impact and create economic opportunities.

- **Valorization techniques (classical):**
  - **Production of fish meal and oil:**
  - **Extraction of bioactive compounds**
  - **Production of biogas**
  - **Fertilizers**



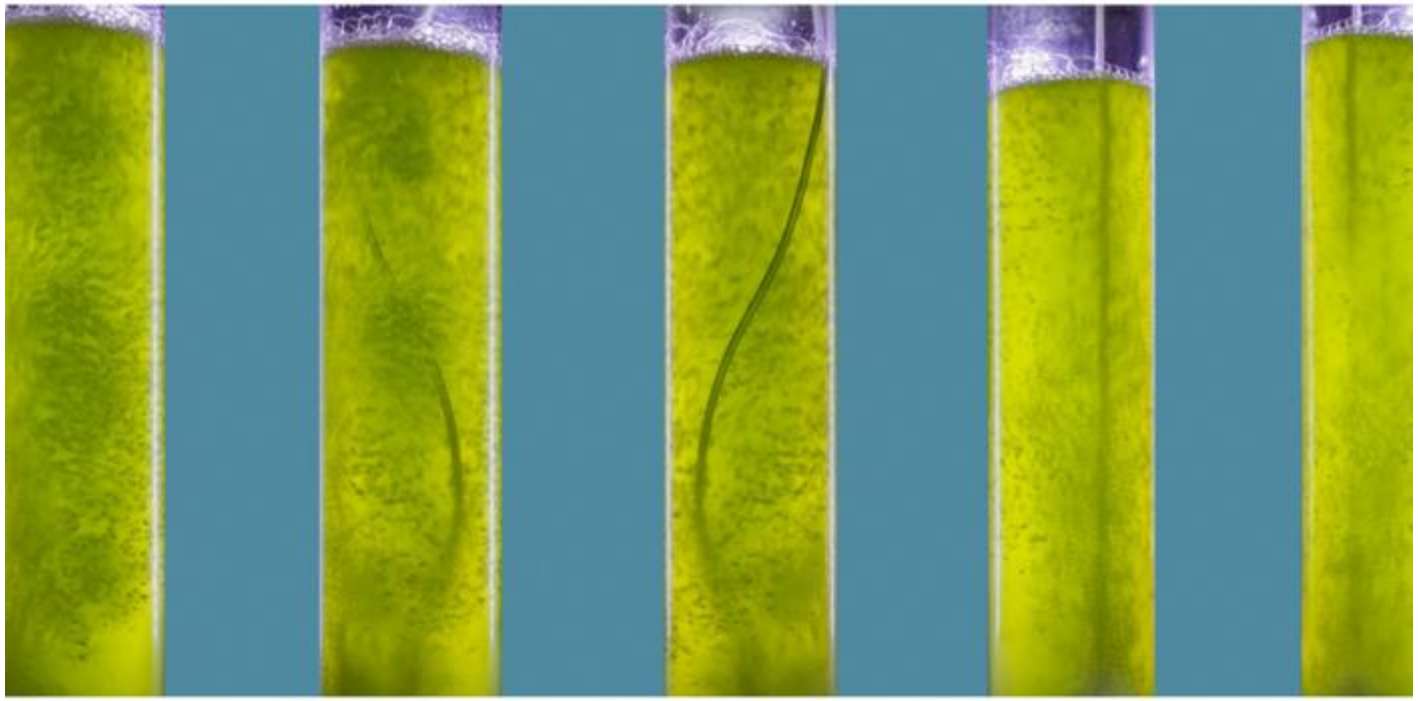
[1] Shahidi, F. and Ambigaipalan, P., 2018. Omega-3 polyunsaturated fatty acids and their health benefits. Annual review of food science and technology, 9, 345-381.

Strategies for minimizing waste and maximizing resource recovery

2.1 By-product valorization

Transforming by-products from systems into valuable products could reduce environmental impact and create economic opportunities.

- **Wastewater**:
  - Irrigation
  - Microalgae
  - Aquaponics
- **Sludge**
  - Fertilisers
  - Growth Media



[1] Shahidi, F. and Ambigaipalan, P., 2018. Omega-3 polyunsaturated fatty acids and their health benefits. Annual review of food science and technology, 9, 345-381.

Strategies for minimizing waste and maximizing resource recovery

3. Use of green technologies

Adopting green technologies enhances efficiency and reduces the environmental footprint of by-product management.

- Anaerobic digestion;
- Enzymatic hydrolysis;
- Membrane filtration;
- Supercritical fluid extraction.

Patra, D., Patra, B.R., Pattnaik, F., Hans, N. and Kushwaha, A., 2022. Recent evolution in green technologies for effective valorization of food and agricultural wastes. In Emerging Trends to Approaching Zero Waste.

Strategies for minimizing waste and maximizing resource recovery

4. Sustainability assessment of valorization methods

Evaluating the **environmental, social, and economic** impacts ensures the sustainability of by-product valorization techniques.

Environmental assessment:

- Measures environmental impacts from production to disposal.
- Identifies opportunities to reduce impacts and resource use.

Social assessment:

- Assesses effects on local employment and health.
- Ensures fair labor practices and community benefits.

Economic assessment:

- Evaluates the financial viability of technologies.
- Considers initial investment, operational costs, and potential revenues.

Ziegler, F., Winther, U., Hognes, E.S., Emanuelsson, A., Sund, V. and Ellingsen, H., 2013. The carbon footprint of Norwegian seafood products on the global seafood market. Journal of Industrial Ecology, 17, 103-116.

Strategies for minimizing waste and maximizing resource recovery

5. Stakeholder engagement

Active participation from all stakeholders enhances the effectiveness of sustainable practices in the by-product management/valorization.

Key Stakeholders:

- Industry players: fishermen, processors, distributors.
- Government and regulators: policy development and enforcement.
- Local communities: addressing social impacts and benefits.
- Researchers and NGOs: providing expertise and promoting best practices.

Some strategies:

- Involve stakeholders in planning and implementation.
- Share information openly to build trust.
- Offer training and resources to support sustainable practices.

Reed, M.S., 2008. Stakeholder participation for environmental management: a literature review. Biological conservation, 141, 2417-2431.

Seafood Side Stream Valorization Projects

FOODIMAR

sustainable climate-Friendly quality fOOD Ingredients from Marine side-stReams

Partners: 6

Countries: Germany, Norway, Sweden, Denmark, Turkey & Belgium

Sea basins: North, Baltic & Mediterranean

Budget: € 1,580,812

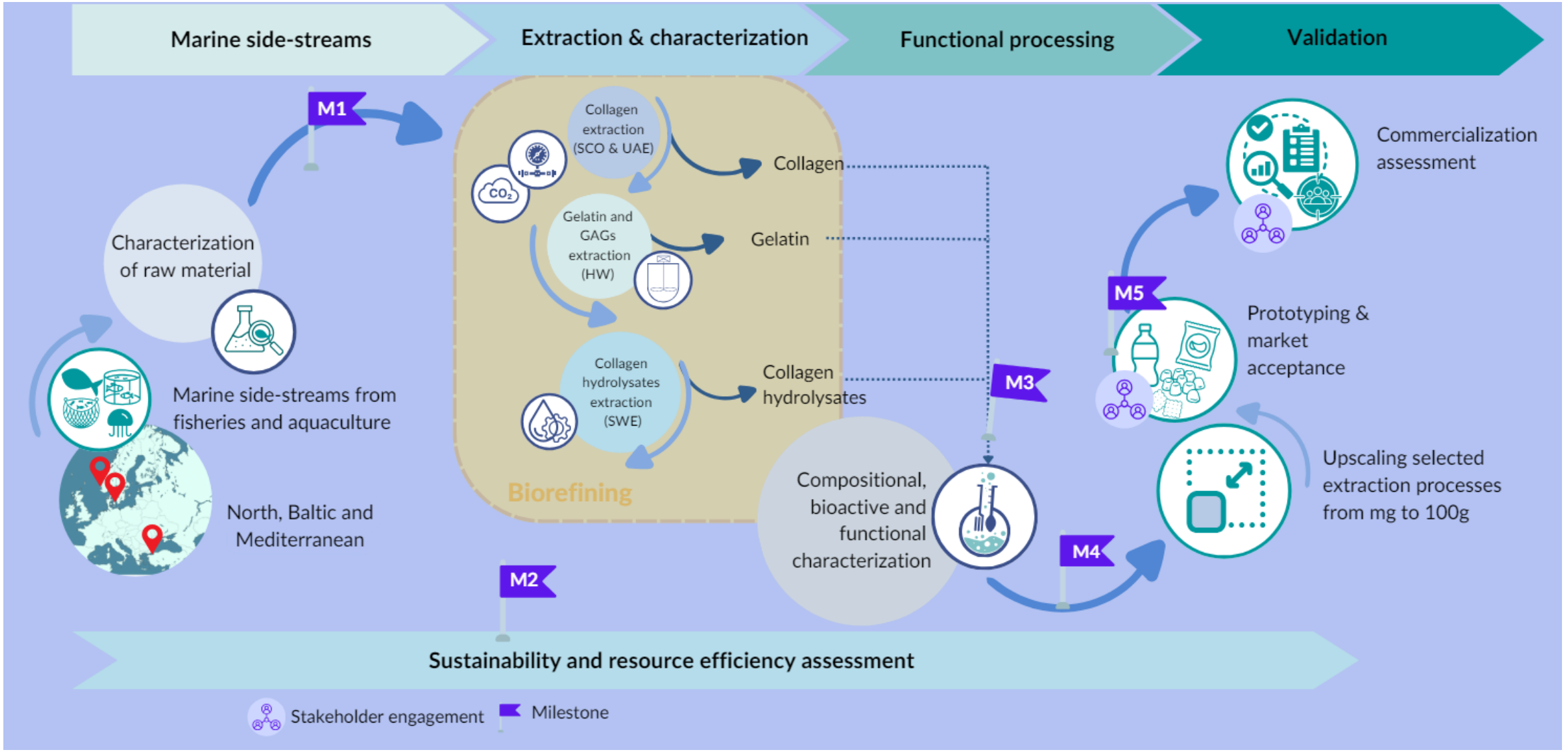
Duration: 36 Months (1 May 2024 – 30 April 2027)

Pillars

Maximize the utilization of seafood side-streams and by-catch to reduce food loss

Raise the value of seafood side-streams by transforming them into high-value products

Promote capacity building and the development of business models



SCO: Supercritical CO2; UAE: Ultrasound-Assisted Extraction; HW: How water; SWE: Subcritical Extraction

Pilots

- Pilot
- Functionality testing & product development
- Characterization & processing of marine biomass
- Market assessment & commercialization
- Sustainability & resource efficiency assessment
- Engagement & transferability

Sustainability in FOODIMAR

Evaluate the positive and negative environmental, economic, and social impacts, as well as the resource efficiency of the FOODIMAR proposed value chains

Life Cycle Assessment (LCA)
Life Cycle Costing (LCC)
Social-LCA

Compare current valorisation pathways with FOODIMAR scenarios

Resource Efficiency Study to identify critical points for optimising processes

Extraction Methods

FOODIMAR

Conventional Methods

Hydrolysis
Chemical Extraction
Thermal Treatments

Benefits

Well established
Extensive knowledge-base
Scaled-up

Challenges/Drawbacks

Off-flavour
High Energy Consumption
Chemical Usage
Lower quality

FOODIMAR Methods

Ultrasound Assisted
Subcritical Water
Supercritical CO2
Hot Water

Benefits

High yield
Less/No chemical usage
Shorter extraction times
Better quality

Challenges/Drawbacks

Expensive
Difficult to scale-up

Siddiqui, et al., 2023

Sustainable Blue Economy Partnership

Co-funded by the European Union

Seafood Side Stream Valorization Projects

waseabi

Optimal utilisation of seafood side-streams through the design of new holistic process lines

https://www.waseabi.eu/

BBI JU Project

May 2019 – October 2023 (Completed)

€3,197,397.00

PROFIUS

Preservation of underutilised fish biomasses for improved quality, stability and utilisation

https://profius-project.com/

BlueBio Cofund

Nov 2021 – Nov 2024

€1,550,000.00

Seafood Side Stream Valorization Projects

ImPrESsIVE

Improved Processing to Enhance Seafood Sidestream Valorization and Exploration

Improved Processing to Enhance Seafood Sidestream Valorisation and Exploration

BlueBio Cofund

Nov 2022 – Nov 2025

Interreg Italia-Malta Bythos

Biotechnologies For Human Health and Blue Growth

https://bythosproject.eu/

Interreg (Italia-Malta)

Jun 2018 – May 2021 (Complete)

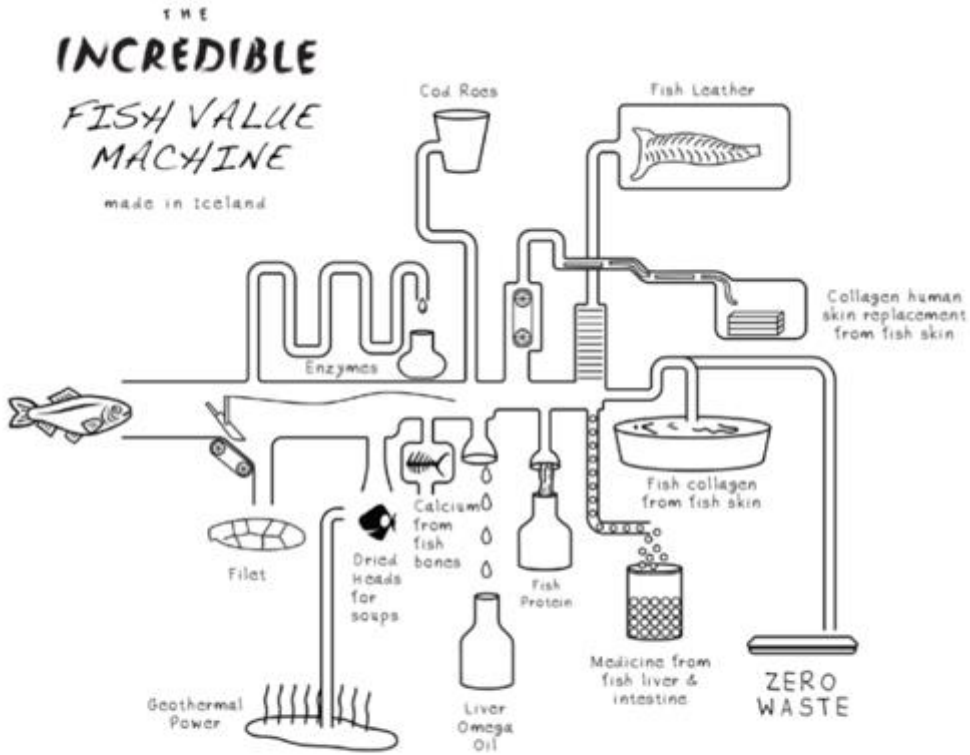
€2,371,592.00

Seafood Side Stream Valorization Projects

100% Fish (Cluster Initiative)

https://sjavarklasinn.is/en/iceland-ocean-cluster/100-fish/

In Iceland, the industry has reached 80% usage of white fish. Companies within the Icelandic Ocean Cluster develop supplements, proteins, cosmetics, pharmaceuticals and other high-value products from different parts of the fish.



Seafood Side Stream Valorization Projects

FOODIMAR Sister Projects (SBEP)

Started early 2024

- **BLUEWAYSE** – BLUE WAY to a Sustainable Europe
- **RE-BLUE** – Resource efficient blue food production from small underutilized pelagic fish species
- **SEAREFINERY** – Improved Valorisation of Marine Sources and Processing Waste for Resource Efficient Blue Food/ Feed and Environmentally Sustainable Materials Development
- **Waste2Taste** – From waste to taste: exploring innovative food applications of postharvest fish losses

Sustainable Blue Economy Partnership

Thank you

FOODIMAR

GET IN TOUCH

FOODIMAR

FOODIMAR

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