ISSN 2599-8293

European Commission

Research and Innovation

CORDIS Results Pack on food from aquatic ecosystems

Research and innovation for sustainable, climate resilient aquaculture and fisheries

A thematic collection of innovative EU-funded research results

April 2025

Contents

Editorial

Aquatic foods comprise animals and plants grown in or harvested from the ocean, lakes and rivers or sustainably farmed. Highly nutritious and with a smaller carbon footprint than land-based crops and livestock, foods from aquatic ecosystems are both good for us and our planet.

As our global population continues to grow, so does the demand for aquatic food, placing increasing pressure upon fisheries and aquaculture. In response to this challenge, the EU, the world's largest market for seafood products, is leading the transition towards sustainable fisheries and the conservation of aquatic ecosystems.

Furthermore, foods sourced from marine and freshwater environments play a key role in safeguarding Europe's food and nutrition security. Therefore, the EU is funding research and innovation into futureproofing European fisheries and aquaculture by conserving fish stocks, protecting biodiversity and mitigating the impacts of a changing climate.

Aquaculture is one of the world's fastest growing food production sectors and an important part of the EU's blue economy. It is also a major source of sustainable food under the European Green Deal. In addition, the common fisheries policy (CFP) promotes the sustainable management of traditional wild capture fisheries by eliminating wasteful or harmful activities and preserving healthy and productive marine ecosystems.

A sustainable food source

This new CORDIS Results Pack spotlights the importance of food from ocean and freshwater resources for global food and nutrition security and the potential for food production fully embedded in the wider aquatic ecosystem. The results also support the goals of the EU's CFP and the sustainable exploitation of fish stocks as outlined under the Farm to Fork strategy.

The work featured also aligns with the EU's research and innovation policy framework, Food 2030, which prioritises nutrition for sustainable and healthy diets, climate resilience and environmental sustainability, circularity and resource efficiency as well as innovation and empowerment of communities.

Highlighted projects include EU-funded research on aquatic food harvested by the fishing industry and farmed by the aquaculture sector to provide highly nutritious seafood while supporting direct and indirect employment in coastal and rural areas.

They cover a wide range of fields, such as fish feeding and breeding, low trophic aquaculture, mesopelagic biota and ecosystem-based management, while focusing on the development of digital tools and platforms for fisheries control. They also include natural ecosystem processes that improve sustainability, efficiency and economic performance by recycling nutrients and reducing environmental impacts in open-water and on-land aquaculture.

Focus on EU-funded research

This CORDIS Results Pack highlights 10 projects funded under the EU's Horizon 2020 and Horizon Europe research programmes. These projects prove the need for improving aquatic food and nutrition security while contributing to the preservation of aquatic ecosystem integrity.

Genetics and targeted feeding to improve fish farm yield

By developing novel feeds that fit the nutritional requirements of selectively bred fish, the AquaIMPACT project is hoping to increase yields, improve welfare and reduce the environmental impact of fish farming in the EU.

Seafood is a healthy food choice. On average we consume 24 kg (live weight) of fish or seafood a year, in the EU. We have been eating more and more seafood for centuries. The world's fish consumption in 2030 is projected to be 18 % higher than in 2018 and aquaculture is set to be the major contributor.

But fish farming is not just about food security – the sector has a significant economic impact too. According to EU (Eurostat) in 2021, an estimated 1.1 million tonnes of aquatic organisms were farmed in the EU, valued at EUR 4.2 billion.

A fundamental aim of both fish breeding and feed development is to improve resource efficiency by reducing mortality, controlling fish quality and improving fish health and welfare.

Around 57 000 people owe their jobs to the industry: working for approximately 14 000 companies. In 2021, Norway alone produced EUR 7.9 billion worth of farmed fish.

So the stakes are high when it comes to resolving some of the challenges the industry faces, which is where the EU-supported AquaIMPACT project comes in.

"A fundamental aim of both fish breeding and feed development is to improve resource efficiency by reducing mortality, controlling fish quality and improving fish health and welfare," explains Antti Kause, project coordinator based at the Natural Resources Institute Finland.

"It makes sense to develop novel feeds that fit the nutritional requirements of selectively bred fish, to reach the common aims more effectively. This has not been done before in farmed fish," he adds.

AquaIMPACT focused on the four main farmed fish species with the highest production volumes and value in the EU: Atlantic salmon, rainbow trout, gilthead sea bream and European sea bass. These species together represent 75 % in volume and 89 % in value of the total farmed finfish production in the EU.

Reducing environmental impact through fish breeding programmes

"Breeding programmes," says Kause, "change fish traits such as feed conversion ratios (FCRs) and the ability to absorb and retain protein and lipids." AquaIMPACT showed that when these traits change enough due to long-term breeding, the nutritional requirements of fish change also.

A 1 % improvement in the FCR in the four species in the EU equates to 30 000 tons less feed needed to produce the same number of fish. For farmers, this means a EUR 36-45 million reduction in feed costs (assuming EUR 1.20-1.50/kg price for feeds).

Reduced use of feed per kg of produced fish means a reduction of some 200 tons of phosphorus (P) and 900 tons of nitrogen (N) loading in water, and lower pressure for the original raw material use.

Breeding programmes aimed at disease resistance result in healthier fish. A small increase in survival due to increased disease resistance, of just 1 %, equates to an annual decrease in fish mortality of approximately 50 million fish in the EU. This also means there would be a major improvement in fish health and welfare, and a reduction in the need for use of medication.

Genotyping fish for selective breeding made more cost-effective

Genotyping is a key part of selective breeding. "In a breeding programme, the level of genetic superiority of thousands of individual fish is determined using two sources of information. The first concerns trait records assessing: growth; resilience; per cent of fillet; per cent of lipids; and disease resistance. The second is the DNA profile of individuals that is quantified by genotyping," Kause explains.

Until now, genotyping has been very costly. But the project has shown that currently available commercial DNA marker analysis is often unnecessarily detailed, and hence too expensive for fish farmers to embrace.

The project showed that costs can be reduced by a smaller number of DNA markers. This transition to the lower-cost DNA analysis has now happened, and such services are now available from genotyping companies, making the tool more accessible.

Exploring the genetics-nutritional model for fish farmers

AquaIMPACT proved that gut microbiota in farmed fish is probably impacted by diets, probiotics and the genetic background of the fish.

The project developed feed formulas that calculate the way a fish's nutritional requirements will change as a result of efficiencies brought about through selective breeding.

Typically, the more efficiently the fish uses the feed, the more nutrient-rich the food needs to be.

For example, if the FCR is improved by selection, and all other traits remain unchanged, the feed needs to contain more phosphorus to support healthy growth. From an environmental point of view, fish feeds are developed to contain less phosphorus, to minimise nutrient loading in the environment.

"This is a nice example of the logic of the genetics-nutritional model. The common solution for both breeders and fish nutritionists is hence to improve the retention efficiency of the fish, making the fish able to retain more phosphorus from the feed," Kause remarks.

A 360 degree approach to the challenges faced by fish farmers

From the development of hardware and software to automatically identify the body weight and body shape of fish, with minimum handling by humans, to smart approaches to genotyping, the project developed a diverse range of solutions.

"We have 11 companies selling the improved products and services that AquaIMPACT developed. In many cases, the people who did the research and development work are the same people who implement the results, making the knowledge transfer more direct," Kause notes.

"Our name, AquaIMPACT, arose from the feeling that the consortium should make a moderate but significant change, taking aquaculture breeding and feed development forward. At a personal level, the project has allowed people to develop their skills, learn from each other and progress in their career," Kause says.

PROJECT
AquaIMPACT - Genomic and nutritional innovations for genetically superior farmed fish to improve efficiency in European aquaculture

COORDINATED BY
Luonnonvarakeskus in Finland

FUNDED UNDER
Horizon 2020 - FOOD

CORDIS FACTSHEET
cordis.europa.eu/project/id/818367

PROJECT WEBSITE
projects.luke.fi/aquaimpact/

Encouraging uptake of sustainable low trophic aquaculture

Adopting a circular approach to aquaculture could help to feed a growing population in a highly sustainable manner.

Feeding a growing global population is one of the biggest challenges facing humanity. It has been estimated that we will have to produce twice as much food by 2050 as we do now.

"Agriculture currently occupies half the inhabitable land on Earth, uses 69 % of the available freshwater, and produces 25 % to 30 % of greenhouse gas emissions," notes AquaVitae project coordinator Philip James from Nofima in Norway.

"We need to diversify our food production systems away from unsustainable forms of resource extraction, and produce food in a way that does not have such a negative impact on the planet."

An integrated multi-trophic approach

One viable option is to create a sustainable and competitive aquaculture industry. Despite more than 70 % of the world's surface being covered by water, only 2 % of the world's food supply is sourced from the sea.

AquaVitae set out to address this, by finding ways of increasing production of low trophic species across the Atlantic Ocean. The project began by identifying tasty, nutritional species such as seaweed, abalone, oysters and mussels, as well as sea cucumber and sea urchins, as future sustainable food and food ingredient options.

The project also adopted an integrated multi-trophic aquaculture approach. Here, species from different trophic levels – from microalgae to finfish – were cultured together.

"The idea is that you can use waste products and nutrients from higher trophic levels to feed lower trophic level species," explains James. "This creates a circular economy, mitigating some of the environmental effects of growing single species separately."

The idea is that you can use waste products and nutrients from higher trophic levels to feed lower trophic level species.

Pilot farming on land and at sea

The project team carried out a number of pilots. "On land, you have a more defined system that you can control and measure," says James. "At sea, the environment is more dynamic. In this project, we looked at both."

In fjords off the Faroe Islands for example, the project team looked at salmon culture, to assess the beneficial effects of adding seaweeds and mussels. In more controlled environments on land, abalone were also cultured along with seaweeds and sea cucumbers.

The land-based culture of shrimp in ponds was also analysed to see what species might thrive from shrimp waste, and new sulfur-detecting sensors tested. Achieving the right levels of sulfur is critical for successful shrimp farming.

The project team also looked at consumer perceptions of aquaculture. Researchers found that consumers were willing to pay up to 50 % more for seafood products based on the high nutritional quality of the products, and up to 40 % more for products that are certified as environmentally friendly.

Benefits of the low trophic aquaculture approach

The project successfully demonstrated numerous benefits to low trophic aquaculture. The key findings are available in an accessible legacy booklet.

"For me, aquaculture of low trophic species is a no-brainer," adds James. "We need a lot more food, and we need to produce this in a sustainable way. Aquaculture is the most sustainable method."

Another highlight of the project for James was the comprehensive exchange programme for early-career researchers. This enabled 13 young scientists to spend time and carry out their work in another country. "These are the people that will carry on the results and the messages of AquaVitae into the future," he says.

PROJECT
AquaVitae - New species, processes and products contributing to increased production and improved sustainability in emerging low trophic, and existing low and high trophic aquaculture value chains in the Atlantic

COORDINATED BY
Nofima AS in Norway

FUNDED UNDER
Horizon 2020 - FOOD

CORDIS FACTSHEET
cordis.europa.eu/project/id/818173

PROJECT WEBSITE
aquavitaeproject.eu/

Nature-inspired aquaculture

As the world's demand for seafood rises, traditional aquaculture and fisheries face growing pressure. Could integrated multi-species systems be the key to a more sustainable future?

Integrated multi-trophic aquaculture (IMTA) leverages natural ecosystem processes to improve sustainability, efficiency, and economic performance. It integrates species from different trophic levels in the same system, allowing the feeds, waste, and nutrients from one species to be recycled and utilised by other species. IMTA can be practised in open-water and on-land systems, in marine or freshwater environments.

Developing IMTA production chains in the Atlantic

We brought together research labs and aquaculture industries across Argentina, Brazil, Ireland, the UK, and South Africa to design IMTA production chains in each of the regions.

Dating back 4 000 years to the late Han dynasty in Asia, IMTA is still in the pre-commercial phase of development in Western countries. The EU-funded ASTRAL project aimed to bridge this gap and establish experimental IMTA systems across the Atlantic region.

"We brought together research labs and aquaculture industries across Argentina, Brazil, Ireland, Scotland, and South Africa to design IMTA production chains in each of the regions," explains project coordinator Elisa Ravagnan.

The main goal was to increase circularity by up to 60 % compared to monoculture aquaculture and increase diversification of income for producers. ASTRAL employed both open-water and land-based IMTA. The latter involves land-based cultivation and utilises recirculating aquaculture systems and biofloc technology-based systems, enabling better control of environmental parameters and water quality. The former, however, is offshore cultivation where aquaculture infrastructure is anchored in the sea and continues to interact with the environment throughout.

Key deliverables and technological innovation

ASTRAL demonstrated the opportunities that IMTA production can create and assessed their sustainability through a series of evaluations, supported by technological development, partnerships, and knowledge exchange. Experimental IMTA labs validated species combinations, optimised culture techniques, and improved biosecurity measures. Infrastructure design also supported increased circularity and efficiency.

In terms of sustainability, environmental and socioeconomic assessments demonstrated that IMTA aligns with circular economy principles by enhancing bioremediation of nutrients and improving economic resilience in aquaculture communities. However, regulatory aspects, start-up investment costs, and licensing procedures remain barriers to the large-scale adoption of IMTA.

ASTRAL also made technological advancements which have been incorporated into a technology user guide for water quality and biomass monitoring. The guide introduces cost-effective kits, biosensors, AI-enabled image analysis, and microplastic detection tools. In addition, the AI data analytics platform can predict water quality and ecosystem interactions, allowing data-informed decision-making in IMTA operations.

An international aquaculture network

In addition to scientific advances, ASTRAL has played a key role in building international collaboration and knowledge exchange in sustainable aquaculture. The project led to the creation of the

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Atlantic Aquaculture Network, a stakeholder platform bringing together researchers, industry stakeholders, and policymakers to promote the uptake of sustainable aquaculture practices in the Atlantic region.

The consortium delivered technical training workshops in eight Atlantic countries and over 50 school clubs in the All-Atlantic Blue Schools Network. These actions aimed to establish an environmentally aware and well-trained future workforce.

Looking ahead, the next step for IMTA development is to expand production to commercial levels and address remaining regulatory and economic challenges. Following the success of ASTRAL, future initiatives can continue to mainstream IMTA into aquaculture, towards a more sustainable and resilient food production system for generations to come.

PROJECT
ASTRAL – All Atlantic Ocean Sustainable, Profitable and Resilient Aquaculture

COORDINATED BY
NORCE Norwegian Research Centre in Norway

FUNDED UNDER
Horizon 2020 - FOOD

CORDIS FACTSHEET
cordis.europa.eu/project/id/863034

PROJECT WEBSITE
astral-project.eu/

Harnessing blue circular potential for a green future

Resource depletion and waste threaten our ocean and waters. For a sustainable future, there is a need to make aquatic value chains circular and products and services bio-based.

Climate change and environmental degradation pose a fundamental threat to both Europe and the world. In response, the European Green Deal aims to reshape the EU into a modern, resource-efficient, and competitive economy. Its key objectives include achieving net-zero greenhouse gas emissions by 2050, fostering economic growth that is independent of resource consumption, and ensuring that all individuals and regions benefit from the transition without being left behind.

To meet these ambitious goals, there is a need for better utilisation of bio-resources and conservation of biodiversity, for resilient ecosystems and nutritious food. Integrated value webs that use interconnected, rather than linear, processes can support a more circular and sustainable economy.

Collaborative efforts towards a circular blue bioeconomy

The BlueBio-coordinated funding scheme was designed to advance the European blue bioeconomy.

"For a fully circular aquaculture and fisheries sector, we need to valorise waste and side streams and incorporate novel sustainable ingredients," highlights BlueBio coordinator Ingeborg Korme.

Since 2018, BlueBio has funded 49 research and innovation projects with a total investment of EUR 43 million. The primary objective has been to identify innovative ways to bring bio-based products and services derived from aquatic resources to market, thereby creating new value chains and enhancing sustainability within the sector.

For a fully circular aquaculture and fisheries sector, we need to valorise waste and side streams and incorporate novel sustainable ingredients.

Overall, BlueBio-funded projects have generated 49 functional foods/ingredients derived from marine organisms and over 80 new products and services. With nearly 50 industrial partners and over 300 stakeholders engaged across different projects, industry participation has played a central role in advancing research ideas to full-scale market applications.

Innovative technologies and new bioresources

One of the most promising areas explored by BlueBio-funded projects is the utilisation of aquatic bio-resources for innovative applications. The MARIKAT project, for example, has explored the potential of polysaccharides from microalgae to produce bioactive compounds for pharmaceuticals, food applications, and biodegradable materials. The Plastisea project has transformed high-purity polysaccharides into bio-based films and coatings, offering sustainable alternatives to plastic packaging.

BlueBio-funded projects have also contributed bio-based solutions for health applications ranging from wound healing to antibiotics. For example, the AquaHeal3D project has created a marine, 3D-printed wound-healing hydrogel dressing derived from salmon roe. The BIOSHELL project has developed functionalised

hydrogels from crustacean shells for wastewater purification. Similarly, BlueCC has extracted chitin-based compounds from invasive crab species that can be used in biomedicine and food preservation. Collectively, these projects demonstrate how innovative processing can unlock new value chains in the blue bioeconomy.

Sustainable aquaculture

One of the key areas of interest for BlueBio has been development of sustainable aquaculture to promote the recycling of nutrients and reduce environmental impact. For instance, the AquaTech4Feed project has formulated novel fish feeds from alternative protein sources, such as algae, duckweed, insects, and microbiomes. Low-trophic animals, such as sea stars and worms, have also been explored as sustainable food and feed sources (InEVal, SIDESTREAM).

The EuFish_SustainableGrowth project focused on underutilised European fish species to create innovative seafood products. This has contributed to a zero-waste approach and encouraged more responsible and sustainable fishing practices. BESTBROOD has introduced genetic markers and bioindicators to refine breeding techniques and support efficient fish farming practices.

Beyond individual projects, BlueBio developed a comprehensive database with information on research projects in areas such as fisheries, aquaculture, seafood processing, and marine biotechnology. This database serves as a valuable resource for stakeholders, facilitating knowledge exchange and identifying gaps and synergies in the blue bioeconomy sector.

PROJECT
BlueBio – ERA-NET Cofund on Blue Bioeconomy – Unlocking the potential of aquatic bioresources

COORDINATED BY
Norway Research Council in Norway

FUNDED UNDER
Horizon 2020 - FOOD

CORDIS FACTSHEET
cordis.europa.eu/project/id/817992

PROJECT WEBSITE
bluebioeconomy.eu/

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How digital tools help balance marine conservation and food security

Explore how data-driven solutions are transforming fisheries management, empowering scientists and policymakers to achieve sustainable fishing.

Balancing food security with marine conservation remains a global challenge. Overfishing, habitat degradation, and climate change are putting increasing pressure on marine ecosystems. This makes it crucial to adopt ecosystem-based fisheries management (EBFM), a comprehensive strategy that integrates ecological, economic, and social aspects of fisheries along with oceanographic, environmental and climatic drivers.

Enter the EcoScope project, a collaborative effort involving 24 partners from academia, research, NGO, and SMEs, developing cutting-edge digital tools to promote and advance EBFM.

"Assessing the human impact on organisms, habitats, and ecosystems; tracking fisheries and stock trends; and evaluating ecosystem health using novel indicators and technologies – all key outputs of EcoScope – are prerequisites for effective ecocentric fisheries management," states Athanassios Tsikliras, EcoScope project coordinator.

Harnessing data for smarter fisheries management

To provide scientists, policymakers, and stakeholders with the resources needed to make informed, sustainable decisions, the project has developed four practical solutions.

EcoScope's interoperable platform has organised and standardised climatic, oceanographic, biogeochemical, biological, and fisheries data across European seas. Users can access these datasets in real time through interactive mapping layers, allowing them to visualise multiple data points simultaneously, such as fleet activity, fish distribution, and ecosystem productivity.

The EcoScope toolbox is a decision-support system that evaluates fisheries management scenarios using ecosystem models, socio-economic indicators, and assessment tools. It provides a comprehensive scoring system, helping decision-makers assess the combined impacts of various management strategies.

Another key output is EcoScope's academy, the educational pillar of the project. To equip scientists, students, policymakers, and other stakeholders with the knowledge needed for ecocentric fisheries management, it offers online and hybrid courses, webinars, and online games.

The fourth solution is the Ecoscope app, a mobile application that enables citizens to report environmental hazards, removal or stranding of protected species, and marine pollution. Reports are submitted online to local management authorities or port police, fostering community involvement and improving cooperation with authorities.

Supporting fisheries management in data-poor regions

The project has also pioneered novel assessment methods for fisheries in data-poor areas, which have historically been excluded from EBFM programmes due to a lack of data.

"In addition to the wide number of data-deficient areas across the world's oceans, stocks that are of no commercial value have generally been overlooked in assessments," says Tsikliras.

The CMSY++ method assesses commercial stocks using only historical catch data. AMSY, a newly developed method, evaluates non-commercial species based on abundance trends derived from scientific surveys, using catch-per-unit-effort (CPUE) or biomass estimates. Together, these innovations provide a more complete picture of marine ecosystem health.

Our approach can hopefully lead to a shift towards the perception that ecocentric fisheries management, albeit demanding and challenging, is a necessary and feasible option that will aid in restoring the sustainability of fisheries and ensure balance between food security and healthy seas.

Engaging policymakers and stakeholders

Policymakers, advisory bodies, and other stakeholders have played a pivotal role in the project. Two foresight workshops gathered input from key stakeholders, including representatives from the European Commission, regional fisheries management organisations, environmentalNGOs, and scientific associations. These workshops helped refine EcoScope's research and outcomes.

"Our approach can hopefully lead to a shift towards the perception that ecocentric fisheries management, albeit demanding and challenging, is a necessary and feasible option that will aid in restoring the sustainability of fisheries and ensure balance between food security and healthy seas," adds Tsikliras.

PROJECT
EcoScope - Ecocentric management for sustainable fisheries and healthy marine ecosystems (EcoScope)

COORDINATED BY
The Aristotle University of Thessaloniki in Greece

FUNDED UNDER
Horizon 2020 - FOOD

CORDIS FACTSHEET
cordis.europa.eu/project/id/101000302

PROJECT WEBSITE
ecoscopium.eu/

Digital innovations for sustainable EU fisheries

Fisheries management needs a digital revamp. Smart tools that empower fishers have the potential to secure and sustain the seafood supply chain.

The fishing industry provides highly nutritious seafood to millions worldwide while supporting direct and indirect employment in coastal regions. However, human activities such as overfishing, environmental degradation and climate change contribute to declining fish populations, threatening biodiversity and food security.

The EU's common fisheries policy aims to regulate fishing activities and align them with the sustainable exploitation of fish stocks as outlined by the EU's 'Farm to Fork' strategy. The integration of digital technologies is essential for ensuring compliance with sustainability standards and improving socio-economic outcomes for fishing communities.

Fisheries digital transformation

To contribute to sustainable management of EU small-scale fisheries, the EU-funded Fish-X has created a secure and interoperable digital platform.

"Successful fisheries management relies on several key factors, including stricter enforcement of regulations, stakeholder engagement, and science-based decision-making," states project coordinator Jana Stünkel.

To help enforce and control fisheries regulations more effectively and to protect endangered fish stocks, the consortium has generated the Fish-X Data Space. Integrated into the GAIA-X infrastructure, it connects fisheries stakeholders and enables the secure and controlled sharing of fisheries data.

The Insight Platform serves as a cartographic user interface displaying aggregated and anonymised fisheries data, ensuring fisher privacy while providing key insights. Instead of tracking vessel movements, it displays density maps and statistical fishing data to inform fisheries management and marine spatial planning.

The Traceability Platform employs blockchain technology to ensure transparent and comprehensive mapping of a seafood product from harvest to sale. A consumer-friendly traceability app allows users to scan seafood products for detailed information, promoting transparency, sustainability and fair economic returns for fishers.

Real-world implementation

To develop the Fish-X digital tools, the consortium has utilised real-world data from use cases in the Mediterranean, Atlantic and Baltic Sea. Development of the Insight Platform has been based on information obtained from small-scale and recreational fisheries. To facilitate monitoring of fishing activities, satellite-mediated devices on vessels and fishing gear have been deployed. Such devices also support management of fisheries resources.

Results from pilot questionnaires indicate an overwhelmingly positive response from participating fishers with the majority indicating a desire to keep the tracking devices. This enthusiasm highlights the importance of vessel tracking in an increasingly competitive maritime environment where offshore wind farms, marine protected areas and other sectors vie for space. Fishers see the value of geolocation data as evidence to assert their traditional fishing grounds during consultation processes.

The traceability application has been based on continuous feedback from stakeholders throughout the fisheries supply chain in the German Baltic Sea region. In consultation with a few selected testing partners, the goal is to ensure seafood transparency from catch to consumer.

Fish-X not only addresses the immediate challenges faced by the fishing industry but also paves the way for the long-awaited digital transformation expected to benefit both the environment and the communities that depend on it.

Towards more sustainable fisheries

As the project progresses, further development and testing will continue until its completion. Additionally, several policy recommendations have been published, contributing to EU fisheries governance.

"Fish-X not only addresses the immediate challenges faced by the fishing industry but also paves the way for the long-awaited digital transformation expected to benefit both the environment and the communities that depend on it," concludes Stünkel.

PROJECT
Fish-X – FISH-X- PROVIDING A EUROPEAN FISHERIES DATASPACE THROUGH A CONSULTATIVE APPROACH

COORDINATED BY
TransMarTech SH in Germany

FUNDED UNDER
HORIZON - Food, Bioeconomy Natural Resources, Agriculture and Environment

CORDIS FACTSHEET
cordis.europa.eu/project/id/101060879

PROJECT WEBSITE
fish-x.eu.eu/

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Exploring food sources in the ocean twilight zone

Are there alternative marine resources we can explore to meet the human demand for food? The MEESO project has dived deep into the ocean to find out.

The mesopelagic zone, often referred to as the twilight zone, lies between 200 and 1 000 metres below sea level. It is home to a remarkable diversity of small fish and other organisms, which migrate to the surface, transporting nutrients and carbon. Despite its crucial role in the oceanic ecosystem, the mesopelagic zone has remained largely unexplored.

Insights into mesopelagic organisms

The EU-funded MEESO project is a pioneering effort to explore the mesopelagic zone's vast potential. The consortium investigated the biomass and distribution of mesopelagic species in the North Atlantic Ocean, seeking to address the potential of developing sustainable fisheries.

Our goal was to see if we can find food deep below the ocean's surface to feed the world's growing population – without repeating the mistakes of overfishing, ecosystem destruction and biodiversity loss that we have previously made in shallower waters.

"Our goal was to see if we can find food deep below the ocean's surface to feed the world's growing population – without repeating the mistakes of overfishing, ecosystem destruction and biodiversity loss that we have previously made in shallower waters," explains project coordinator Webjørn Melle.

To address the low density of mesopelagic species, researchers employed acoustics, optical technology and developed new trawl technology which allowed them to map the abundance and movement patterns of these species. The generated maps highlighted areas with significant mesopelagic biomass and helped explain the spatial dynamics of mesopelagic communities. Importantly, the improved accuracy of biomass estimation ensured that exploitation will not lead to overfishing and disturbance of the delicate balance of the oceanic ecosystem.

Development of new catch methods

Mesopelagic fish species may meet growing seafood demands as promising raw material for food supplements as well as fish feed. However, the MEESO consortium had to address challenges associated with the depth that mesopelagic species live in, their small sizes and concentrations.

"Making a living from catching these species is not going to be easy and requires technological innovations to improve catches and onboard conservation and/or processing," emphasises Melle.

Researchers developed and tested commercial trawls and methods for processing the catch, both at sea and on land. Investigation of processed biomass has led to the identification of biologically active compounds as well as nutritional quality and the presence of contaminants.

Moreover, the development of mathematical models helped researchers predict the possible trajectories for mesopelagic resources, considering their internal dynamics and climate change.

Sustainable exploitation

With malnourishment being a global issue, seafood has great potential to contribute to food security. MEESO's market analyses exploring potential uses of mesopelagic species have identified promising market opportunities in food production.

However, policy decisions on mesopelagic fishery should not only consider the economic viability but also its impact on the wider ecosystem, and particularly the role of the mesopelagic zone in the global climate system. Considering that many mesopelagic species migrate to the ocean's surface to feed during the night, they are implicated in pelagic trophic

interactions and contribute to carbon sequestration from the ocean's surface.

Collaboration with policymakers, industry stakeholders and environmental organisations will help develop regulations and monitoring systems to ensure the responsible management of mesopelagic fisheries. Moreover, MEESO'S sister project, SUMMER, is investigating the repercussions of fishing at such great depths. Collectively, the work of the two projects is expected to lead to the development of new marine resources, while maintaining the resilience of our oceans.

PROJECT
MEESO – Ecologically and economically sustainable mesopelagic fisheries

COORDINATED BY
HAVFORSKNINGSINSTITUTTET in Norway

FUNDED UNDER
Horizon 2020 - FOOD

CORDIS FACTSHEET
cordis.europa.eu/project/id/817669

Feeding the future with sustainable aquaculture

As seafood demand rises, natural ecosystems face increasing pressure. Innovative solutions, from zero-waste feeds to disease-resistant fish, are shaping a greener, more resilient industry.

Aquaculture, the aquatic equivalent of agriculture, facilitates fish production under controlled conditions. It provides a critical pathway to replenish wild stocks and support biodiversity conservation. With the world population projected to increase by 30 % by 2050, the issue of ensuring a safe and nutritious food supply while minimising environmental impact has become more pressing than ever.

Diversification of European aquaculture

We wanted to demonstrate that sustainability and profitability in aquaculture can go hand in hand. We combined scientific research, industry collaboration, and real-world validation to improve efficiency, resource use, and resilience in aquaculture systems.

To meet future demand and enable long-term sustainability, the European aquaculture sector is aiming for 4.5 million tons of sustainable seafood annually. However, current aquaculture production involves a small number of species, including salmon, trout, sea bass, sea bream, mussels, and oysters.

The EU-funded NewTechAqua project was established to advance and diversify European aquaculture through technologically advanced, resilient, and sustainable solutions.

"We wanted to demonstrate that sustainability and profitability in aquaculture can go hand in hand. We combined scientific research, industry collaboration, and real-world validation to improve efficiency, resource use, and resilience in aquaculture systems," explains project coordinator Alessio Bonaldo.

Sustainable solutions

NewTechAqua replaced wild-captured fishmeal and fish oil with by-products of fisheries, aquaculture, and microalgae to create zero-waste diets. New feeds enriched with natural additives enhanced fish health and significantly reduced disease incidence, such as *Sparicotyle chrysophrii* in sea bream. Microbiome application studies introduced novel means of improving fish health through tailored nutrition.

By leveraging big data and artificial intelligence, the consortium developed epidemiological models that predicted disease outbreaks in salmon and Mediterranean species. They also enhanced disease resistance in key aquaculture species, such as oysters, using various genomic selection approaches.

NewTechAqua demonstrated sustainable farming systems, such as recirculating aquaculture where water is cycled and reused after mechanical and biological filtration. Biofloc technology was also tested to enhance the growth of grey mullet by using beneficial microorganisms to improve water quality and recycle nutrients.

Real-world conditions testing

Many of NewTechAqua's innovations were tested in the field under commercial environments. Validation was a rigorous process, beginning with training aquaculture experts through webinars and classroom learning, followed by lab-scale tests in controlled environments.

The consortium compared the most promising diets for their impact on fish growth, immunity, and microbiome stability. There were impressive gains in health and sustainability, identifying the potential of NewTechAqua to enhance the

industry's environmental performance, as well as its economic competitiveness and long-term sustainability.

Project recognition

NewTechAqua has had a tangible and far-reaching impact on shaping the future of sustainable aquaculture across the Mediterranean region. Several of the companies involved in the project are currently commercialising some of the most significant innovations to ensure that they are translated into tangible benefits for the sector.

"The territorial impact of NewTechAqua extends beyond the European Union, reaching aquaculture stakeholders in non-EU Mediterranean countries," highlights Bonaldo.

This wide-reaching impact has been recognised by two prestigious awards. The 2023 WestMed Award for Sustainable Fisheries and Aquaculture Development acknowledged NewTechAqua as an exemplary project that embodies sustainability, innovation, and resilience in Mediterranean aquaculture. Moreover, the MedFish4Ever Award for Innovative Practices in Aquaculture recognised the project's role in developing scalable, cutting-edge solutions to improve regional cooperation and sustainable marine aquaculture practices.

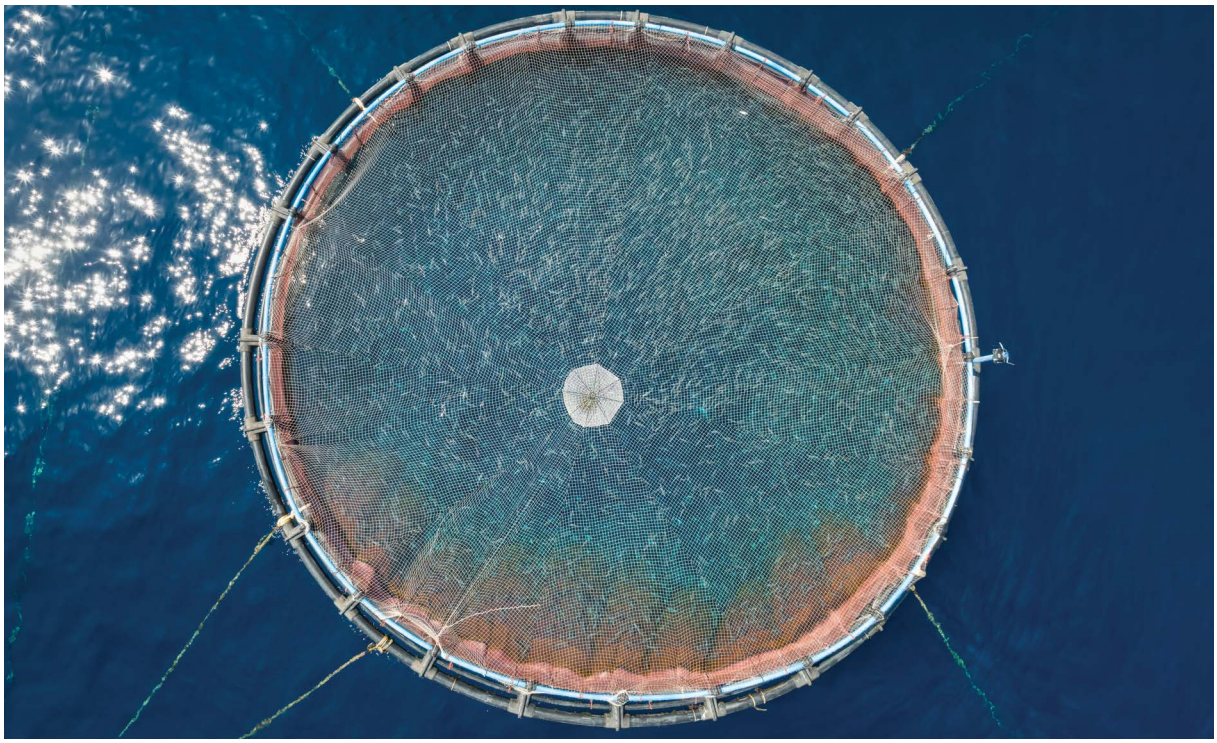
PROJECT
NewTechAqua - New Technologies, Tools and Strategies for a Sustainable, Resilient and Innovative European Aquaculture

COORDINATED BY
University of Bologna in Italy

FUNDED UNDER
Horizon 2020 - FOOD

CORDIS FACTSHEET
cordis.europa.eu/project/id/862658

PROJECT WEBSITE
newtechaqua.eu/



Fishing for solutions: how to achieve sustainable fisheries

The future of fishing is here. The SEAwise project is making sustainable fisheries a reality with cutting-edge research and smart ecosystem-based policies.

Fisheries play a vital role in Europe's economy and coastal communities, providing sustenance, employment and social activities. However, balancing economic benefits with sustainable ecosystem management is a challenge exacerbated by climate change and increased competition for marine resources and space.

SEAwise is designed to take the concept of EBFM and translate it into a fully operational approach for decision-makers to deploy.

Ecosystem-based fisheries management (EBFM)is an approach that considers the social and economic benefits of fisheries alongside the environmental impacts. The SEAwise project aims to understand the current EBFM landscape in Europe and facilitate the broad implementation of this approach.

"SEAwise is designed to take the concept of EBFM and translate it into a fully operational approach for decision-makers to deploy," states Anna Rindorf, SEAwise project coordinator.

Integrating knowledge for better fisheries management

Project work centres on exchanging and integrating knowledge about human well-being, changes in fish stocks and fishing effects on ecosystems. Using models, it assesses the impacts of closed fishing areas, management strategies for specific fleets, and catch- or effort-based approaches. The project draws from case studies in the North Sea, Baltic Sea, Mediterranean Sea and Western waters, enabling a comprehensive and context specific understanding of EBFM in Europe.

SEAwise research points to declines in growth and the number of new fish emerging in many stocks. But it also shows that with different management strategies the total weight of fish populations can still be high. The project analysed various management approaches, focusing on small-scale and large-scale fisheries. It used socioeconomic models to predict economic impacts, carbon emissions, and other factors linked to fisheries behaviour and fishing communities' resilience.

Balancing management strategies and sustainability

Results indicate that a balanced approach can mitigate negative socioeconomic impacts while reducing carbon emissions per kilogram of fish landed. This approach is positioned between the current management system and a sustainable fishing mortality providing the maximum long-term yield (FMSY) with a strict landing obligation, which limits the discarding of unwanted fish at sea.

"Across case studies, the status quo management performed poorly, while management based on FMSY as a target with strict implementations of a landing obligation led to increased spawning stock biomass (the portion of a fish population capable of reproducing), lower fishing mortality level and small increases in long-term landings," explains Rindorf.

The project also investigated the effectiveness of closed areas in reducing bycatch and protecting marine habitats. Findings suggest this method can be truly effective if designed appropriately. "If specific fishing techniques were prohibited in fit-to-purpose areas, it can lower the risk of incidental bycatch and prevent seafloor degradation," Rindorf adds.

Innovative tools for fisheries management

SEAwise is delivering tools, based on high-quality predictive models, that present ecological and social impacts of and on fisheries in an accessible format. These tools facilitate discussions among managers and stakeholders, ensuring policy decisions are based on clear insights.

One of the project's key innovations is the extension of multispecies-multifleet models. Unlike traditional single-species models, these simulations consider interactions between multiple species, fishing fleets, gear types and landing locations. This allows for a more holistic assessment of fisheries management measures, capturing ecological and economic considerations.

SEAwise also developed an online advice tool to provide comprehensive insights into fisheries management. Catering for diverse audiences, it provides an overview of the topic for general users and detailed data for managers, scientists and stakeholders.

PROJECT
SEAwise - Shaping ecosystem based fisheries management (SEAwise)

COORDINATED BY
Technical University of Denmark in Denmark

FUNDED UNDER
Horizon 2020 - FOOD

CORDIS FACTSHEET
cordis.europa.eu/project/id/101000318

PROJECT WEBSITE
seawiseproject.org/

Sustainable management of our deep oceans

While protecting the mysterious mesopelagic oceanic zone is critical, microbial communities that live here could be sustainably exploited for new pharmaceuticals.

The mesopelagic zone of oceans begins at depths where only 1 % of light can reach and ends where there is no light at all. This covers depths of between 200 and 1 000 metres, depending on the region, and accounts for about 20 % of our ocean's volume.

We wanted to identify the best methods for estimating biomass and biodiversity in this zone, and support ecosystem-based management.

While this oceanic zone is estimated to contain nearly 90 % of pelagic fish biomass, much of this region remains underexplored. Massive potential in terms of fishmeal production and the discovery of new molecules for nutraceuticals and pharmaceuticals is therefore underexploited.

"This is one of the least explored ecosystems on Earth," notes SUMMER project coordinator Raúl Prellezo from AZTI in Spain. "We wanted to identify the best methods for estimating biomass and biodiversity in this zone, and support ecosystem-based management."

Estimating biomass within the mesopelagic zone

To achieve this, the project conducted surveys of fish populations at sea and combined these with existing data. Lab-based work such as gut content analysis was also carried out.

"Using the information gathered, we were able to estimate biomass within this zone," explains Prellezo. "We were also able to estimate the composition of this ecosystem, its role in the carbon cycle, and the relationship with other species and sea layers."

Interesting findings were made. For example, the SUMMER project demonstrated how daily vertical excursions of mesopelagic fish significantly enhance carbon sequestration (i.e. the capture and storage of carbon) and shed light on feeding interactions between mesopelagic species.

The project's findings were combined to create a decision assessment tool. This is designed to enable fisheries and ecosystem management services to consider all factors when looking at opportunities for sustainable commercial exploitation. This is timely, given growing industry focus on the commercial potential of the mesopelagic zone.

Mesopelagic microbial communities and new pharmaceuticals

The results of the SUMMER project suggest that exploiting fish for human consumption from this region, and transforming catches into fishmeal and fish oil, would be hard to make financially viable. "In fact, we obtained data suggesting significant risks of overfishing," says Prellezo. "This underlines the need to protect this zone."

On the other hand, the project team identified several unique biochemical traits from mesopelagic microbial communities that could be promising sources for new pharmaceuticals.

"Our research found that the mesopelagic zone is rich in microbial diversity, and capable of producing unique bioactive compounds," adds Prellezo. "This could constitute a sustainable avenue for exploiting this zone."

Protecting important marine ecosystems

The SUMMER project has contributed to our understanding of this mysterious zone in our oceans and underlined the importance of caution when looking to exploit fish populations. Combined analysis suggests that obtaining fishmeal and fish oil from mesopelagic populations would be challenging. Further research is therefore needed to investigate commercial viability here.

"A clear message from this project is that under current economic and technical conditions, it is not worth exploiting this zone," notes Prellezo.

"On the other hand, we have learned more about how nutrients and organic carbon are transported from the surface to deep-sea layers, and how this could be crucial for climate regulation. Our recommendation would be to protect this sea layer and explore microbial communities that could be sustainably exploited."

PROJECT
SUMMER - Sustainable management of mesopelagic resources

COORDINATED BY
AZTI in Spain

FUNDED UNDER
Horizon 2020 - FOOD

CORDIS FACTSHEET
cordis.europa.eu/project/id/817806

PROJECT WEBSITE
summerh2020.eu/

CORDIS Results Pack

Available online in six language versions: cordis.europa.eu/article/id/457663

Published
on behalf of the European Commission by CORDIS at the
Publications Office of the European Union
L-2985 Luxembourg
LUXEMBOURG

cordis@publications.europa.eu

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This Results Pack is a collaboration between CORDIS and the European Commission's Directorate-General for Research and Innovation (DG RTD).

Print	ISBN 978-92-78-44810-3	ISSN 2599-8285	doi:10.2830/4608660	OA-01-25-046-EN-C
PDF	ISBN 978-92-78-44809-7	ISSN 2599-8293	doi:10.2830/1085840	OA-01-25-046-EN-N

Luxembourg: Publications Office of the European Union, 2025

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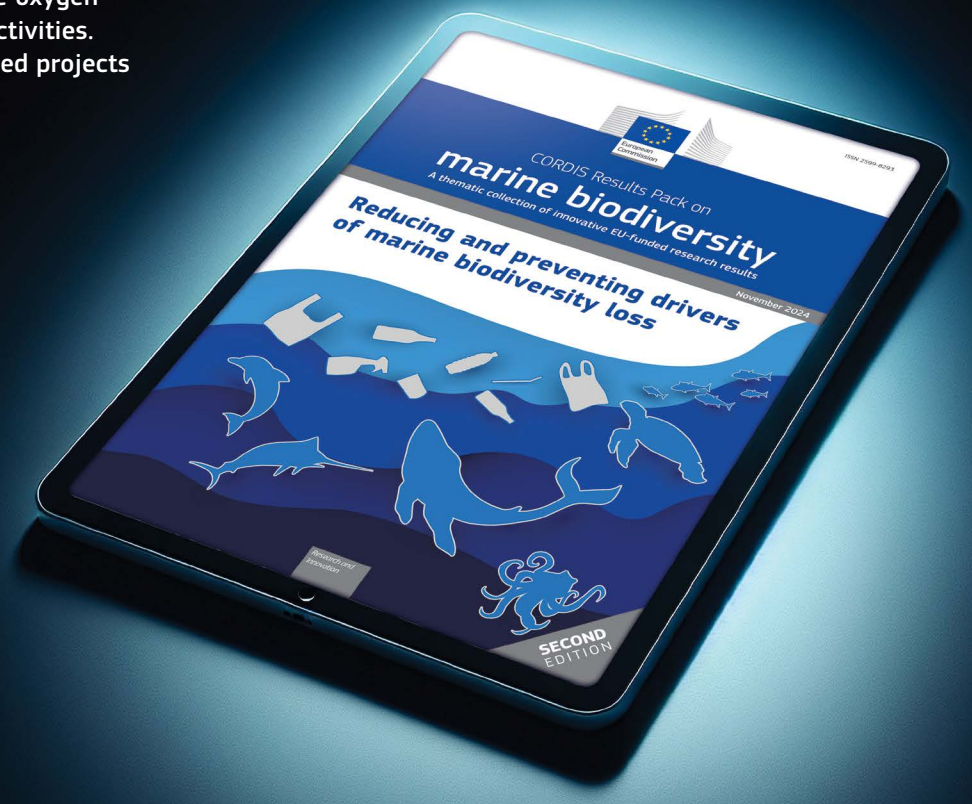
RESULTS PACK ON MARINE BIODIVERSITY

The world's ocean, which feeds us, regulates our climate and generates much of the oxygen we breathe, is threatened by human activities. This Results Pack features 13 EU-funded projects working to protect marine ecosystems and conserve their biodiversity.



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