FROM PERSISTENT PLASTICS TO DESIGNED DEGRADATION: BIODEGRADABLE NET SYSTEMS FOR SUSTAINABLE AQUACULTURE

BIOAQUA-SIM

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MOTIVATION

Aquaculture cage nets and ropes are predominantly manufactured from fossil-based polymers such as polyethylene (PE), polypropylene (PP), and nylon (PA).

These materials provide excellent mechanical reliability, they persist in marine environments for decades, contributing to ghost gear formation, microplastic pollution, and increasing maintenance and end-of-life management costs.

Sustainable alternatives are needed to reduce environmental impact and long-term costs.

RESEARCH OBJECTIVE

The objective of BIOAQUA-SIM is to establish an integrated experimental–numerical framework for evaluating biodegradable net materials as alternatives to conventional aquaculture polymers.

Rather than pre-selecting a single polymer family, the study adopts a comparative, market-representative approach, assessing biodegradable and conventional materials under identical environmental, mechanical, and hydrodynamic conditions.

METHODOLOGICAL FRAMEWORK

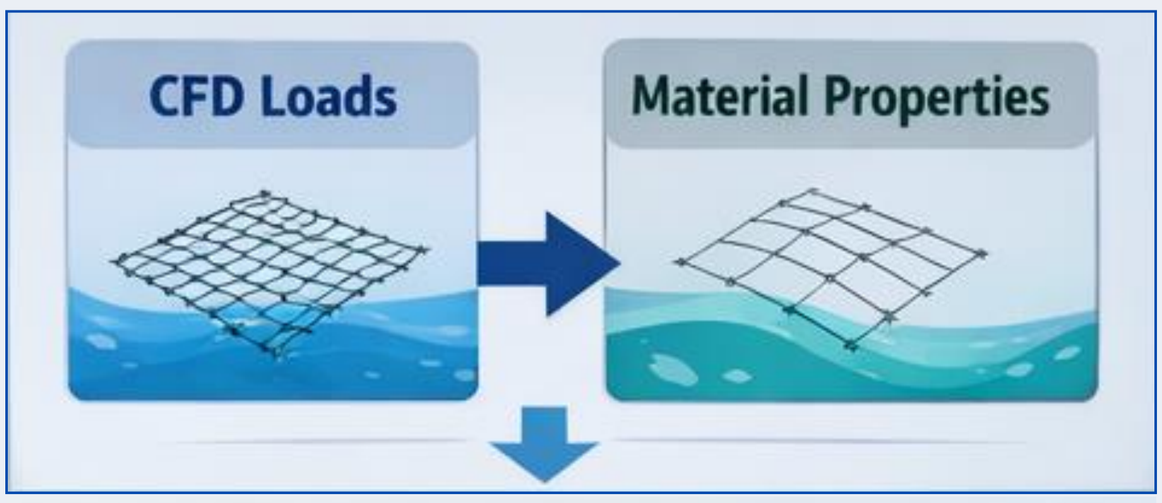
BIOAQUA-SIM applies a two-track methodology combining experimental material testing with numerical hydrodynamic analysis.

EXPERIMENTAL TRACK - MATERIAL AGEING AND TESTING

Selected materials will be tested before and after exposure to saline water, UV radiation, mechanical loading and biofouling in order to quantify changes in mechanical and physical properties.

NUMERICAL TRACK - HYDRODYNAMIC LOADING

CFD simulations are used to estimate hydrodynamic forces and pressure loads acting on aquaculture cage nets. Simulations consider different flow velocities and fouling scenarios to reflect realistic offshore and nearshore operating conditions.



LIFE CYCLE COST ASSESSMENT (LCCA)

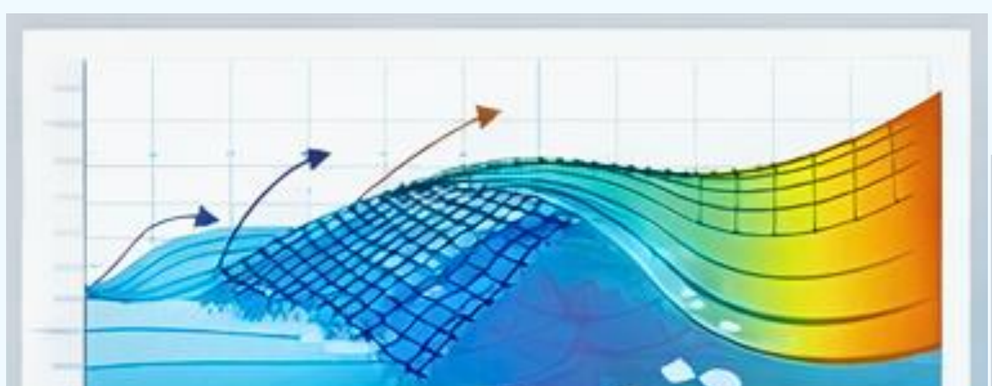
Comparing costs of biodegradable vs. conventional net systems.

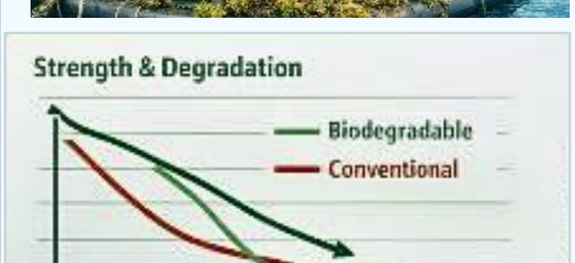
ENVIRONMENTAL BENEFITS & ECONOMIC FEASIBILITY

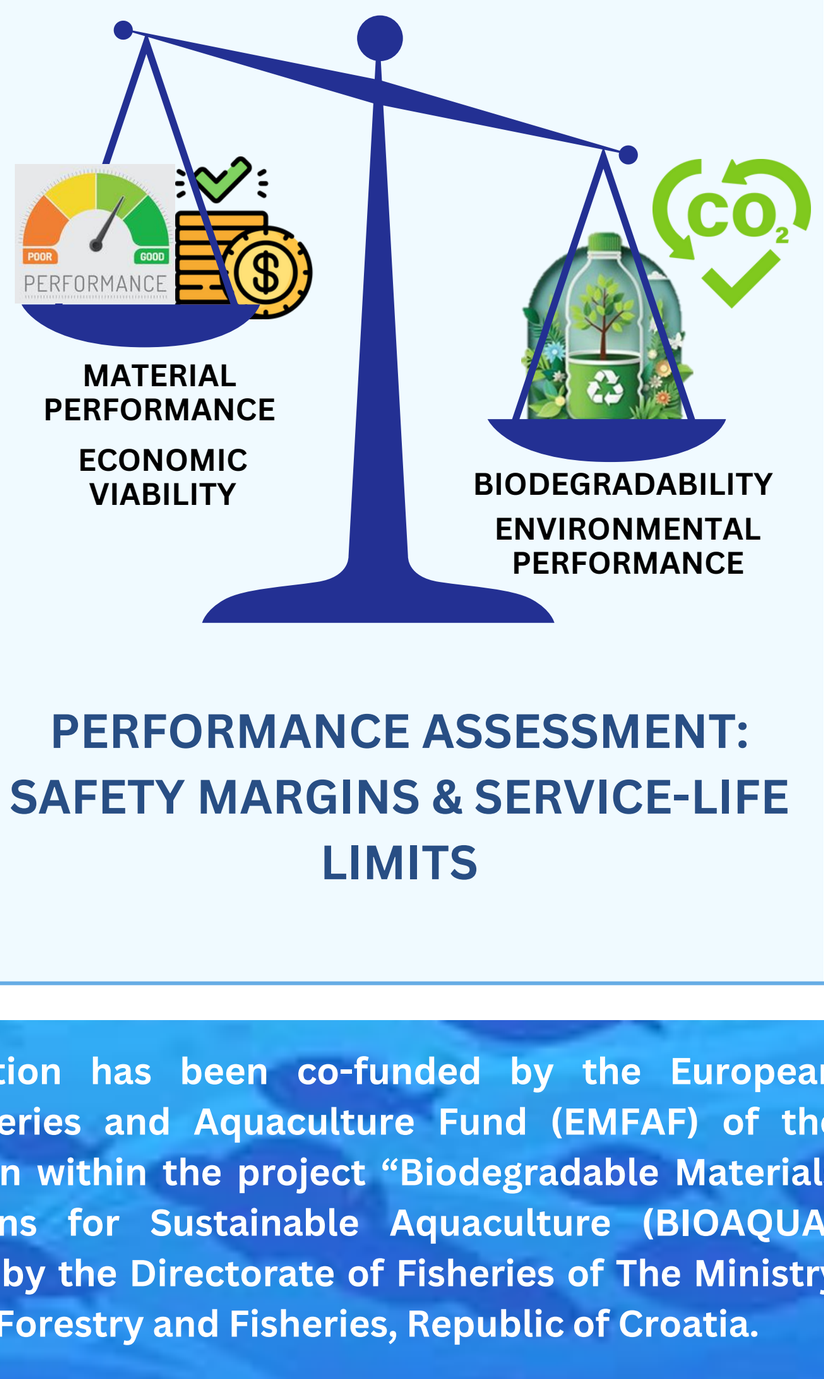
EXPECTED OUTCOMES

BIOAQUA-SIM is expected to provide a practical, evidence-based foundation for material selection and net system design in aquaculture. By linking hydrodynamic loading, material ageing, and economic performance, the project aims to support the development of net systems that maintain structural integrity during service while reducing long-term environmental impacts.

- Quantified degradation of biodegradable and conventional net materials under marine conditions
- CFD-based hydrodynamic load estimates for cage nets under flow and fouling conditions
- Integrated assessment of net performance, safety margins, and service-life limits
- Life cycle cost comparison of alternative aquaculture net systems
- Design and material selection guidelines for sustainable aquaculture nets







PERFORMANCE ASSESSMENT: SAFETY MARGINS & SERVICE-LIFE LIMITS

Sufinancira Europska unija

Program ZA RIBARSTVO I AKVAKULTURU

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