global seaweed coalition

European Investment Bank

# Financing opportunities for EIB in support of sustainable seaweed and bivalve sectors in the EU, and criteria to ensure their sustainability

March 2025

Photo: Ocean Rainforest

# Disclaimer

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This document has been produced with the financial assistance of the European Investment Bank (EIB). The views expressed herein are those of the authors, the Global Seaweed Coalition, and do not represent the views of the EIB.

Hosted by the UN Global Compact, the Global Seaweed Coalition is a global partnership established to support the safety and sustainability of the seaweed industry as it scales up and to unite a fragmented market through a unified vision and goals. The Global Seaweed Coalition aims to support a seaweed industry that will make a significant contribution to the United Nations’ Sustainable Development Goals through improving public health and food security, alleviating poverty, renewing marine ecosystems, and mitigating climate change.

# Objectives of this report

Contribute to understanding how the European Investment Bank (EIB) can support the nascent seaweed sector and further develop the bivalve sector in Europe through debt financing to achieve its potential for growth in a sustainable manner, and identify clear criteria to ensure its sustainability.

# Executive summary (1/3)

*Introduction*

- **Seaweed and bivalve aquaculture** can restore **ocean health**, mitigate **climate change**, reduce resource overexploitation, and **improve livelihoods**, especially in coastal areas. They offer nutritious food, substitute plastics, sequester carbon, and restore biodiversity, **aligning with the EU's blue economy and climate goals.**
- Despite a tripling of start-ups and investments between 2010 and 2021, European seaweed companies face financial, production, market knowledge, and governance challenges. The European bivalve industry, while established, also needs modernization and investment to improve competitiveness, sustainability and climate resilience.
- **The European Investment Bank (EIB) prioritizes blue economy investments**, supporting sustainable seafood production and coastal resilience. EIB support could significantly boost the algae and bivalve industries, aiding in developing seaweed farms, processing facilities, and biorefineries in Europe. Consequently, the EIB commissioned this report to the Global Seaweed Coalition to **better understand how it can support the nascent seaweed sector and further develop the bivalve sector in Europe through debt financing** to achieve its potential for growth in a sustainable manner and identify clear criteria to ensure its sustainability.

*Seaweed and bivalves: status and potential of regenerative mariculture in Europe*

- Seaweed production in Europe (c. 300k wet tonnes per year) is still **dominated by wild harvesting**, but seaweed aquaculture is growing with around **75 seaweed farms** as of today, accounting for 4% of the total seaweed production in Europe. Today, around 75% percent of seaweed is used for human consumption, with the remaining c. 25% is used in personal care, nutraceuticals, soil fertilizers, and animal feeds**. 200+ start-ups** have emerged over the past decade, trying to revolutionize the way seaweed is produced and valorised. Market forecasts all point to a **double digit positive CAGR**[1] over the next decades for seaweed products. To unleash its potential, the European seaweed industry needs to overcome certain awareness, technological and regulatory barriers. However, European seaweed also benefits from an **unprecedented political support** and can leverage a **rich and solid network** of enabling organisations.
- Europe accounts for 4% of global bivalve production, 26% when excl. China. With **553k tonnes produced in 2021**, bivalves are the most produced commodity group farmed in the EU aquaculture (49% of EU aquaculture volumes). The European bivalve industry is worth €1.27B, dominated by 3 groups of species (**Mussels, Oysters, Clams**), those are mostly cultured (90% vs. 10% wild catch) and they account for 99% of EU bivalve production. Mussel is by far the most farmed bivalve species in EU in terms of volumes (>75%), with a production mostly concentrated in 3 countries: Spain, France and Italy. EU mussels' volumes decreased over the past 2 decades, more than compensated by price increases leading to a 2022 production 33% higher than 2014 with volumes 7% lower. Oysters represent 4 times less volumes than mussels in EU aquaculture, but almost as much overall value (€466m in 2021), with France being by far the leading producer. Clams account for a minor part of farmed bivalve volumes in EU but catch up with mussels and oysters in terms of overall value (€327m in 2021), with Italy being a strong leader. Although the EU production of bivalves remained stable recently, several factors including climate change induced ones could make it challenging for the years to come.



1 Compound Annual Growth Rate

# Executive summary (2/3)

*Investment opportunities for the EIB in the seaweed and bivalve sectors in Europe*

- The EIB has begun to step up its lending and advisory activities in marine-related sectors, including €229 million for fisheries and aquaculture between 2019 and 2023, and wants to investigate how to further support the European bivalve and seaweed European sectors through debt financing. **Seaweed and bivalve aquaculture indeed need funding to scale up and become more efficient / resilient** to climate change and the typology of companies (mostly SMEs) made them **more likely to benefit from debt funding** than equity (except high growth start-up profile exceptions). This report identified 5 debt financing opportunities for seaweed and 5 for bivalves, through 20+ interviews with sector experts and desktop research.
- **Debt financing opportunities identified for the seaweed industry in Europe include**:

1. **Revolving loans**, with an average deal size €200k – €1.5 m, to provide access to working capital to manage seasonality of spends, payment delays from public grants and subsidies
2. **Seaweed farming infrastructure**, with an average deal size €500k – €2 m to finance new lines, moorings, boats, basins, etc. to increase seaweed production; or sensors, software or hatchery to optimize it
3. **Seaweed processing and logistics**, with an average deal size €500k – €5 m to finance capex for primary processing (e.g., dryer), single application processing (e.g., bio-stimulants) or logistics (e.g., warehouse)
4. **Biorefinery**, with an average deal size €20m – €50m to finance construction and first years of operation of seaweed biorefinery facility, demo plant or commercial-scale plant
5. **M&A**, with an average deal size €1m – €10 m to finance consolidation between players, vertical integration (e.g., production + products) or horizontal (massification of production/ processing)

- **Debt financing opportunities identified for the bivalve industry in Europe include:**

1. **Revolving loan**, with an average deal size €100k – €1 m, to provide access to working capital to manage seasonality of spends, payment delays from public grants and subsidies, as well as temporary drops in activity
2. **Farming infrastructure and green transition**, with an average deal size €100k – €2 m, to finance land-based basins for adaptation to viruses / heat waves, new farming infrastructure, hatchery to optimize spat resilience; and solutions to renew equipment and farm sites with climate-friendly alternatives
3. **Mechanization**, with an average deal size €20k – €500k, to finance new equipment to mechanize seeding / bivalve management and handling / harvesting
4. **Buyout and rehabilitation**, with an average deal size €500k – €3 m, to finance takeover of a business, e.g. in the case of a transfer during retirement, and/or the rehabilitation of disused shellfish farming sites
5. **IMTA**, with an average deal size €200k – €1m, to finance diversification of activities to include for instance seaweed farming as additional income stream – cf. seaweed financing opportunities

# Executive summary (3/3)

*Operationa-lizing investment opportunities*

- 4 deployment strategies have been identified for the EIB to deploy debt into the European bivalve and seaweed industries:
  - **Direct EIB investment** : Direct deployment, on a deal-by-deal basis, by existing investment structures within the EIB. EIB ticket in a project would be minimum €15m (but typically around €50m). This strategy might only be eligible for a small number of deals.
  - **Deployment through MBIL mechanism:** Deployment via a commercial bank partnering with the EIB through a Multiple Beneficiary Intermediated Loan (MBIL), with a portion of the funds being earmarked for investment into seaweed/ bivalve sectors with clear sustainability criteria
  - **Deployment through blended finance vehicle:** Creation of a dedicated blended fund vehicle managed by a third party, blending debt (from EIB), guarantees (from EIF for instance), grants (from EMFAF[2] for instance or other grant schemes). Deployment of debt, backed by a guarantee and de-risked through capacity building/ technical assistance funded through the grants, aligning EIB/ EIF sustainability criteria
  - **Deployment through matching of crowdlending**: Partnership with crowdlending platform (or platforms) to match every euro raised through crowdlending with one euro of EIB debt. This strategy is less likely to be implementable with EIB procedures and way of working
- Preferred route(s) among those options will have to be decided by EIB, who can benefit from a rich ecosystem of potential partners (banks, funds, European and National support organisations) to deploy debt funding into sustainable seaweed and bivalve European sectors. An impact Due Diligence process will take place after the selection of the most suited deployment strategy(ies) by the EIB, with governances, processes, and reference frameworks adjusted to each deployment route.
- To complement existing EIB's assessment methodologies with specific inputs regarding bivalve and seaweed farming, recognized and widely adopted certification standards will provide a solid foundation, with 5 international certification schemes (notably EU Organic certification) and 4 more local certification schemes (notably KRAV or Naturland) presenting a serious fit vs. the EIB's areas of interest and objectives
- In the absence of certification or in case of doubt regarding a specific aspect for a certified company, a first step before more in-depth due diligence is to ensure that a target investee's operations present no red flag (e.g. destructive harvesting practices, excessive use of artificial inputs) that could constitute a genuine exclusion criterion given the EIB's strategy

2 European Maritime, Fisheries and Aquaculture Fund

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# Chapter I

# Seaweed and bivalves: status and potential of regenerative mariculture in Europe


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# Chapter I

# Seaweed and bivalves: status and potential of regenerative mariculture in Europe


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# Seaweed aquaculture and applications: Introduction

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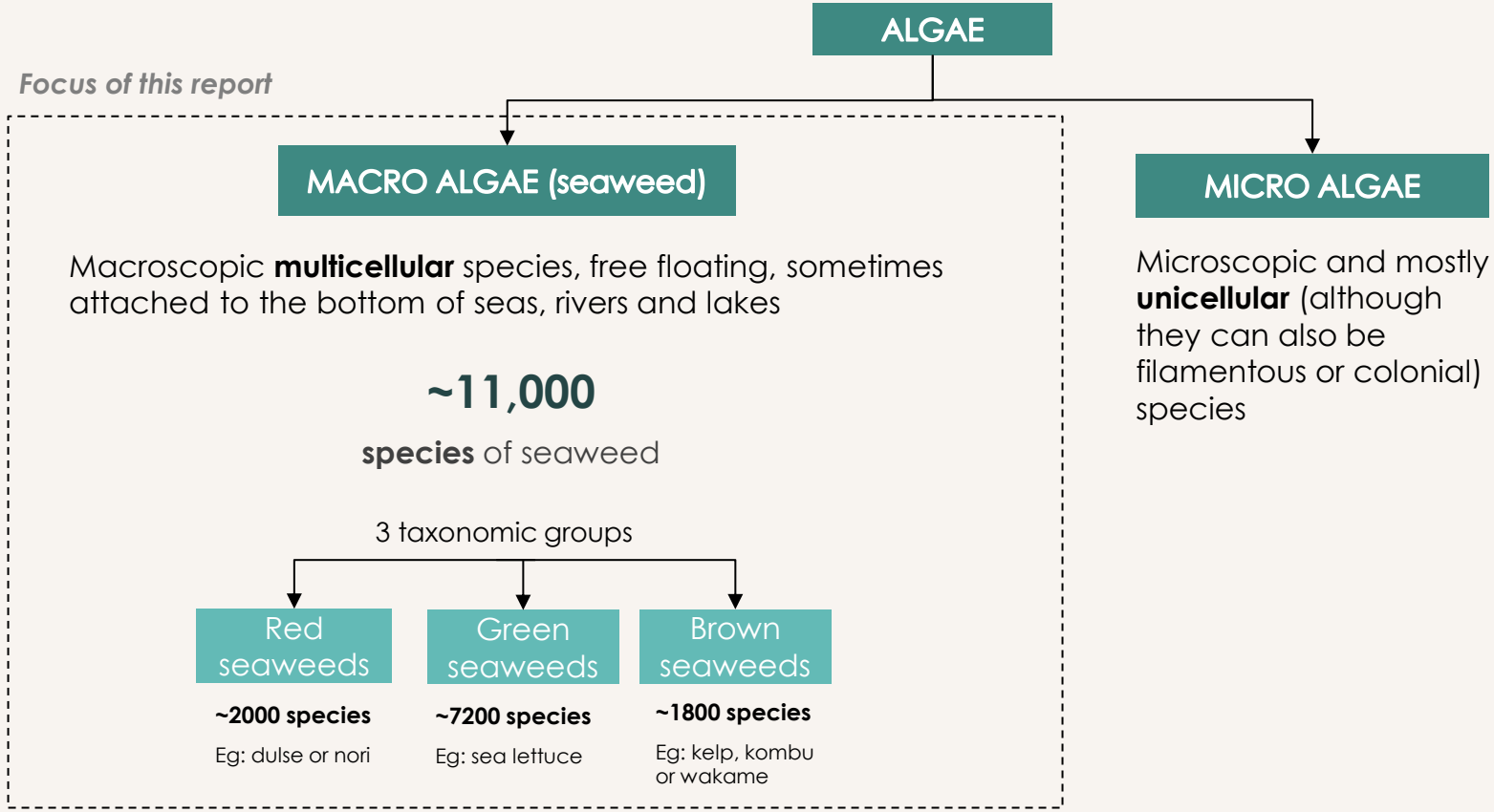
# What are seaweeds?

*Image Credits: Shutterstock*
*Source graph: EANA*




Seaweed or macro-algae, are **multicellular** and **photosynthetic** organisms. They produce **oxygen** by photosynthesizing energy from the sun. They are composed **of stripes, blades, and holdfasts**, and don't have roots, stems, leaves, or flowers.

Source: EABA: https://www.what-are-algae.com/

# History and context

## Ancient times

- ~1,500 years ago: earliest traces of usage of **seaweed as food in China**
- Two main uses in Europe's coastal Atlantic regions: **human consumption** and **agriculture** (cattle food and soil enrichment)

## 17th century

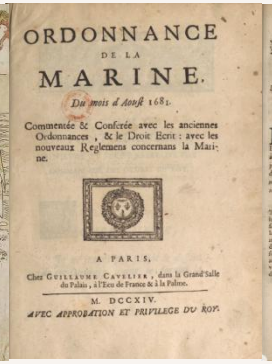
- In 1658, the ability of seaweed to produce a **thickening gel** is discovered in Japan
- First recorded **commercial use of seaweed** for the production of **glass** in Europe (France & Norway)
- First national regulation in France for **seaweed harvesting**

## 19th century

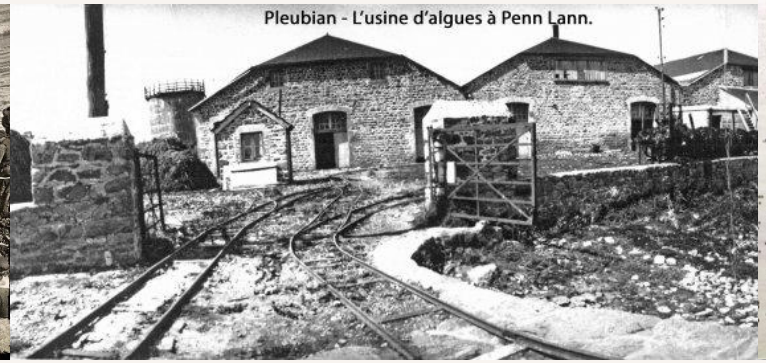
- Use of seaweed in the production of **iodine:** 2nd industrial valorization of seaweed
- Discovery of **alginate**: 3rd industrialization of seaweed

## 20th century

- **Large-scale production** of seaweed grew in Asia: By the 1950s, **Japan** become the world's leading producer of seaweed
- First seaweed farm for the thickener **carrageenan** was established in the Philippine

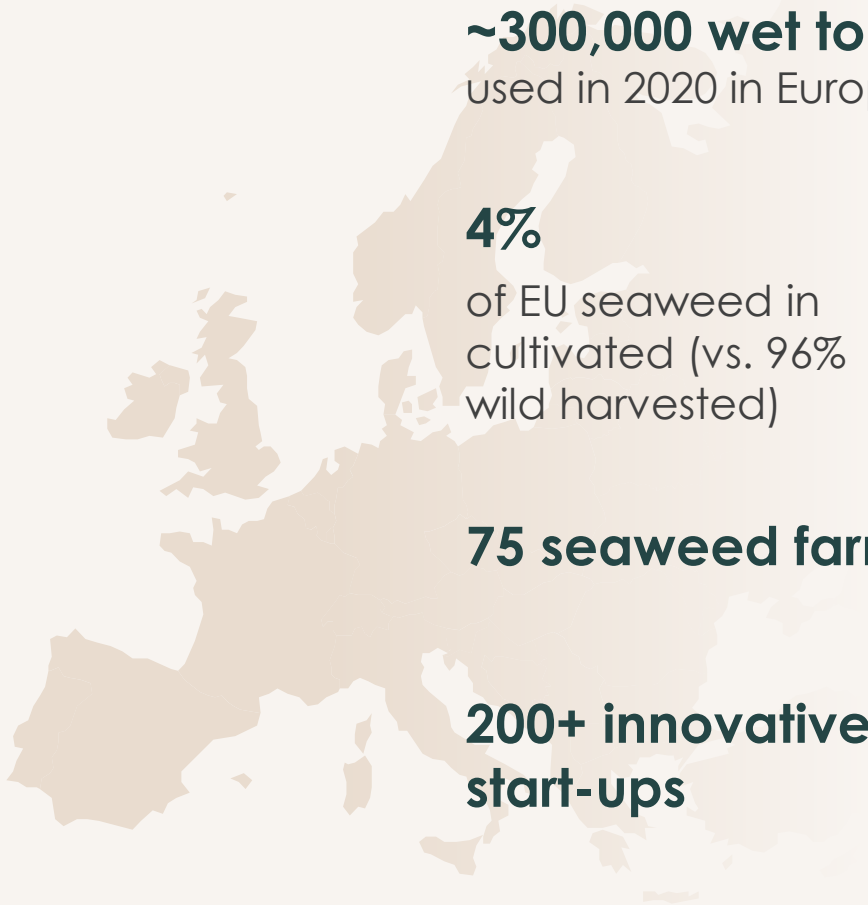







*Sources: O'Shea, T., Jones, R., Markham, A., Norell, E., Scott, J., Theuerkauf, S. and T. Waters. 2019. Towards a Blue Revolution: Catalyzing Private Investment in Sustainable Aquaculture Production Systems. The Nature Conservancy and Encourage Capital, Arlington, Virginia, USA.*
*Henry, S., Taillens, M., Laurans, M., & Frangoudes, K. (2021). Histoires d'algues en Finistère. ARCHIMER. https://archimer.ifremer.fr/doc/00740/85159/*
https://www.seaweed.ie/irish_seaweed_contacts/doc/Filieres_12p_UK.pdf

# European seaweed industry at a glance



**~300,000 wet tons**
used in 2020 in Europe

**4%**
of EU seaweed in cultivated (vs. 96% wild harvested)

**75 seaweed farms**

**200+ innovative start-ups**

- Seaweed production in Europe is still dominated by wild harvesting, but **seaweed aquaculture is growing**
- **Today, around 75% percent** of seaweed is used for **human consumption**, with the remaining 25% used in personal care, nutraceuticals, soil fertilizers, and animal feeds.
- Numerous start-ups have emerged over the past decade, trying to **revolutionize the way seaweed is produced and valorised**
- Market forecast all point to a **double digit positive CAGR** over the next decades for seaweed products
- To unleash its potential, the European seaweed industry needs to **overcome certain awareness, technological and regulatory barriers**
- However, European seaweed also **benefits from an unprecedented political support** and can leverage a **rich and solid network of enabling organisations**

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*Sources: O'Shea, T., Jones, R., Markham, A., Norell, E., Scott, J., Theuerkauf, S. and T. Waters. 2019. Towards a Blue Revolution: Catalyzing Private Investment in Sustainable Aquaculture Production Systems. The Nature Conservancy and Encourage Capital, Arlington, Virginia, USA.*
Vasquez Calderon, Sanchez Lopez, *An overview of the algae industry in Europe. Producers, production systems, species, biomass uses, other steps in the value chain, and socio-economic data,* Publication Office of the European Commission, JRC, 2022)
https://openknowledge.fao.org/server/api/core/bitstreams/97409d09-2f8e-4712-b11e-60105d89959b/content

# Seaweed is a powerful nature-based solution with many environmental benefits

1/10

## Biodiversity enhancement

- Home to rich **biodiversity**, weather marine or terrestrial
- Foundational component of the **food chain**
- **Habitats** and **nurseries** for marine species

2/10

## Water quality

- Through **photosynthesis** seaweed creates oxygen
- Ability to increase the pH of the water it grows in and consequently **reduces acidification locally**
- Capacity to **uptake excessive nutrients**

3/10

## Coastal protection / resilience

- Natural seaweed forests (and seaweed farms) help **protect coastal areas** by dissipating the energy of surface waves

4/10

## Indirect environmental benefits

- Less pressure on lands (for land-based farming) & freshwater supplies
- Mitigate the ecological threats posed by plastic pollution

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*Sources: https://www.fao.org/documents/card/en/c/cb5670en*
*https://wedocs.unep.org/bitstream/handle/20.500.11822/42642/seaweed_farming_cli mate.pdf?sequence=3&isAllowed=y*
*https://www.seaweedeurope.com/wp-content/uploads/2020/10/Seaweed_for_Europe- Hidden_Champion_of_the_ocean-Report.pdf*

# Seaweed can also contribute to the fight against climate change

5/10

## Carbon sequestration

- Through photosynthesis, seaweed take in **dissolved carbon** from the water
- The carbon that seaweed store into their own biomass can then be **sequestrated** when parts of the seaweed are not reincluded into food chains but are **stored in the deep ocean** – more than 200 meters deep – for more than 100 years

6/10

## Climate mitigation

- Seaweed-based products can serve as **alternatives to more carbon-intensive products**
- **Reduced pressure on cattle farming**, which contributes to 14.5% of the total human-induced greenhouse gas emissions
- Other pathways include **replacing carbon-intensive energy with seaweed biofuels**, but seaweed biofuels remains at experimental and pilot stages

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*Sources: https://www.fao.org/documents/card/en/c/cb5670en*
*https://wedocs.unep.org/bitstream/handle/20.500.11822/42642/seaweed_farming_cli mate.pdf?sequence=3&isAllowed=y*
*https://www.seaweedeurope.com/wp-content/uploads/2020/10/Seaweed_for_Europe- Hidden_Champion_of_the_ocean-Report.pdf*

# Lastly, seaweed can deliver many socio-economic positive impacts

7/10

## Nutrition & health benefits

- Most seaweed are **edible** and **highly nutritious**, containing **nutrients**, **minerals** (Na, K, P, Ca, Mg, I, Fe), **vitamins** (A, B1, B2, B12, C, D, E), and **low lipid**
- **Reduces diseases** such as obesity and Type II diabetes
- Seaweed are also used as **food additives**, the most commonly used being agar, carrageenan, and alginate

8/10

## Women empowerment & gender equity

- In developed and in developing countries seaweed farming also showed **positive results on gender equity**
- Provides them with **recognition**, **societal influence**, **financial independence**, and the opportunity to develop **entrepreneurial skills** through the creation of value-added products derived from seaweed such as food and cosmetics

9/10

## Diversification of livelihoods in developing countries

- Provides **job opportunities** for coastal communities and in regions where fishers are **facing job insecurity** due to declining fish stocks
- Possibility of creating **value-added seaweed products** that could also in turn yield increased benefits for farmers

10/10

## Business applications & job creation

- Seaweed can be commercialized in **multiple product applications**, offering promising opportunities for industry development
- Potential to offer employment opportunities not only for those requiring **reskilling** or **upskilling** but also for the **younger generation** entering the job market

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*Sources: https://unglobalcompact.org/library/5968; https://www.researchgate.net/publication/237149904_Social_and_economic_dimensions_of_carrageenan_seaweed_farming_in_the_United_Republic_of_Tanzania; https://wedocs.unep.org/bitstream/handle/20.500.11822/42642/seaweed_farming_climate.pdf?sequence=3&isAllowed=y https://pubmed.ncbi.nlm.nih.gov/27941599/*

# All the mentioned benefits of seaweed effectively contribute to the achievement of UN SDGs

SUSTAINABLE DEVELOPMENT GOALS


Livelihood & social cohesion


Nutrition & health benefits

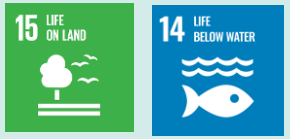

Business applications & job creation


Women empowerment & gender equality


Biodiversity enhancement


Water quality protection


Coastal protection




Indirect environmental benefits


Carbon sequestration


Indirect carbon sequestration

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# Seaweed aquaculture and applications: Status and potential in Europe

- Value chain analysis
- Market perspectives
- Remaining barriers
- Enabling environment

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# The seaweed value chain (simplified)

1 > 2 > 3

## *Production*

- Wild harvested seaweed:
  - Harvested at sea
  - Harvested on coast
  - Beach cast
- Cultivated seaweed:
  - At sea
  - On land

## *Processing*

- Includes activities such as:
  - Pre-treatment (drying, freezing)
  - 1st stage bio-refinery
  - Use of by-products

## *Product applications*

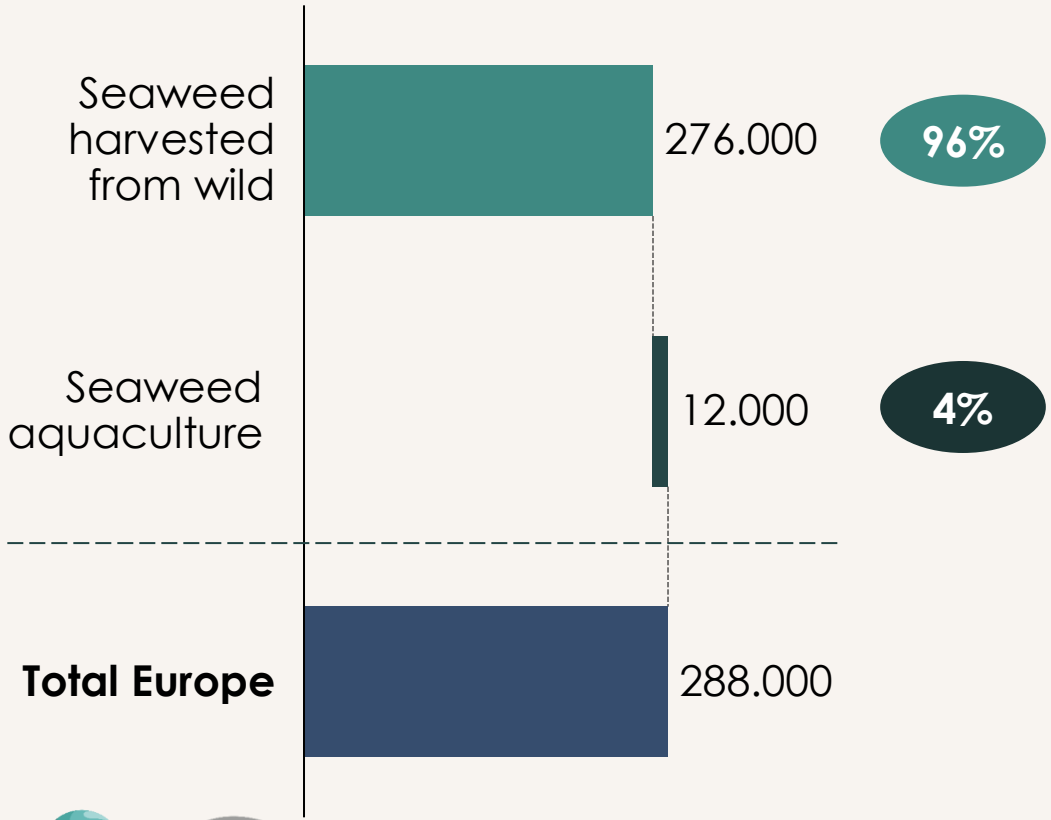
- Various applications of seaweed: respective value chains of different seaweed-based end product segments
- Main markets include:
  - Food (hydrocolloids & direct consumption)
  - Agriculture (fertilizers & animal feed)
  - Health & cosmetics

Source: Seaweed for Europe, Hidden Champion

# Seaweed produced in Europe today mostly comes from wild harvesting

## Seaweed production in 2019 in Europe

Tonnes wet weight – Source FAO




## Illustration – deep dive France

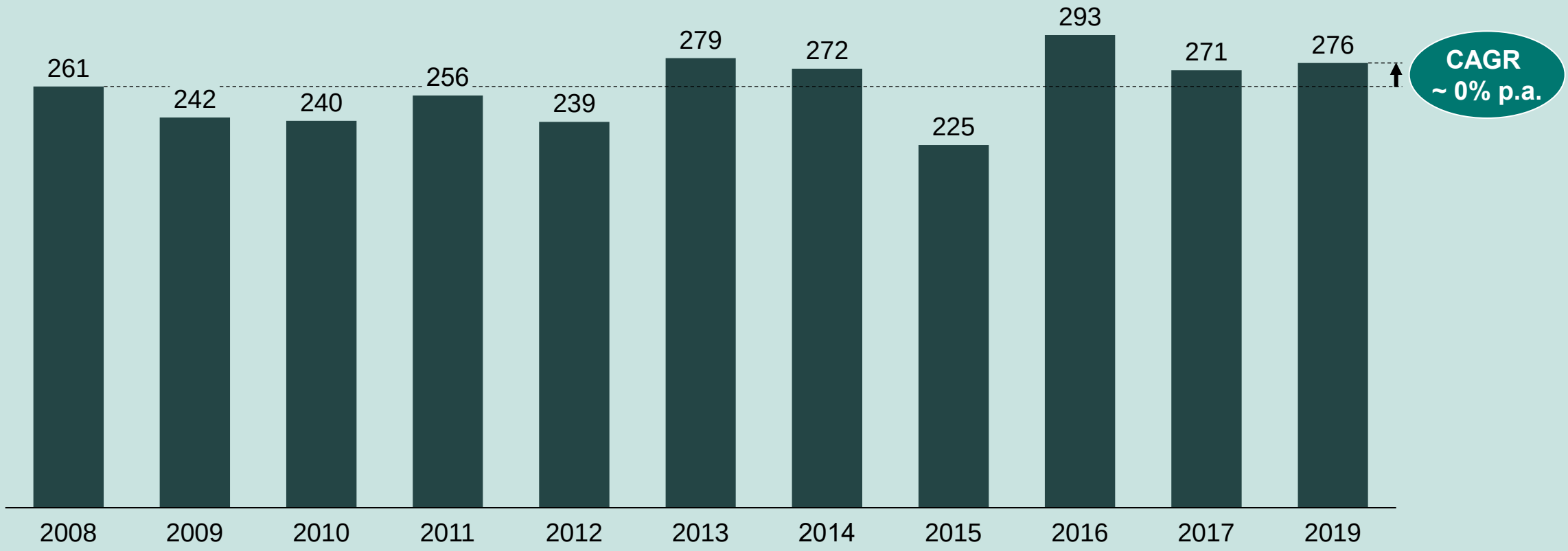
| | | | |
|---|---|---|---|
| Harvested from the wild | Harvested at sea |  | 93% |
| | Harvested on coast |  | 5% |
| | Beach cast |  | ~1% |
| Aquaculture | On-land and at sea |  | ~1% |



Source: Vasquez Calderon, Sanchez Lopez, *An overview of the algae industry in Europe. Producers, production systems, species, biomass uses, other steps in the value chain, and socio-economic data,* Publication Office of the European Commission, JRC, 2022; POIDS SOCIO-ÉCONOMIQUE DE LA FILIÈRE ALGUES EN PAYS DE BREST, Rapport d'étude, Adeupa, Cluster Algues, juin 2021

# Yet, production of seaweed from wild harvesting has been plateauing over the two last decades

## Total seaweed harvesting, thousands tonnes, live (wet) in Europe




*Sources*: FAO. 2019. Fishery and Aquaculture Statistics. Global capture production 1950-2017 (FishstatJ). In: FAO Fisheries and Aquaculture Department [online]. Rome. Updated 2019. www.fao.org/fishery/statistics/software/fishstatj/en

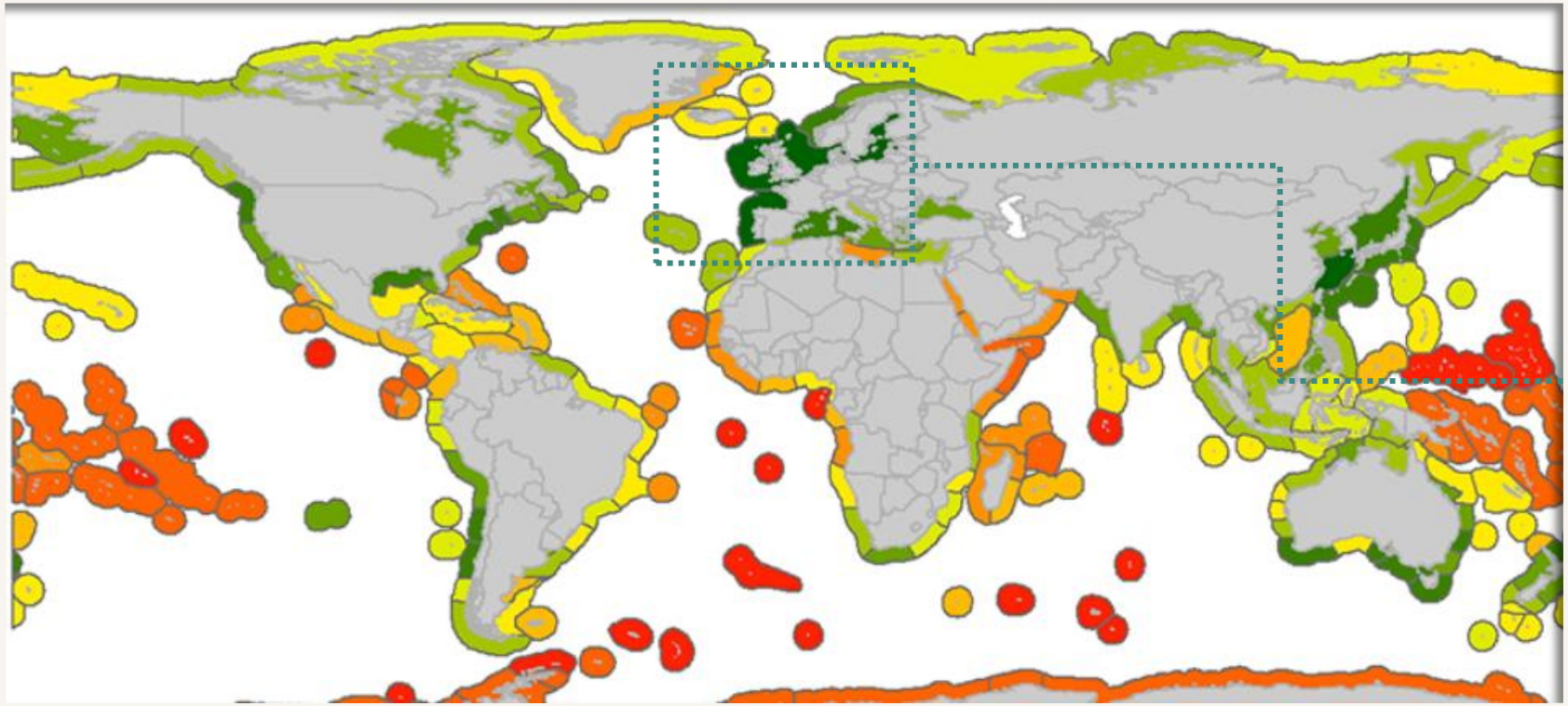
# The growth of European seaweed supply depends on a transition to farming

| | Asia | Europe |
|---|---|---|
| Main production method | Farming | Wild harvesting |
| Seaweed production 2020 (wet tonnes) | ~35 million | ~300,000 |
| 2000 – 2020 y-o-y growth | ~7% p.a. | ~0% p.a. |
| Share of aquaculture | 99% | 4% |

Source: FAO, Experts interviews

# Europe is perfectly positioned: cold and nutrient rich waters are well suited to grow seaweed

**Mapping of high opportunity marine ecoregions for development of seaweed aquaculture,** based on the synthesis of environmental, socioeconomic, and human health factors

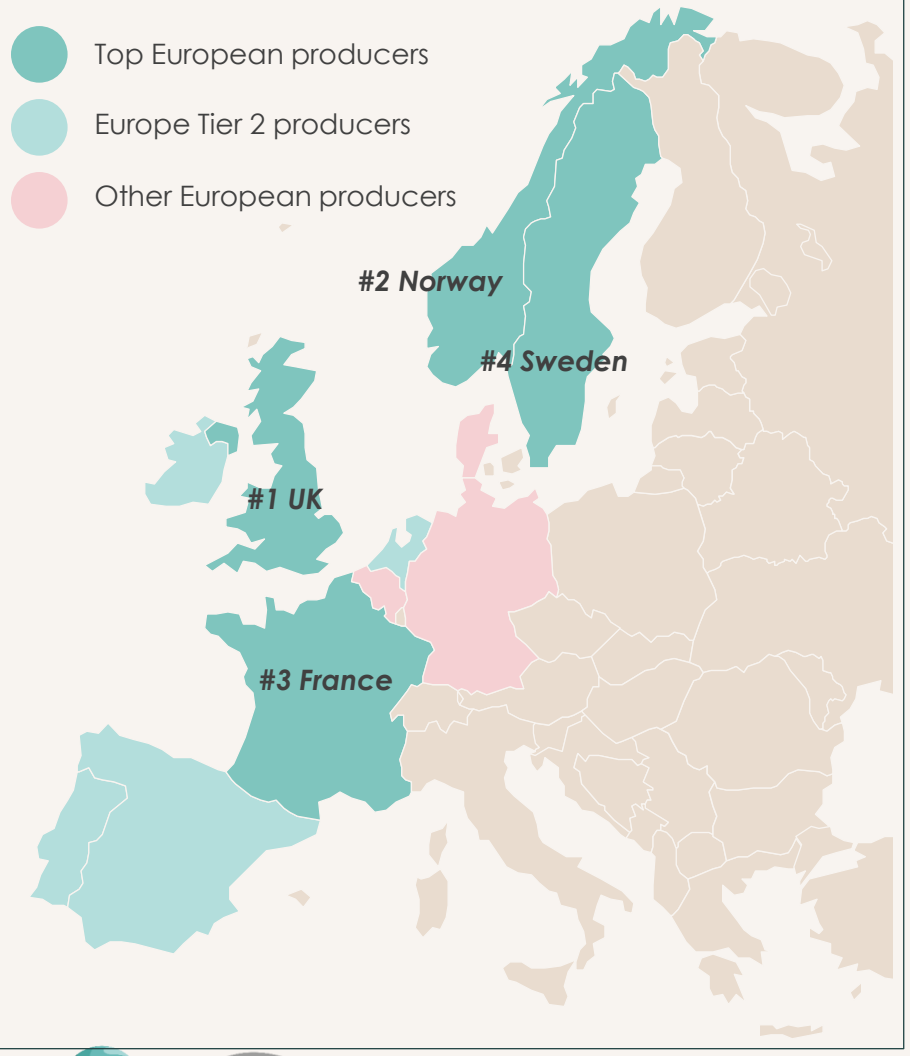



**All European EEZ** (Exclusive Economic Zones) have been assessed as "**high opportunity" to develop seaweed aquaculture**



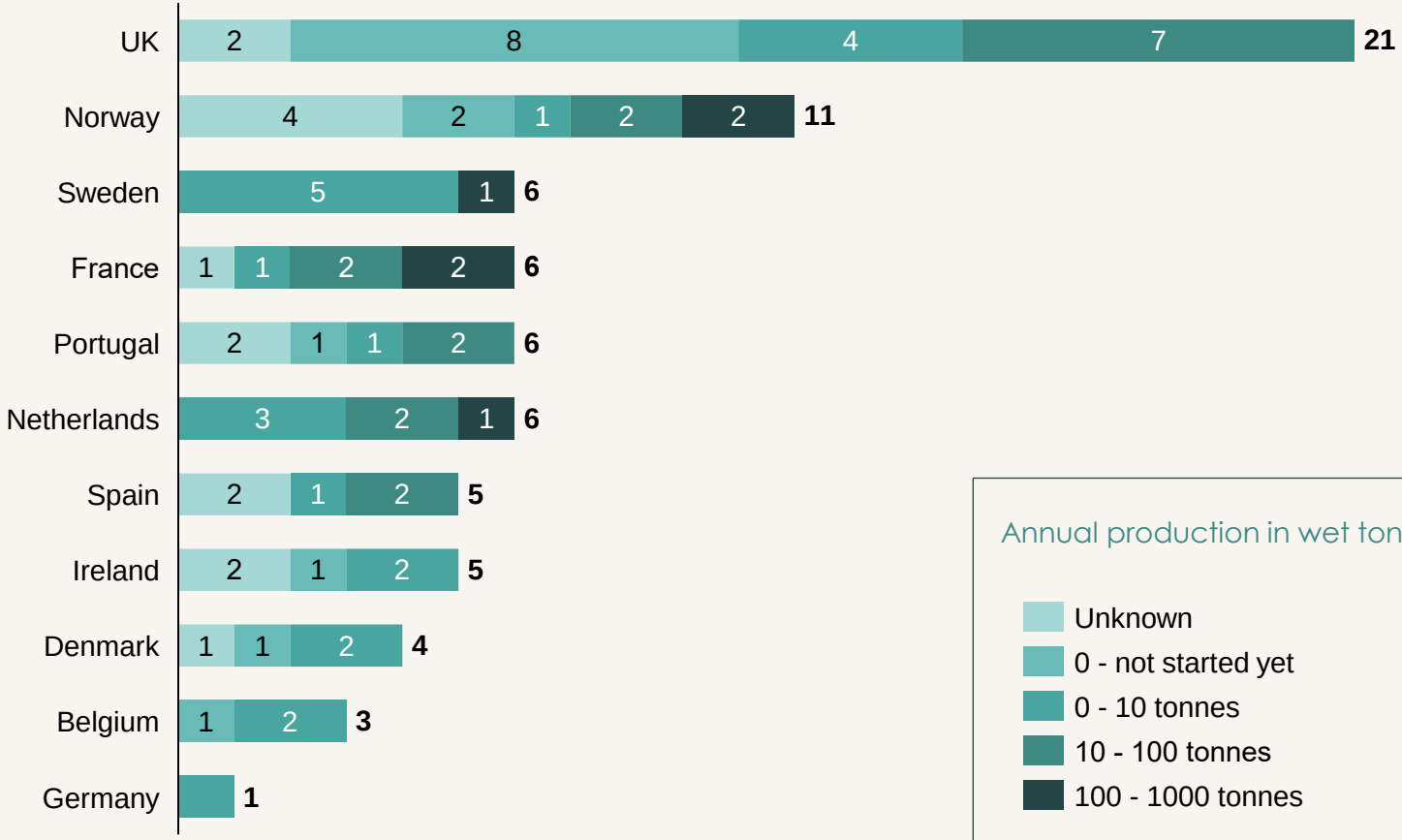
Source: Theuerkauf SJ, Morris JA Jr, Waters TJ, Wickliffe LC, Alleway HK, Jones RC (2019) A global spatial analysis reveals where marine aquaculture can benefit nature and people. PLoS ONE 14(10): e0222282. https://doi.org/10.1371/journal.pone.0222282

# Seaweed farming is growing in Europe, counting around 75 farms in 11 countries, although most of them are still at a nascent stage




## Breakdown of number of seaweed farms in Europe per maturity

Bucketed by annual production in wet tonnes – excl. Faroe Islands, Greenland and Iceland, representing an additional 5 farms in total

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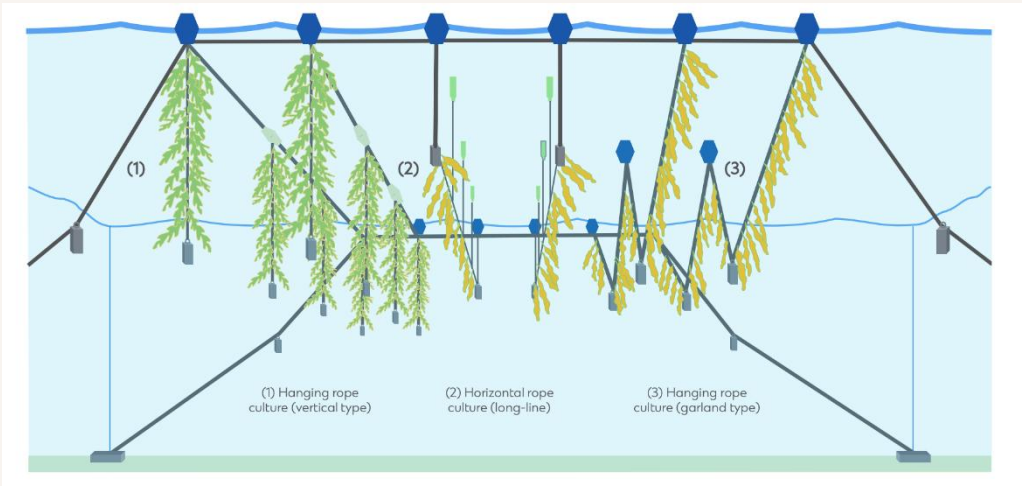
*Sources: Phyconomy.net, Global Seaweed Coalition analysis*

# 2 main seaweed cultivation methods are used in Europe

| | Cultivation at sea | Cultivation onshore (land-based) |
|---|---|---|
| **Key features** | Seaweed seedlings are deployed at sea, attached to cultivation substrates such as ropes. These ropes are suspended several metres below the surface and separated from each other so that boats can be used to harvest the mature seaweed. | Seedlings are deployed in onshore water ponds, greenhouses and raceway systems for cultivation in highly controlled environments in terms of light, temperature and nutrient content. |
| **Illustration** |  |   |
| **Main species grown** | • Saccharina latissimi (Kombu) – Brown<br>• Alaria esculenta (Atlantic wakame) – Brown<br>• Laminaria digitata (Oarweed) – Brown | • Palmaria palmata (Dulse) - Red<br>• Ulva (Sea lettuce) – Green |
| **Main countries** | • North-West Europe (Norway, UK, France, Netherlands) | • Mostly southern Europe (Portugal, France)<br>• Emerging projects in the Netherlands and Denmark |



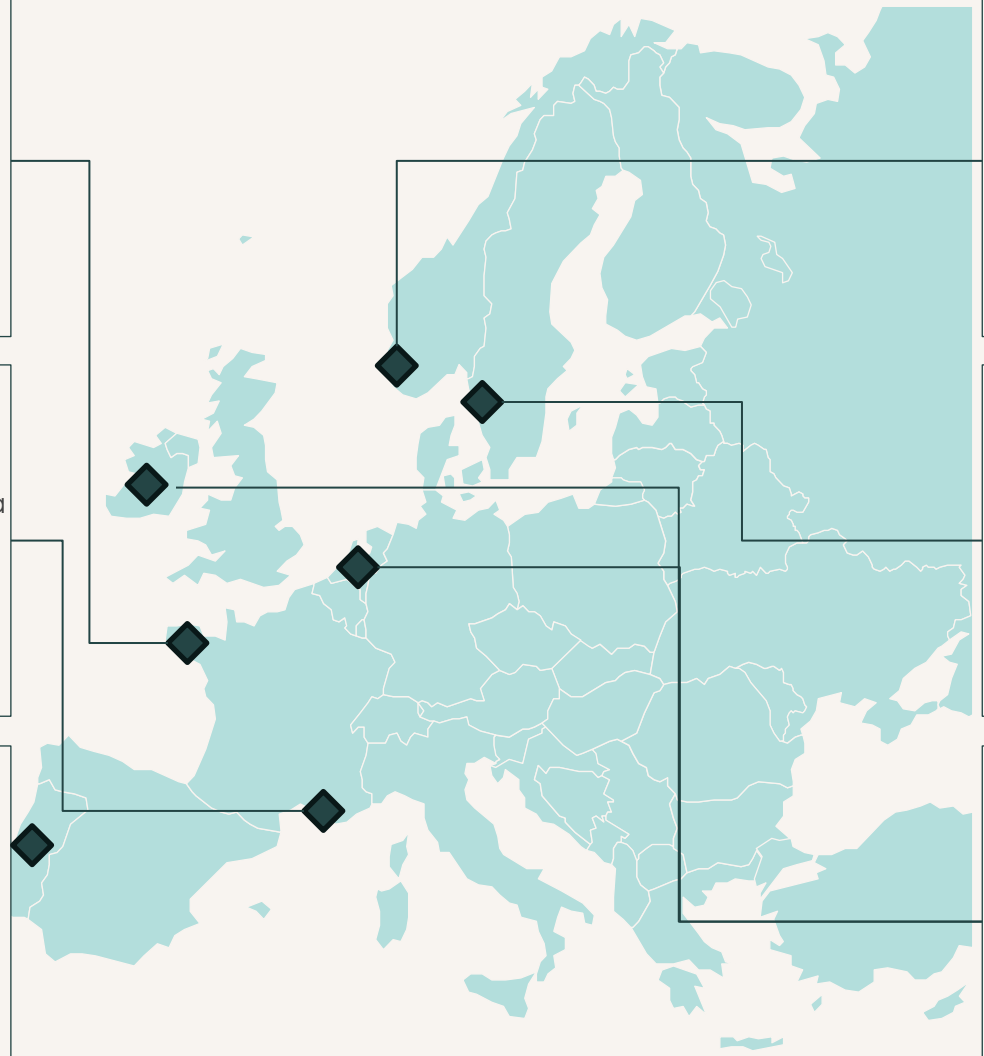
Source: https://av.sc.com/corp-en/nr/content/docs/Kelp-is-on-the-way_web-upload_191223.pdf; ALGAPLUS, Global Seaweed Coalition analysis

# Key seaweed farming players in Europe *(non exhaustive)*

### Algolesko (France)
- **Volume 2023:** over 200 wet tonnes
- **Farm size:** 150 ha (+ 150ha licensed but not exploited yet)
- **Creation year :** 2013
- **Total disclosed investments since 2020**: $1,397,433

### Eranova (France)
- **Volume 2023:** 100 - 1000 tonnes
- **Farm size:** 1.2 ha + project to scale up to 50 ha (land-based)
- **Creation year :** 2016
- **Total disclosed investments since 2020**: $8,400,000

### Algaplus (Portugal)
- **Volume 2023:** 10 - 100 tonnes
- **Farm size:** 12 ha (land-based)
- **Creation year :** 2012
- **Total disclosed investments since 2020**:n/a



### Arctic Seaweed (Norway)
- **Volume 2023:** 100 - 1000 tonnes
- **Farm size:** n/a
- **Creation year :** 2017
- **Total disclosed investments since 2020**: n/a

### Nordic Seafarm (Sweden)
- **Volume 2023:** 100 - 1000 tonnes
- **Farm size:** 30 ha
- **Creation year :** 2016
- **Total disclosed investments since 2020**: $2,100,000

### The Seaweed Company (Netherlands + Ireland)
- **Volume 2023:** 100 - 1000 tonnes
- **Farm size:** n/a
- **Creation year :** 2018
- **Total disclosed investments since 2020**: n/a



European Investment Bank

*Sources: Phyconomy.net, Global Seaweed Coalition analysis*

# Seaweed processing can use up to 7 steps, but marketable end-products can be valorised along most of these steps

## Harvesting

**Manual Harvesting**
Collecting seaweed by hand, often used for high-value species

**Mechanical Harvesting**
Using machinery to collect large quantities, typically for industrial purposes.

## Cleaning and Washing

**Initial Rinsing**
Removing sand, debris, and salt by washing with seawater or freshwater

**Thorough Cleaning**
Additional cleaning to remove impurities, sometimes involving multiple rinsing stages

## Drying

**Drying methods**

- **Sun Drying:** Spreading seaweed in the sun to dry naturally, a traditional and low-cost method.
- **Hot Air Drying:** Using heated air to dry seaweed more quickly and uniformly.
- **Freeze Drying:** Removing moisture through sublimation at low temperatures, preserving nutritional and bioactive compounds.
- **Rotary Drying**: Using a rotating drum with hot air to dry seaweed continuously

## Milling and Grinding

**Coarse Grinding:**
Breaking down dried seaweed into smaller pieces.

**Fine Grinding:**
Producing seaweed powder for various applications, including food additives and cosmetics.

## Extraction

**Extraction methods**

- **Water Extraction:** Soaking seaweed in water to extract water-soluble components.
- **Alkali Extraction:** Using alkaline solutions to extract specific polysaccharides like alginates.
- **Acid Extraction:** Employing acidic solutions to extract compounds such as carrageenan.
- **Enzymatic Extraction**: Using enzymes to break down cell walls and release desired compounds.
- **Solvent Extraction**: Utilizing organic solvents to extract lipids and other non-polar compounds.

## Purification and Refining

**Extraction methods**

- **Filtration:** Removing impurities from extracts through various filtration techniques.
- **Centrifugation**: Separating components based on density differences using centrifugal force.
- **Precipitation:** Adding agents to precipitate specific compounds for collection and purification.

## Fermentation

**Lactic Acid Fermentation:**
Fermenting seaweed with lactic acid bacteria to enhance preservation and nutritional properties.

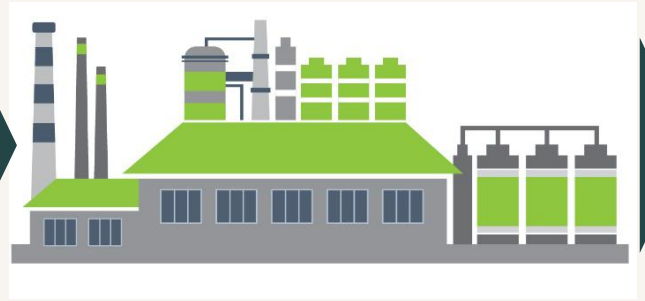
**Ethanol Fermentation:**
Fermenting to produce ethanol for biofuels or other industrial uses

# Seaweed biorefinery is a concept which is gaining momentum to maximise value extracted by seaweed while minimising production waste

## The seaweed biorefinery concept

- **Multi-Product Creation**: Using seaweed to make a variety of useful products like food, medicine, and bio-stimulants, much like how a traditional refinery processes oil into gasoline, plastics, and other products.
- **Sustainable Process**: It focuses on using all parts of the seaweed, ensuring nothing goes to waste, which helps protect the environment and makes the process more efficient and eco-friendly.
- **Integrated Approach**: Different processing methods are combined in one facility to extract as many valuable components from seaweed as possible, maximizing the benefits and economic value from a single source.

*Seaweed (wet, dried, frozen, fermented, etc.)*



- *Nutraceuticals*
- *Food additives*
- *Cosmetics*
- *Pigments*
- *Paper*
- *Fertilizers*
- *…*

## Examples of European biorefinery players

Algaia – Your natural partner

> **Based in France**
> **Seaweed based products :** vitamins, ingredients, alginate, packaging, etc.
> **Creation year :** 2016
> **Total disclosed investments since 2020**: $2,600,000

OCEANIUM

> **Based in Scotland**
> **Seaweed based products :** fucoidan, proteins, fibers, pigments and inks, packaging
> **Creation year :** 2018
> **Total disclosed investments since 2020**: $7,000,000

ORIGIN BY OCEAN

> **Based in Finland**
> **Seaweed based products : alginate,** fucoidan, laminarin, pigments, proteins, etc.
> **Creation year :** 2019
> **Total disclosed investments since 2020**: $10,375,000

European Investment Bank

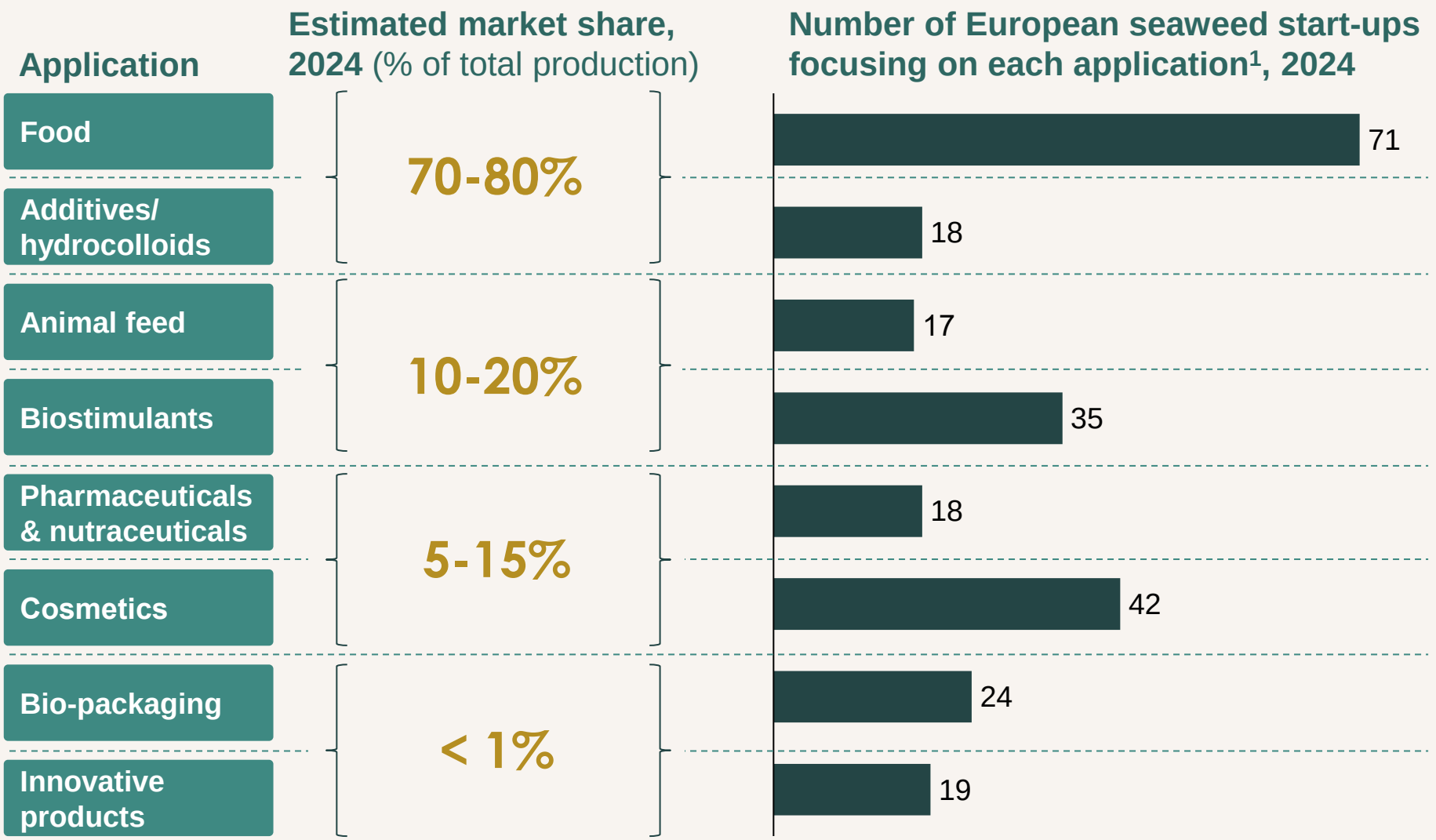
*Sources: Phyconomy.net, Global Seaweed Coalition analysis*

# Seaweed is highly versatile and can be used for multiple product applications

| Application | Product examples | Primary functions |
|---|---|---|
| **Food** | Raw salads, crisps, spaghetti, burgers | Source of (tasty) energy, protein and vitamins |
| **Additives/ hydrocolloids** | Gelatine substitutes, processed meat and dairy | Provision of thickening, stabilising and emulsifying properties |
| **Animal feed** | Livestock feed supplements, aquafeed supplements, pet food additives | Promotion of positive immune response and gut health; improvement of digestive processes |
| **Biostimulants** | Seed treatments | Stimulation of plant growth, protection against abiotic stress |
| **Pharmaceuticals & nutraceuticals** | Gastrointestinal protectors, biodegradable wound care products / nutrient health supplements | Source of bioactive and nutrient-rich ingredients |
| **Cosmetics** | Anti-aging moisturisers, toothpaste | Source of bioactive and nutrient-rich ingredients; provision of thickening, stabilising and emulsifying properties |
| **Bio-packaging** | Packaging, coatings and plastic films for food containers | Source of marine-safe and compostable plastic molecules |
| **Innovative products** | Pigments and inks, hygiene products, textiles, char for carbon sequestration, construction materials, etc. | |

Sources: Seaweed for Europe

# Innovative start-ups are emerging in Europe against all types of applications




- Majority of European production is today used in food applications (mostly through hydrocolloids and direct consumption)
- Other main applications today are around animal feed and fertilisers, followed by cosmetics and nutraceuticals
- Interestingly, the pipeline of European seaweed start-ups is actively exploring all types of applications, including less mature ones like bio-packaging, pigments or textiles

*Sources: Expert interviews, Phyconomy.net, Global Seaweed Coalition analysis*

1: some companies are positioned against several applications

# All recent reports forecast a solid growth for the global seaweed sector for the decade to come


By Standard Chartered

November 2023

**Key Insights**

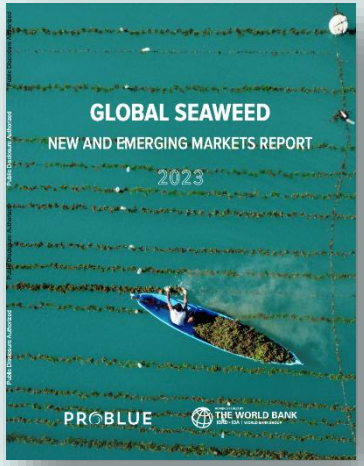
- USD100 billion of investments up to 2040 may create USD313 billion in value and 200 million jobs
- The biggest barrier is lack of funding for seaweed companies.
- There is a need to establish large-scale ocean-focused investment funds that make it easier for seaweed operators to access funding.


By The Nature Conservancy and Bain & Company

September 2023

**Key Insights**

- Bio-stimulants and bio-plastics are two of the most promising growth markets for seaweed over the next five to ten years and can generate significant demand—up to 1 million tons of seaweed for each by 2027.
- 1 million tons of seaweed used for bio-stimulants could lead to 0.1 – 0.4 megatons of avoided CO2e emissions per year.




By The World Bank, undertaken by Hatch Innovation Services

August 2023

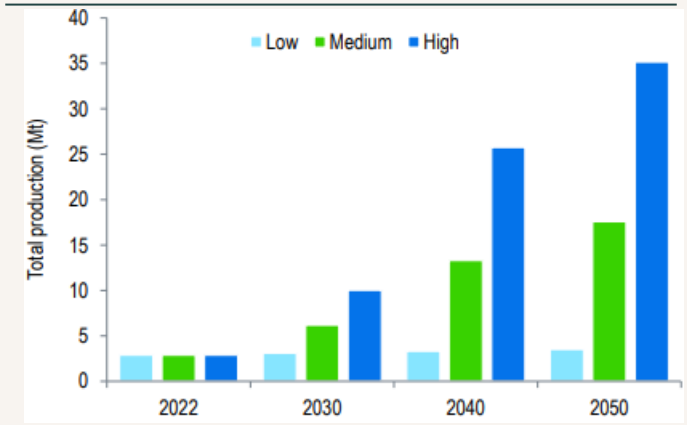
**Key Insights**

- Ten global seaweed markets have the potential to grow by an additional USD 11.8 billion by 2030
- The seaweed sector has clear growth potential beyond its current markets and can help shape a world free of poverty on a livable planet.
- Enhanced seaweed production and improved value chains can contribute to meeting at least nine of the 17 SDSs.

# Focus on Standard Charterer forecasts for seaweed global markets

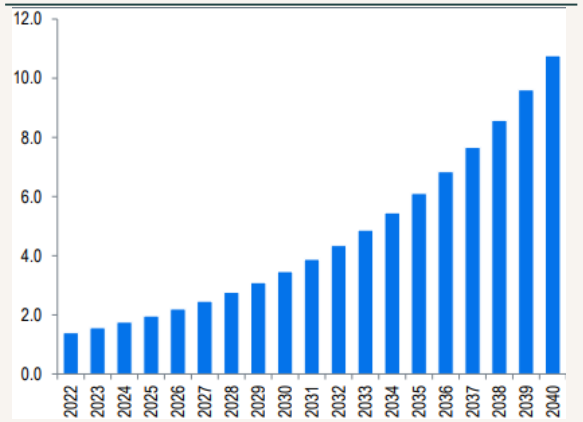

## Food-related seaweed demand

Estimates based on low-, medium- and high-growth scenarios



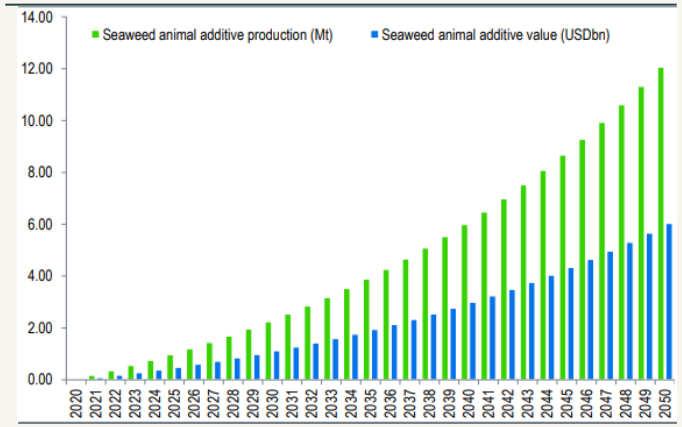

Source: Murai et al, 2020, Chen et al (2018), Vellinga (2022) CBI, Island Institute, United Nations, FAO, Standard Chartered Research

## Potential value of the seaweed biostimulant market - USD bn




Source: Standard Chartered Research

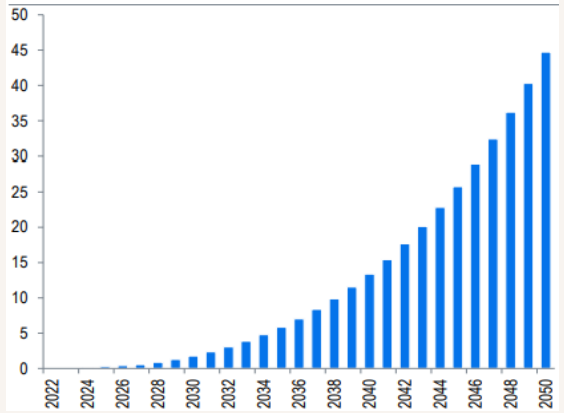
## Market potential for seaweed as an animal feed additive*




*Assuming that seaweed additives comprise 3-5% of animal feed

Source:IFIF, World Bank, FAO, Standard Chartered Research

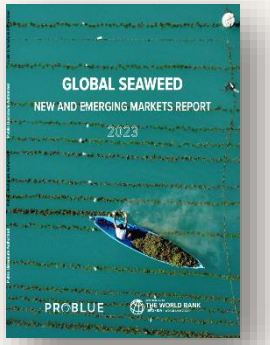
## Potential value of the bioplastic seaweed market - USD bn



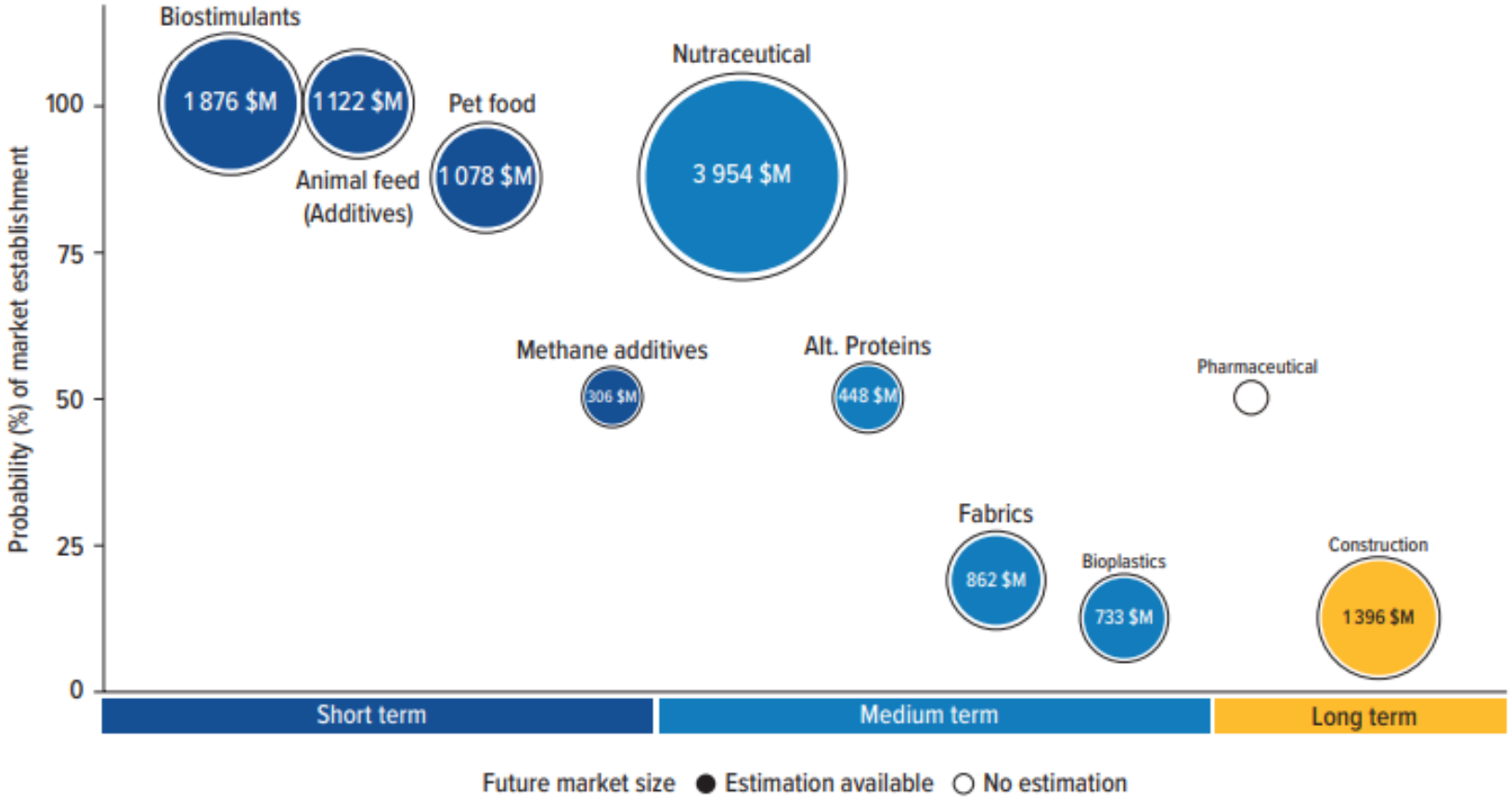

Source: Standard Chartered Research

- Food-related seaweed demand could increase 12-fold by 2050
- The value of the seaweed-related biostimulant market could increase from c.USD 1.4bn in 2022 to USD 3.5bn by 2030 and USD 10.8bn by 2040
- The seaweed bioplastics market could reach a value of USD 1.8bn by 2030, rising to USD 45bn by 2050.
- The market for seaweed as an animal feed additive could be worth USD 1.2bn by 2030 and USD 6.4bn by 2050

# Focus on the World Bank forecast for seaweed global markets




## Predicted seaweed market size by 2030 ($ millions) with chance of market establishment indicated by colour on a high-level market horizon timeline



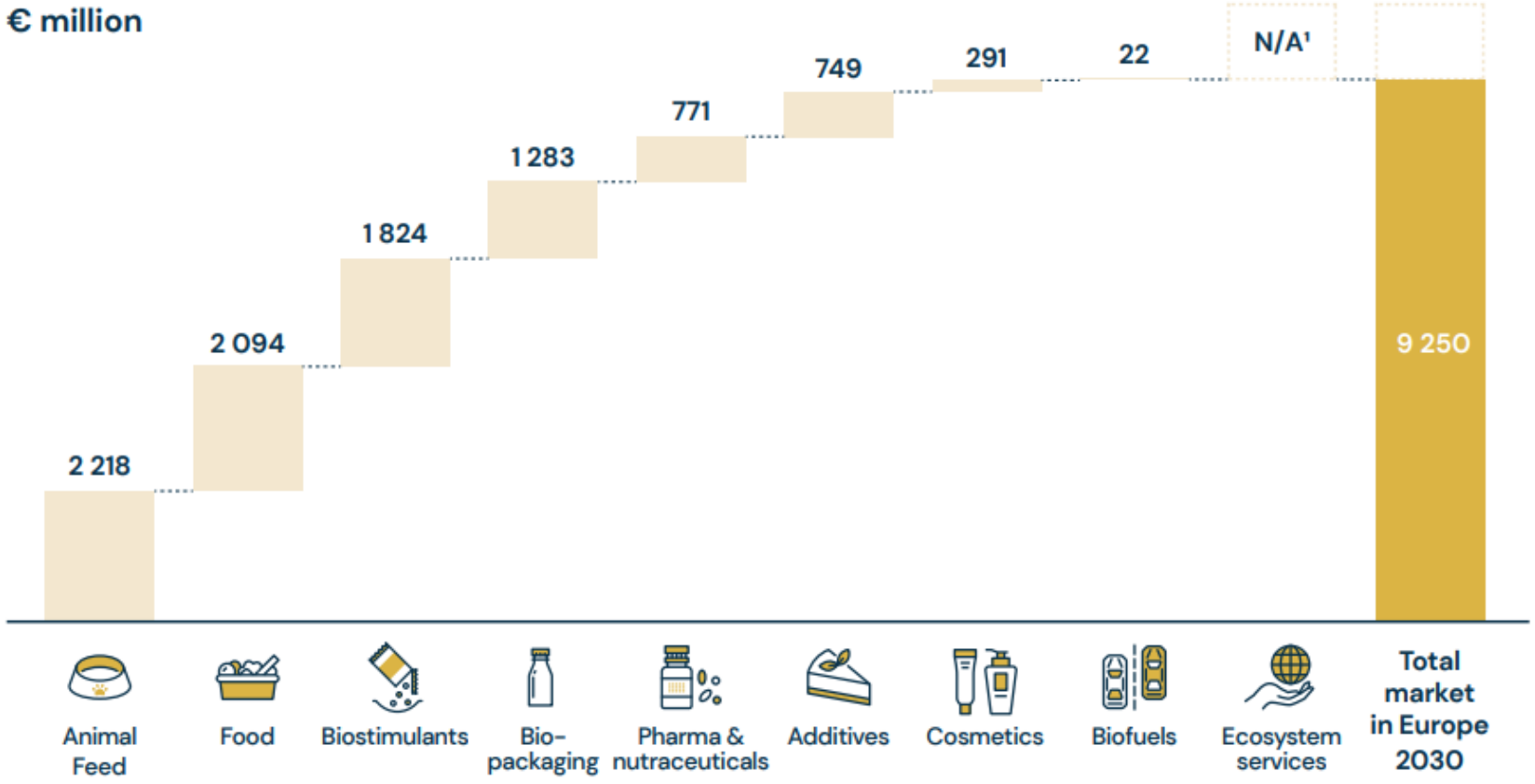

**Note: this market analysis does not consider conventional and established market applications like agar, alginate, carrageenan, food and aquaculture feed sectors**

- The most promising short-term markets for seaweed (beyond conventional market applications) are biostimulants, animal feed, pet foods, and methane-reducing additives
- Nutritional supplements, known as nutraceuticals, alternative proteins, bioplastics, and fabrics offer medium-term opportunities.
- Pharmaceuticals and construction offer long-term opportunities

*Sources: Wolrd Bank and Hatch Blue: GLOBAL SEAWEED NEW AND EMERGING MARKETS REPORT 2023*

# The Seaweed for Europe coalition also established European-centric market scenarios for 2030

## European demand for seaweed products in 2030 (high ambition case)




1. As of today, not yet quantified, but important focus for future research.
Note: Values are for high ambition level - see Appendix for low and moderate ambition level outcomes. Total may differ due to rounding.

**Note: this analysis dates from 2020 and did not anticipate for COVID 19 related implications on global economy**

- European demand for seaweed is projected to reach €3.0- 9.3 billion in 2030 across all eight segments, with feed, food and biostimulants the largest
- In the high ambition case, this would mean the seaweed market in Europe would be larger than EU aquaculture production in 2017, worth €5.1 billion, and within touching distance of the overall EU fisheries sector, valued at approximately €12-13 billion in the same year

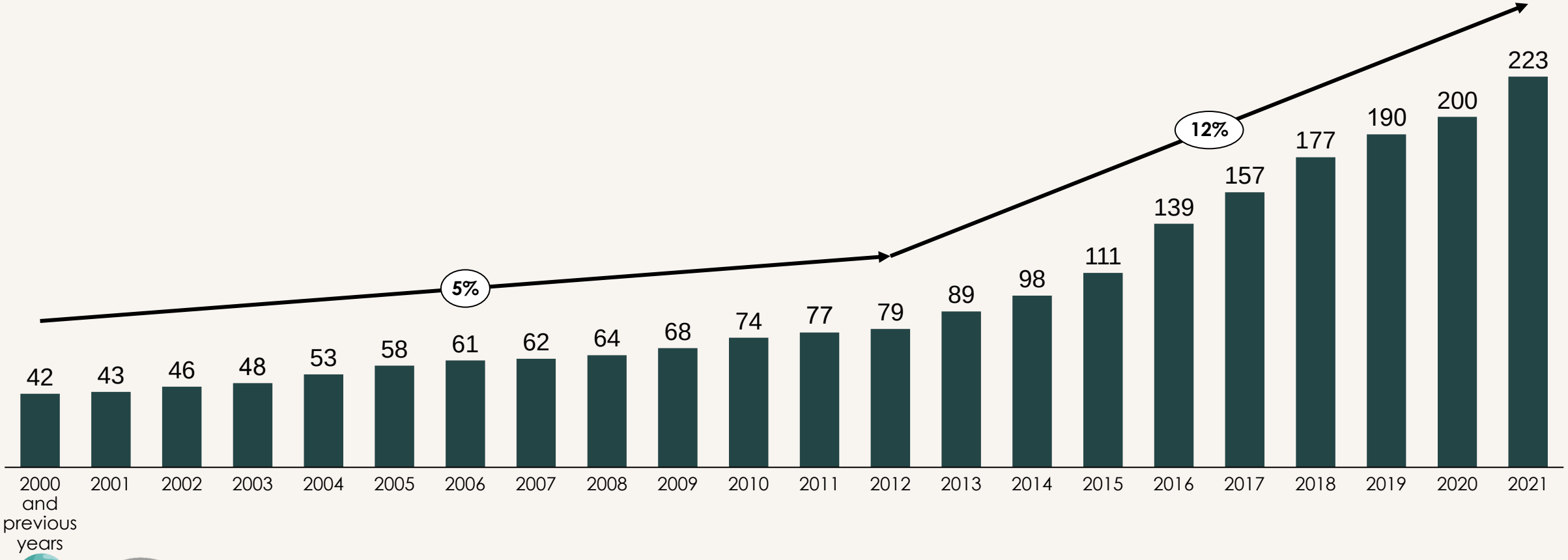


*Sources: Vincent, A., Stanley, A. and Ring, J., "Hidden champion of the ocean: Seaweed as a growth engine for a sustainable European future", Seaweed for Europe, 2020*

# The European pipeline of innovative start-ups is dynamic: we observe a growing number of innovative seaweed companies created in Europe

## Pipeline breakdown by companies' year of creation

(accumulated number of companies, within 223 established companies and start-ups)

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*Sources: Investor Memo Seaweed for Europe*

# 2023 has seen successful fundraises from seaweed companies

| | |
|---|---|
| ORIGIN BY OCEAN | €7.5 million (ingredients) |
| OCEAN HARVEST TECHNOLOGY | €7.0 million (feed) |
| Seaweed Solutions | €4.4 million (farming) |
| ERANOVA Technology from the sea | €1.3 million (farming and biopackaging) |
| OCEAN RAINFOREST SUSTAINABLE NORDIC SEAWEED | €6.0 million (farming) |
| FlexSea | €3.5 million (biopackaging) |

Source: Press clips

# To unleash its potential in Europe, the seaweed industry still must overcome some key challenges

| | |
|---|---|
| **Limited understanding of potential and need for advocacy** | European demand needs to grow faster, accelerated for example by the development of innovative product and service applications and access to new markets, supported by strong communication and awareness raising campaigns |
| **Fragmented industry** | European industry needs to overcome its fragmentation through capacity scale up and potentially integration/ consolidation of existing players. Besides, best practices need to be better shared between European seaweed pioneers |
| **Unfit regulations** | Time to market is slowed down and expensive due to constraining regulations and standards much more stringent than in other continents (e.g., novel foods catalogue, iodine content). Access to concessions is still a major hurdle in most European countries where the process lacks standardisation and transparency and is often too lengthy |
| **Technology barriers** | Technology innovations can help decrease production costs and increase yield of seaweed farms (selective breeding, farm infrastructure, seeding and harvesting assets). Innovation is also needed to increase performance and efficiency of new seaweed products. |
| **Difficulty to access funding** | Most seaweed projects are considered too risky or early stage to be financed through conventional loan provided by commercial banks. However, they are often not sufficiently attractive in terms of ROI to convince venture capitalists. |

# The seaweed agenda benefits from an unprecedented political support from the European Commission – The EU Algae Initiative and EU4Algae

## The EU Algae Initiative

- Launched in November 2022 by the European Commission
- Approved by EU Parliament in May 2023
- **23 actions** led by the Commission to "increase the sustainable production, safe consumption and innovative use of algae and algae-based products

*"Stronger EU algae farming and processing sectors can respond to demand in a wide range of industries, starting with food, animal feed or bio-based plastic to cosmetics, pharmaceuticals or biofuels. Algae biomass can serve as an alternative to raw materials that now are usually fossil-fuel-based, which is very much in line with the European Green Deal's decarbonisation ambition. With this initiative we approach the EU algae sector in such a holistic way as never before"*

**Virginijus Sinkevičius, Commissioner for Environment, Oceans and Fisheries**

## EU4Algae

**Gathering algae interested parties, from all relevant public and private organizations, EU4Algae Forum is aimed at:**

- Centralizing and making algae-relevant information accessible
- Offering a forum to for industry representatives to discuss and exchange about the sector
- Supporting the implementation of the EU Algae Initiative

# The seaweed agenda benefits from an unprecedented political support from the European Commission – EU funding

## Dozens of EU-funded projects directly relevant seaweed

- EMFF/ EMFAF
- LIFE Programme
- Horizon 2020
- Horizon Europe / Mission Ocean
- DG MARE
- …

SEAMARK Seaweed-based Market Applications

AlgaeDemo

Ulva farm

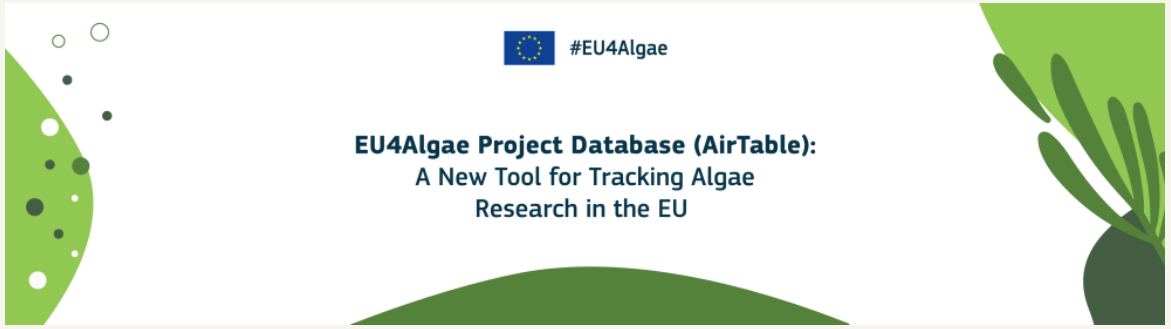
Kelp-EU

iCULTURE

SEAFOOD ALG-TERNATIVE
100% plant-based range of seafood products

AlgaePro BANOS

## New database to search and access those projects




EU4Algae Project Database | Copy base

MASTER

Views | Grid view | Hide fields | Filtered by MICRO/MACRO | Group | Sorted by 1 field

Find a view

Grid view

| | Start | End | ACRONYM | DESCRIPTION | MICRO/... |
|---|---|---|---|---|---|
| 1 | 1/11/2023 | 31/10/2025 | DOEP | Delivery of algae oil into vegan milk through novel O/W emulsions (nano-emulsi... | Macro |
| 2 | 1/10/2023 | 30/9/2028 | PRODIGEST | Nanostructure formation during food protein digestion and influence on intestina... | Macro |
| 3 | 1/9/2023 | 31/8/2027 | iCULTURE | iCulture: A digital bio-platform and co-culture bioprocess to prospect and utilize ... | Macro |
| 4 | 14/8/2023 | 13/8/2025 | SeaWeedWorm | Discovering how bioactive compounds from seaweed kill parasitic worms | Macro |
| 5 | 1/7/2023 | 30/6/2024 | WoTe-Agoprene | Agoprene - biofoams for the future furniture | Macro |
| 6 | 1/6/2023 | 31/5/2025 | C-FAARER | Community-driven Farming for the Atlantic and Arctic sea basins through REgene... | Macro |
| 7 | 1/5/2023 | 30/4/2027 | BOOSTER | BOOSTING DROUGHT TOLERANCE IN KEY CEREALS IN THE ERA OF CLIMATE CHA... | Macro |
| 8 | 1/5/2023 | 30/4/2027 | IMPRESS | INNOVATIVE APPROACHES FOR MARINE AND FRESHWATER BASED INGREDIENT... | Macro |
| 9 | 1/5/2023 | 30/4/2026 | NOVAFOODIES | Demonstration of innovative functional food production systems based on a sust... | Macro |
| | 1/4/2023 | 31/3/2027 | AlgaePro BANOS | Accelerating algae product developments in Baltic and North Sea | Macro |
| 11 | 1/1/2023 | 31/12/2026 | OCEAN CITIZEN | Marine forest coastal restoration: an underwater gardening socio-ecological plan | Macro |
| 12 | 1/1/2023 | 31/12/2026 | FEEDACTIV | Development of functional fish feed based on bioactive compounds of marine an... | Macro |
| 13 | 1/1/2023 | 30/6/2026 | ULTFARMS | circUlar Low Trophic oFfshore Aquaculture in wind farms and Restoration of Mari... | Macro |
| 14 | 1/1/2023 | 31/12/2026 | OLAMUR | Offshore Low-trophic Aquaculture in Multi-Use Scenario Realisation | Macro |
| 15 | 1/1/2023 | 31/12/2026 | BLUE4ALL | Blueprint demonstration for co-created effective, efficient and resilient networks ... | Macro |

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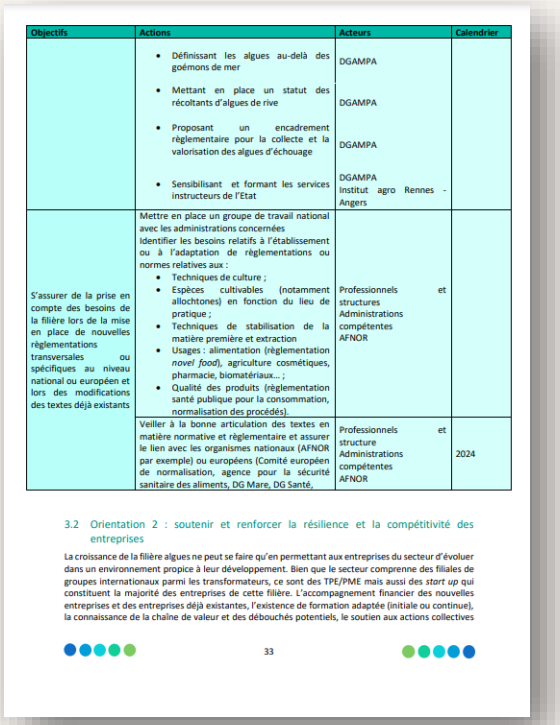
# At member state level, the seaweed topic is also increasingly picked up by governments

## Case study France

France released during Spring 2024 an ambitious and detailed national roadmap to develop the seaweed sector

| Objectifs | Actions | Acteurs | Calendrier |
|---|---|---|---|
| | • Définissant les algues au-delà des goémons de mer | DGAMPA | |
| | • Mettant en place un statut des récoltants d'algues de rive | DGAMPA | |
| | • Proposant un encadrement règlementaire pour la collecte et la valorisation des algues d'échouage | DGAMPA | |
| | • Sensibilisant et formant les services instructeurs de l'État | DGAMPA<br>Institut agro Rennes - Angers | |
| S'assurer de la prise en compte des besoins de la filière lors de la mise en place de nouvelles réglementations transversales ou spécifiques au niveau national ou européen et lors des modifications des textes déjà existants | Mettre en place un groupe de travail national avec les administrations concernées<br>Identifier les besoins relatifs à l'établissement ou à l'adaptation de règlementations ou normes relatives aux :<br>• Techniques de culture ;<br>• Espèces cultivables (notamment allochtones) en fonction du lieu de pratique ;<br>• Techniques de stabilisation de la matière première et extraction<br>• Usages : alimentation (règlementation *novel food*), agriculture cosmétiques, pharmacie, biomatériaux… ;<br>• Qualité des produits (règlementation santé publique pour la consommation, normalisation des procédés). | Professionnels et structures<br>Administrations compétentes<br>AFNOR | |
| | Veiller à la bonne articulation des textes en matière normative et règlementaire et assurer le lien avec les organismes nationaux (AFNOR par exemple) ou européens (Comité européen de normalisation, agence pour la sécurité sanitaire des aliments, DG Mare, DG Santé, | Professionnels et structure<br>Administrations compétentes<br>AFNOR | 2024 |

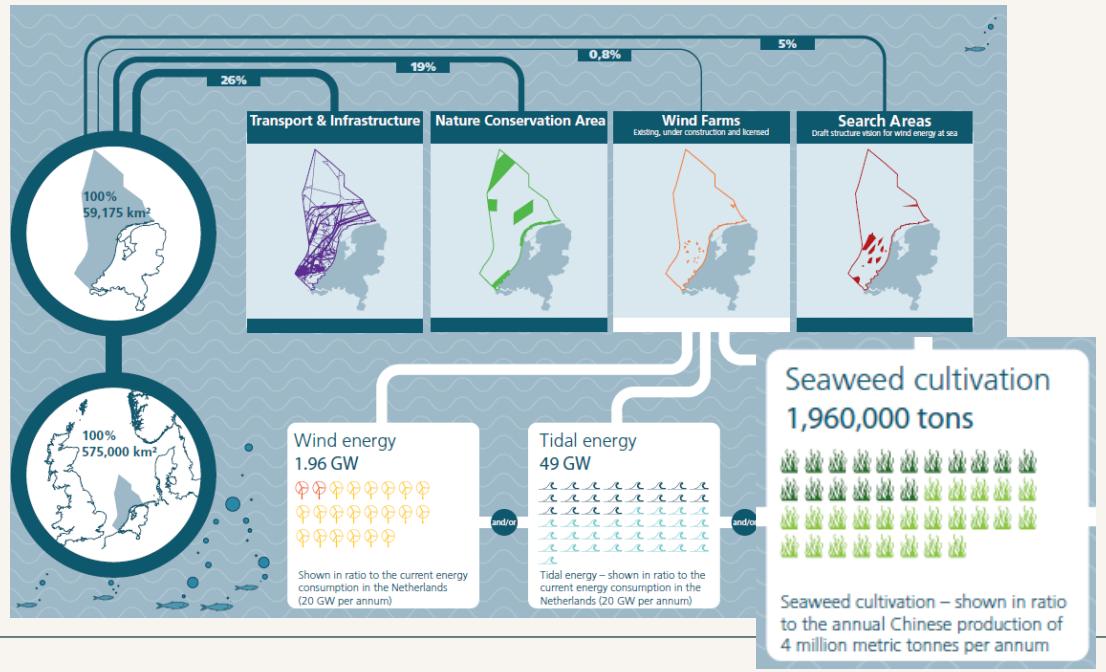
3.2 Orientation 2 : soutenir et renforcer la résilience et la compétitivité des entreprises

La croissance de la filière algues ne peut se faire qu'en permettant aux entreprises du secteur d'évoluer dans un environnement propice à leur développement. Bien que le secteur comprenne des filiales de groupes internationaux parmi les transformateurs, ce sont des TPE/PME mais aussi des *start up* qui constituent la majorité des entreprises de cette filière. L'accompagnement financier des nouvelles entreprises et des entreprises déjà existantes, l'existence de formation adaptée (initiale ou continue), la connaissance de la chaîne de valeur et des débouchés potentiels, le soutien aux actions collectives



## Case study Netherlands

Dutch Government's North Sea 2050 Spatial Agenda, includes multi-use activities such as seaweed, mussel, fish IMTA, and seaweed co-location with wind-turbines and wave-energy.

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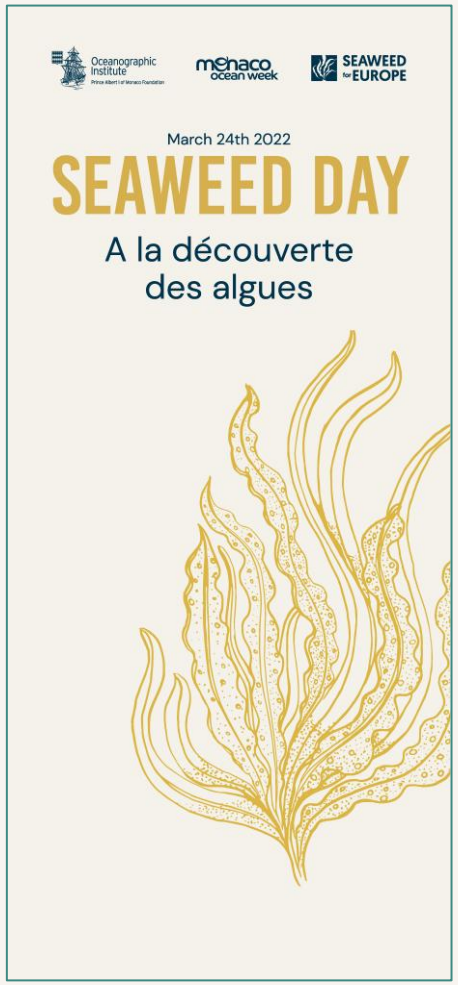
# Numerous events and conferences allow for advocacy, networking and knowledge sharing around the European seaweed agenda





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# Non-state actors like academia, NGOs and stakeholders' organisations are also rich and active to support the European seaweed industry

## Strong network of public and private research centres

Generating the new products, research, and innovations necessary to scale up seaweed production and transformation

## Active ecosystem of supporting organisations
(non exhaustive)



Sources: Investor Memo Seaweed for Europe

# Chapter I

# Seaweed and bivalves: status and potential of regenerative mariculture in Europe


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# Bivalve aquaculture: Introduction

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# Bivalves are aquatic shelled molluscs that can be gathered in 4 groups, with a key characteristic of being filter feeders

## Bivalves

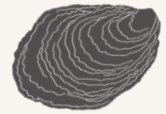
- **Aquatic molluscs,** i.e. soft bodied invertebrates
- **With a shell that includes two parts called *valves*,** joined along a hinge that allows it to open and close
- Like fish, they **breathe through gills**
- **Bivalves are filter feeders:** they feed primarily on **phytoplankton** (micro-algae) suspended in the water column
- **Some bivalves** have a **retractable foot** that enables them to move or burrow

## ~8,000

**species** of marine bivalves

## 4 species groupings

Mussels



Oysters

Clams*

Scallops

*Including cockles and arkshells

Sources: O'Shea, T., Jones, R., Markham, A., Norell, E., Scott, J., Theuerkauf, S. and T. Waters. 2019. Towards a Blue Revolution: Catalyzing Private Investment in Sustainable Aquaculture Production Systems. The Nature Conservancy and Encourage Capital, Arlington, Virginia, USA.
David F. Willer and David C. Aldridge, 2020. Sustainable bivalve farming can deliver food security in the tropics
US National Oceanic and Atmospheric Administration (NOAA)

# Bivalve aquaculture in Europe at a glance: ~0.5m tonnes produced (half of EU aquaculture volumes), worth ~€1.3B (a third of EU aquaculture value)

> Europe accounts for **4% of global bivalve production**, 26% when excl. China

> **Bivalves** are the **most produced commodity group farmed in the EU aquaculture**

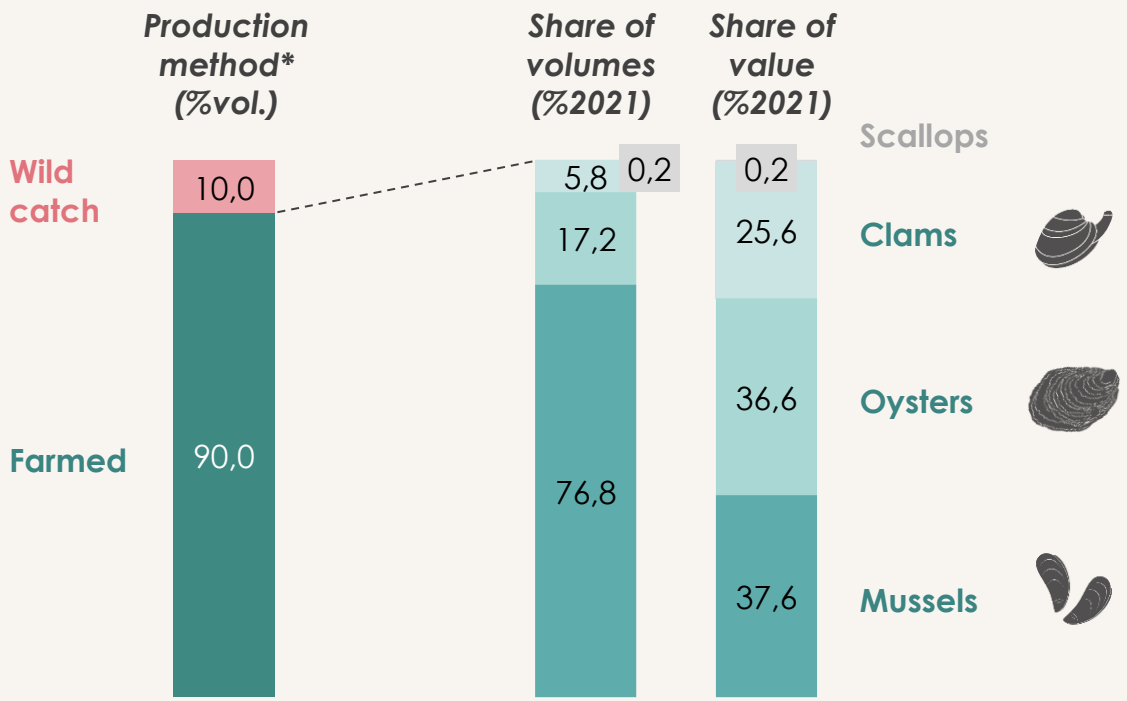
**553k tonnes**
**Produced** in 2021

**€1.27B**
**Worth**

**49%**
of EU aquaculture **volumes**

**30%**
of EU aquaculture **value**

## >99% of EU production rely on 3 groups of species




*Estimate based on Global statistics

in scope out of scope

Sources: O'Shea, T., Jones, R., Markham, A., Norell, E., Scott, J., Theuerkauf, S. and T. Waters. 2019. Towards a Blue Revolution: Catalyzing Private Investment in Sustainable Aquaculture Production Systems. The Nature Conservancy and Encourage Capital, Arlington, Virginia, USA.
European Market Observatory For Fisheries And Aquaculture Products, The EU Fish Market, 2023 Edition

# Impact on human communities

1/8

## Strengthen global food security

- Bivalves are a **source of high-quality proteins** for human populations
- **Higher protein content than many meats and plant crops** (150mg $kcal^{-1}$ vs. e.g. 121 for chicken, 98 for beef, 88 for soya)
- **High levels of omega-3 fatty acids, and micronutrients** s.a. zinc, iron, vitamin A and vitamin B12

2/8

## Well-being of human populations: health

- **Research about encapsulating nutrients in a feed that is palatable to bivalves** to elevate vitamins levels in their tissue and turn them into **fortified food to tackle malnutrition**
- **Oyster aquaculture may inhibit the spread of disease in wild populations** as farmed oysters filter disease-causing parasites which are subsequently removed during harvest

3/8

## Well-being of human populations: socio-economic

- **Bivalves have the potential to contribute to the improvement of the GDP in developing nations** in a significant way, due to their high export value vs. traditional fish species
- **Also, bivalve farming can contribute to gender equality in coastal communities,** as women are able to work in aquaculture farms located close to the coast

European Investment Bank

Sources: O'Shea, T., Jones, R., Markham, A., Norell, E., Scott, J., Theuerkauf, S. and T. Waters. 2019. Towards a Blue Revolution: Catalyzing Private Investment in Sustainable Aquaculture Production Systems. The Nature Conservancy and Encourage Capital, Arlington, Virginia, USA.
External Research (incl. https://www.moulesdebouchot.fr/les-producteurs/)

# Impact on climate change mitigation

4/8

## Low carbon footprint

- **Bivalves require minimal energy to produce** (although depuration consumes notable amounts of electricity)
- **On average:** 83t of $CO_2$ produced per tonne of edible beef proteins, vs. **296kg emissions per tonne of (Bouchot) mussel protein (x280)**
- **Mussels have the lowest carbon footprint** of any food product

5/8

## Carbon sequestration capability

- The question of **whether bivalve farming leads to a net sequestration of $CO_2$** (regarding the **carbon dioxide uptake in the shells** during the production process) remains a **topic of scientific debate**
- A **pilot project has evaluated the $CO_2$ emissions** involved in mussel farming, showing that **mussels do absorb $CO_2$**
- **First certificate of carbon credits** awarded in Italy

6/8

## Water usage and protection vs. eutrophication

- **Bivalves require no freshwater to grow, they filter planktonic algae** and fix nitrogen and phosphorus within their tissue
- **In areas of eutrophication** (from which 60% of coastal estuaries suffer), bivalves can help **decrease nutrient loading**
- An **oyster** can filter up to **190 litres per day;** a **mussel 40 litres** (x500 mussels / sqm)

European Investment Bank

Sources: O'Shea, T., Jones, R., Markham, A., Norell, E., Scott, J., Theuerkauf, S. and T. Waters. 2019. Towards a Blue Revolution: Catalyzing Private Investment in Sustainable Aquaculture Production Systems. The Nature Conservancy and Encourage Capital, Arlington, Virginia, USA.
External Research (incl. https://www.moulesdebouchot.fr/les-producteurs/)

# Impact on biodiversity

7/8

## Benefits to wild stocks

- **Bivalves are filter-feeders, i.e. non-fed vs. aquaculture fish production, that can imply high amounts of wild catch** upstream in the value chain (5kg of wild fish are needed to produce 1kg of salmon)
- Also, due to a free floating embryotic stage, bivalve aquaculture can **provide seedstock for wild populations**

8/8

## Habitat creation and improvement

- **The reefs formed by bivalves create habitat for other ocean wildlife** to colonise and use (s.a. barnacles, seaweeds and nursery grounds for fish)
- **Water filtration from bivalves can also help improve light availability**, potentially improving growing conditions for other important coastal habitats, s.a. seagrasses

Sources: O'Shea, T., Jones, R., Markham, A., Norell, E., Scott, J., Theuerkauf, S. and T. Waters. 2019. Towards a Blue Revolution: Catalyzing Private Investment in Sustainable Aquaculture Production Systems. The Nature Conservancy and Encourage Capital, Arlington, Virginia, USA.
External Research

# Supporting bivalve production in the EU could address UN SDGs linked to food security (2), human health (3), responsible production (12), climate action (13), clean water (6) and ocean protection (14)

SUSTAINABLE DEVELOPMENT GOALS

**IMPACT ON HUMAN COMMUNITIES**

- Strengthen global food security — 2 ZERO HUNGER
- Well-being of human populations: health — 3 GOOD HEALTH AND WELL-BEING
- Well-being of human populations: socio-economic — 5 GENDER EQUALITY, 8 DECENT WORK AND ECONOMIC GROWTH

**IMPACT ON CLIMATE CHANGE MITIGATION**

- Low carbon footprint — 12 RESPONSIBLE CONSUMPTION AND PRODUCTION, 13 CLIMATE ACTION
- Carbon sequestration capability — 13 CLIMATE ACTION
- Water usage and protection vs. eutrophication — 6 CLEAN WATER AND SANITATION, 14 LIFE BELOW WATER

**IMPACT ON BIODIVERSITY**

- Benefits to wild stocks — 14 LIFE BELOW WATER
- Habitat creation and improvement — 14 LIFE BELOW WATER

**in scope** when considering European production of bivalves

European Investment Bank

Sources: O'Shea, T., Jones, R., Markham, A., Norell, E., Scott, J., Theuerkauf, S. and T. Waters. 2019. Towards a Blue Revolution: Catalyzing Private Investment in Sustainable Aquaculture Production Systems. The Nature Conservancy and Encourage Capital, Arlington, Virginia, USA.
External Research

# However, like any form of (food) production, bivalve farming is not without impact, and several environmental effects must be kept in mind, and further investigated by the scientific and production ecosystem – s.a.

## BIOACCUMULATION

As they are **filter-feeders,** bivalves can **concentrate harmful micro-organisms** (from agriculture run-off or sewage), **toxins** (from algae or bacteria), **chemicals** present in the water, **metals, microplastics…**

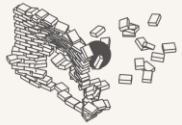
All these substances can then **move up the food chain,** directly or indirectly, **to humans**

## HABITAT MODIFICATION

**Culture systems add physical structures** to the environment, which could **entrap wildlife** and **affect sedimentation and light**

e.g. especially under the conditions of slow water exchange, feces can accumulate along with empty shells up to 10cm of biodeposit per year, progressively changing the seabed structure

## HABITAT DESTRUCTION



**Spat collection remove wild individuals** and can at the same time **affect other forms of wildlife**

Some **mechanical harvesting methods,** notably **dredging** in case of on-bottom cultures, **significantly affect the seabed**

## REMOVAL OF PLANKTON

The expansion of bivalve aquaculture may cause **depletion of phytoplankton abundance** and **alteration of plankton community structure,** especially **when bivalve stock is too large**

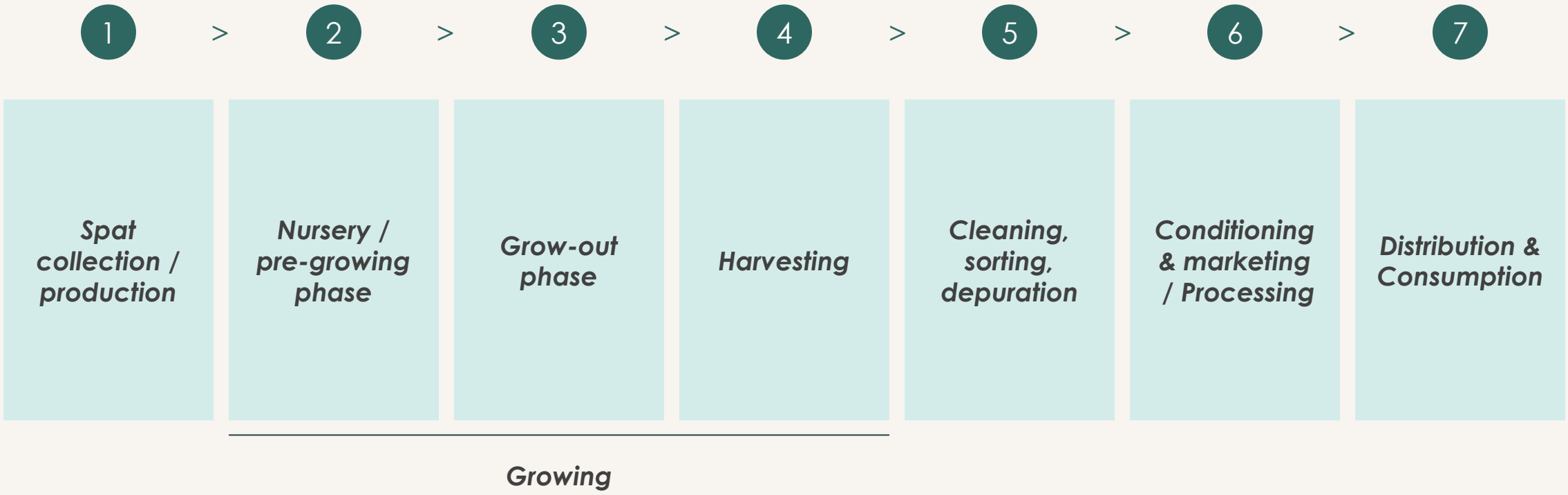
## CHANGE IN HYDRO-DYNAMIC PATTERNS

Gears, structures and materials in bivalve farms can **affect the local hydrodynamic** of farming area through **generating friction force with water currents**

The **velocity reduction** attributed to bivalve farming structures is **usually between 25% and 75 %,** but in extreme cases, velocity reduction can reach 90 %

Sources: Karsoon Tan, Peng Xu, Leiheng Huang, Cong Luo, Jinman Huang, Hanafiah Fazhan, Kit Yue Kwan, Effects of bivalve aquaculture on plankton and benthic community, Science of The Total Environment, Volume 914, 2024
External Research

# The overall bivalve aquaculture value chain can be segmented into 7 key steps, presenting some specificities depending on the cultivated species



# Focus on Mussels:

- Detailed value chain
- EU production key facts and figures
- Market trends: EU and top producers
- Mussel producers

# Mussel production detailed value chain: 6 key steps, minor importance of hatcheries to date, 4 main production techniques, some processing

1 > 2 > 3 > 4 > 5 > 6 > 7

## 1 Spat collection / production

**Spat collection**

- ***Setting collectors*** (e.g. ropes, nets) in the water to naturally attract and collect wild mussel larvae
- ***Monitoring***
- ***Harvesting***

**Hatcheries**

***Far less common,*** as it is an expensive method (vs. low ex-farm price of mussels) + main producers not affected by lack of spats… to date

## 2 Nursery / pre-growing phase

**Direct deployment**

The prevalent practice is to ***directly deploy the collected spat to the grow-out systems*** where they remain until they reach market size

## 3 Grow-out phase

**Grow-out methods (12-18 months)**

- ***Raft culture:*** hanging ropes or nets from floating wooden rafts
- ***Longline culture:*** suspended lines anchored to the seabed
- ***Bouchot culture:*** wooden poles (bouchots) driven into the seabed in the intertidal zone
- ***Bottom culture:*** mussels are seeded directly on the seabed

## 4 Harvesting

**Harvesting methods**

- ***Raft and longline cultures:*** ropes or nets are pulled up on boats (manually or mechanically), mussels are detached by hand, and placed in containers
- ***Bouchot culture:*** access during low tide, manually or mechanically scraped
- ***Bottom culture:*** boats equipped with dredges or rakes

## 5 Cleaning, sorting, depuration

**Cleaning and sorting**

- ***Cleaning:*** harvested mussels are cleaned to remove debris and impurities (with high pressure water jets or mechanical scrubbers)
- ***Sorting:*** based on size and quality

**Depuration**

***Mussels are held in clean, filtered seawater tanks*** to purge them of any sand, silt, or potential bacteria or viruses

## 6 Conditioning & marketing / processing

**Conditioning & distrib.**

- ***Some producers*** create their ***own commercial company***
- Others create ***associate producers trading companies***
- ***Independent treatment plants*** also ensuring mussel commercialisation

**Processing (mainly Spain)**

- ***Various stages of processing*** can take place in the same plant or in specialised plants

## 7 Distribution & Consumption

**Distribution**

***Via wholesalers, or directly***

- Fishmongers
- HORECA

***Via central purchasing bodies***

- Mass retailers

***Direct to consumers***

**Consumption**

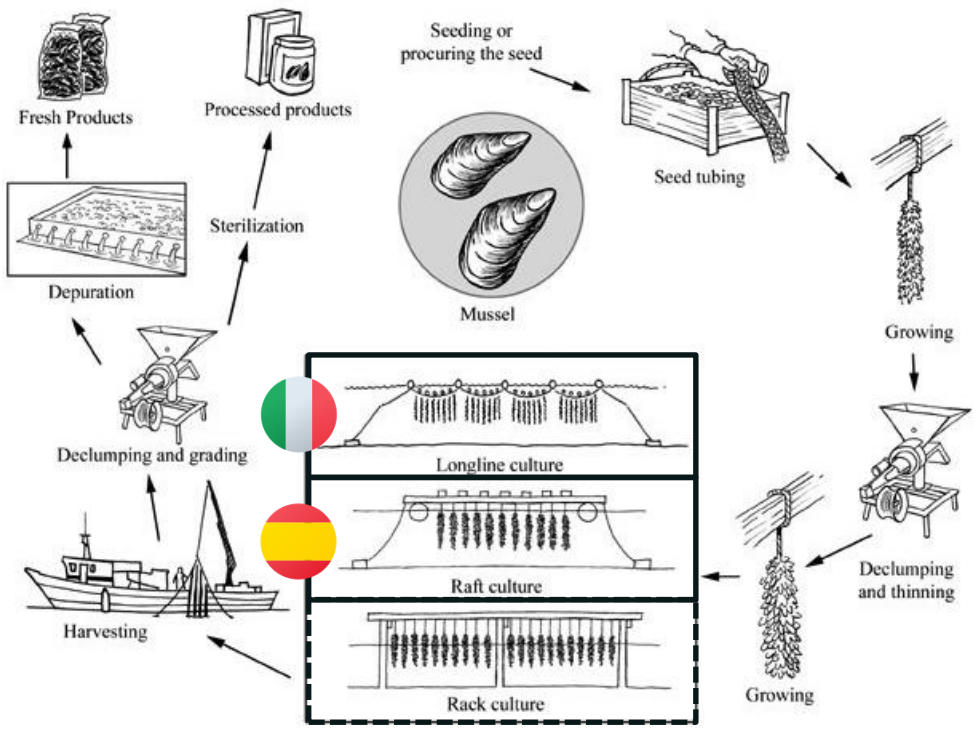
- Fresh
- Prepared-preserved / canned
- Frozen

European Investment Bank

*Sources: European Market Observatory For Fisheries And Aquaculture Products, The EU Fish Market, 2023 Edition*
*European Market Observatory For Fisheries And Aquaculture Products, Mussel in the EU Case Study, 2022*

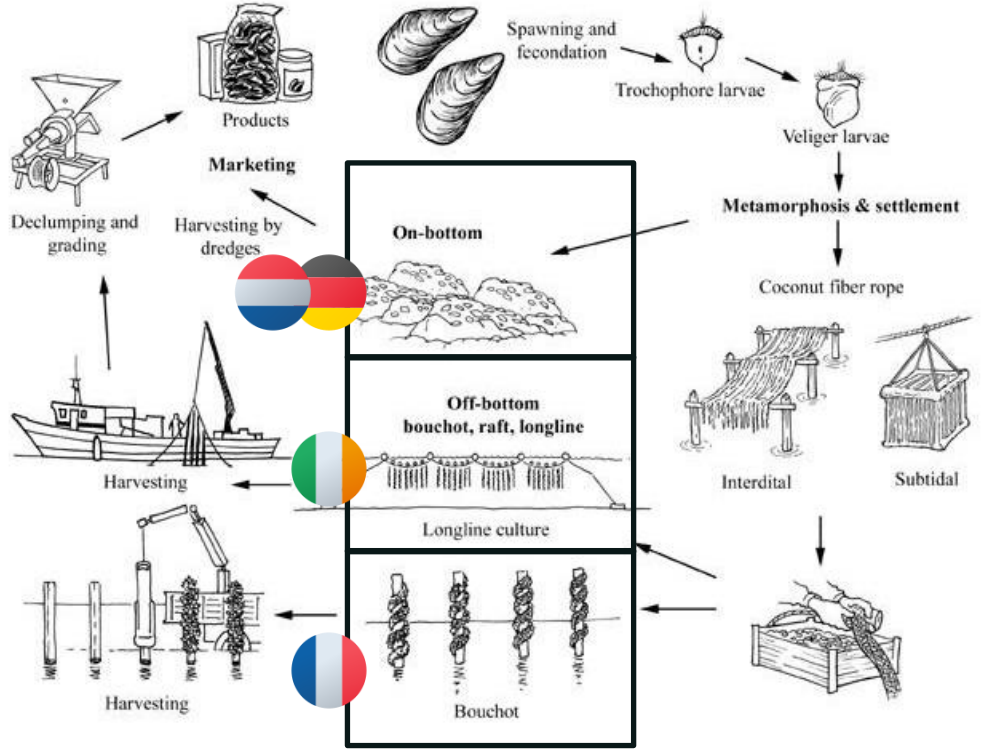
# Mussel production detailed value chain: illustrations of production methods for the 2 main species cultivated

## Mytilus galloprovincialis (Mediterranean Mussel)




*Source: FAO*

## Mytilus edulis (Blue Mussel)

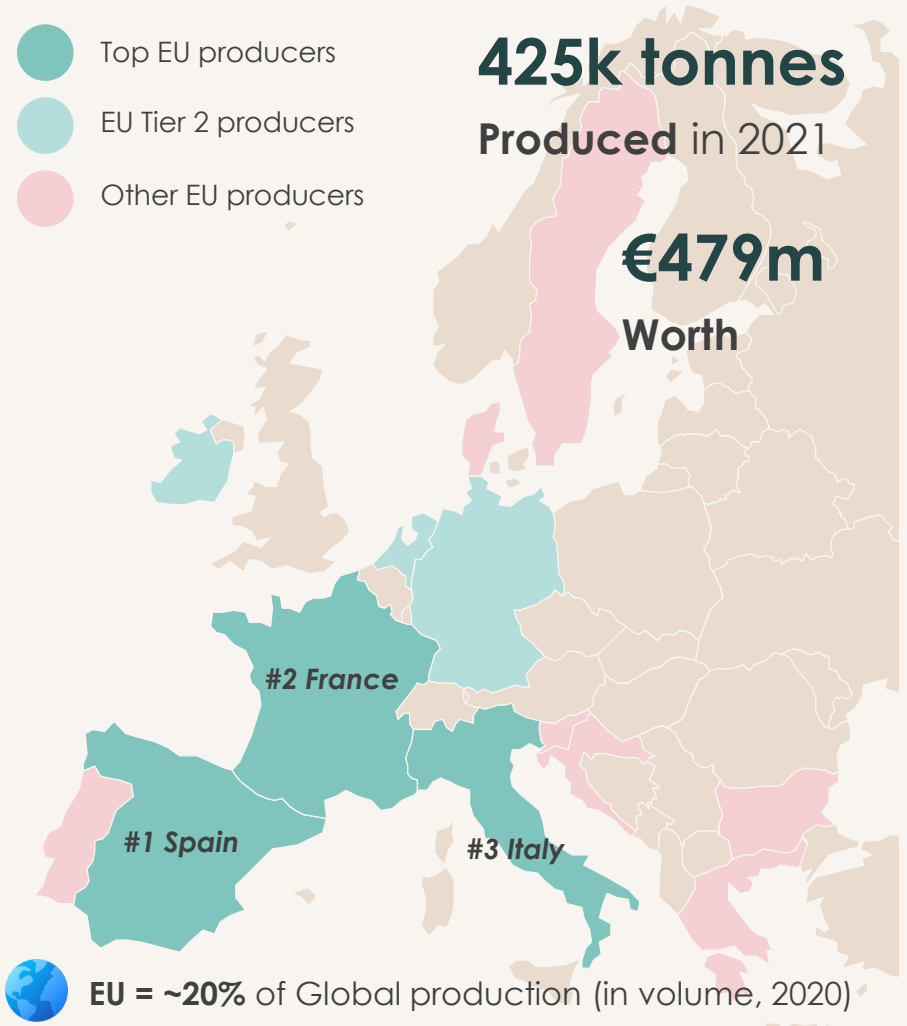



*Source: FAO*

**Note: Main production method illustrated by country, although several types of grow-out techniques usually coexist in every producing country**

*Sources: European Market Observatory For Fisheries And Aquaculture Products, Mussel in the EU Case Study, 2022*

# EU production key facts and figures: 3/4 of vol. and val. concentrated by 3 countries, with Spain and France each accounting for ~30% of value




**EU = ~20%** of Global production (in volume, 2020)

72% val. / 78% vol.

## SPAIN
- **Volume 2021:** 203kt (48% of EU)
- **Value 2021:** €137m (29% of EU)
- **Avg €/kg:** €0.68 (vs. €1.13 EU average)
- **Main species:** Mediterranean mussel
- **Main method:** Raft culture

## FRANCE
- **Volume 2021:** 66kt (16% of EU)
- **Value 2021:** €150m (31% of EU)
- **Avg €/kg:** €2.25 (vs. €1.13 EU average)
- **Main species:** Blue mussel
- **Main method:** Bouchot culture

## ITALY
- **Volume 2021:** 62kt (15% of EU)
- **Value 2021:** €56m (12% of EU)
- **Avg €/kg:** €0.90 (vs. €1.13 EU average)
- **Main species:** Mediterranean mussel
- **Main method:** Longline culture

## NETHERLANDS
- **Volume 2021:** 33kt (8% of EU)
- **Value 2021:** €65m (14% of EU)
- **Avg €/kg:** €1.99 (vs. €1.13 EU average)
- **Main species:** Blue mussel
- **Main method:** Bottom culture

## IRELAND
- **Volume 2021:** 17kt (4% of EU)
- **Value 2021:** €17m (4% of EU)
- **Avg €/kg:** €0.98 (vs. €1.13 EU average)
- **Main species:** Blue mussel
- **Main method:** Longline culture

## GERMANY
- **Volume 2021:** 14kt (3% of EU)
- **Value 2021:** €32m (7% of EU)
- **Avg €/kg:** €2.27 (vs. €1.13 EU average)
- **Main species:** Blue mussel
- **Main method:** Bottom culture

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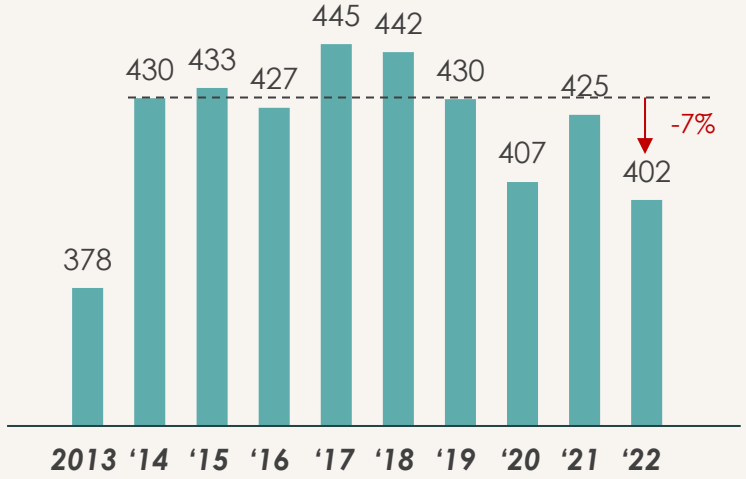
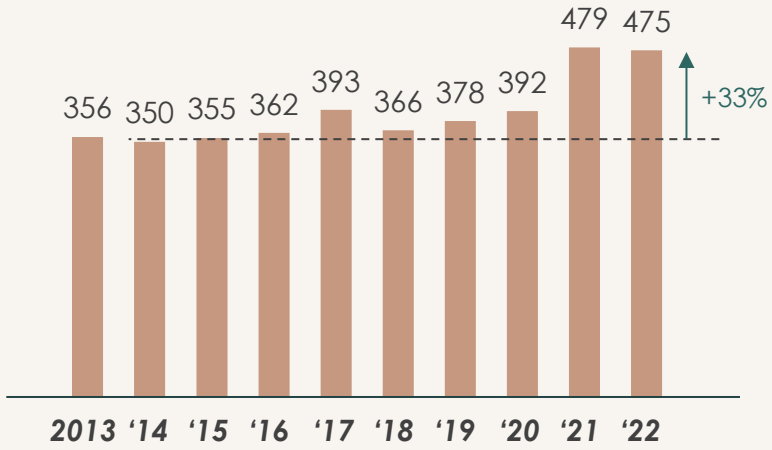
*Sources: European Market Observatory For Fisheries And Aquaculture Products, The EU Fish Market, 2023 Edition*
*Eurostat data, fish_aq2a*
*European Market Observatory For Fisheries And Aquaculture Products, Mussel in the EU Case Study, 2022*

# EU market trends: decreasing volumes over the past 2 decades, more than compensated by price increases leading to a 2022 production worth 33% more vs. 2014 with volumes 7% lower

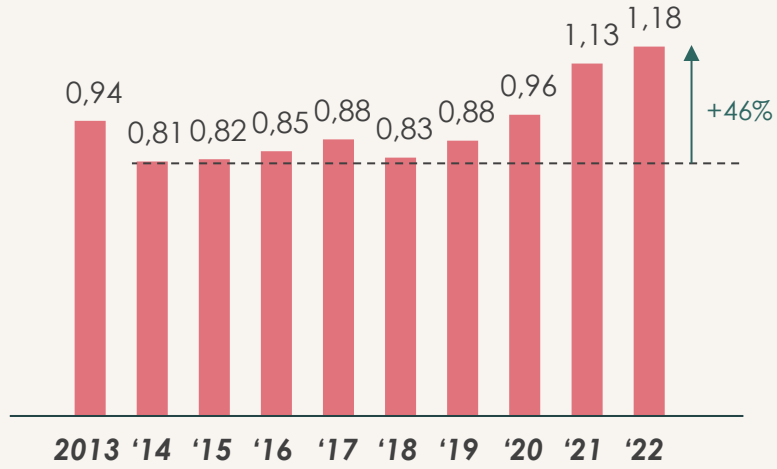
**Production volume (ktonnes)**




**Production value (€m)**




**Average price (€/kg)**

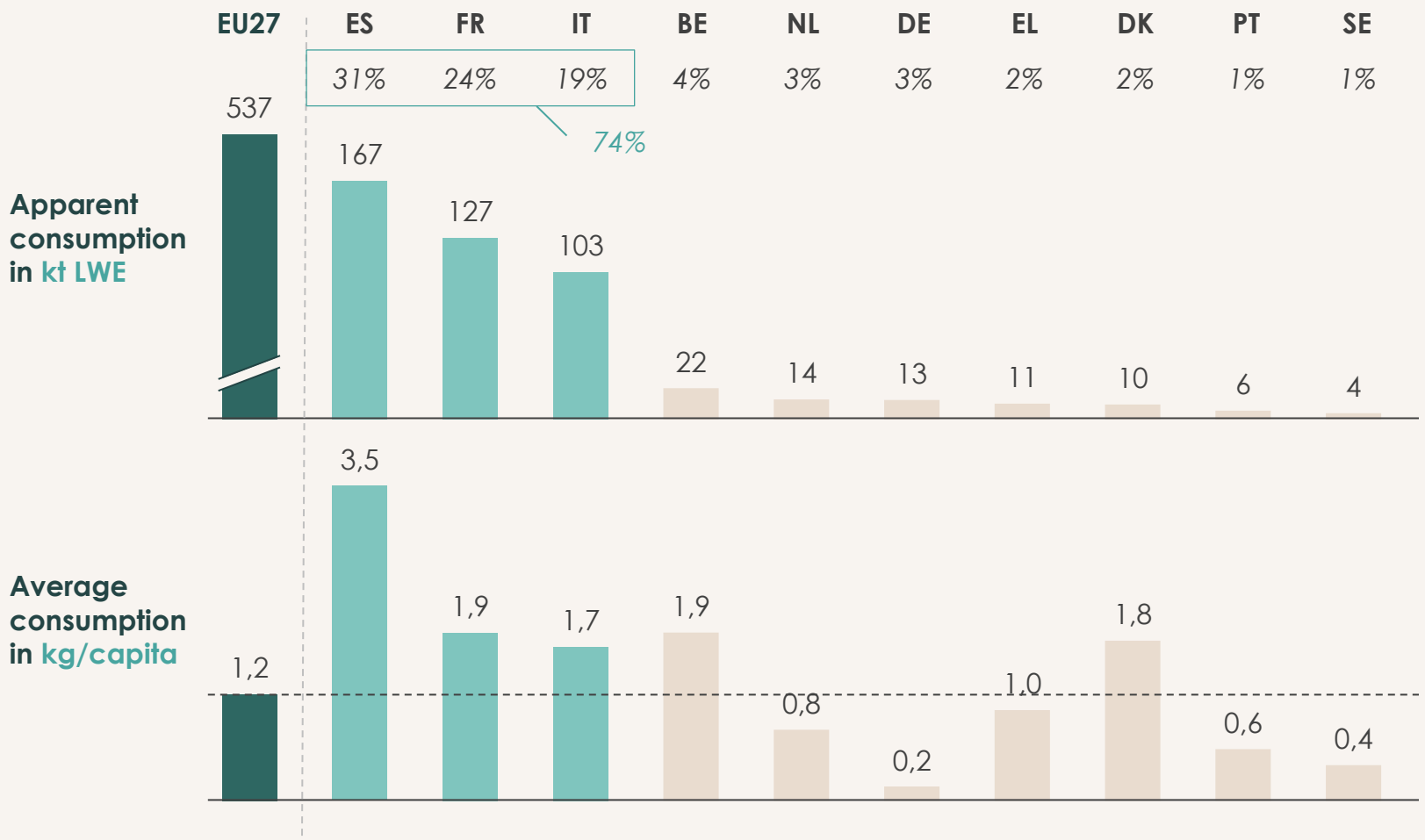



- Mussels cover **~3/4 of the total volume of bivalve production in Europe** (425kt / 553 kt in 2021)
- The EU farmed production of mussels has been on a **downward trend over the last two decades (from 600kt in the late 1990s to ~400-430kt) vs. increasing in the rest of the world** + new decrease after covid, reaching a **low point of 400kt in 2022** (-7% vs. 2014)
- **Various explanatory factors mentioned in the literature,** s.a. (depending on the region) diseases, lack of spat, algal blooms, predation, low earnings, sometimes exacerbated by local conditions s.a. the small size of mussel enterprises, the lack of innovation in the production processes or the impacts of climate change
- **However, EU mussel production value has been stable** over the 2013-2018 period, **then increasing since 2018,** to reach **€475m in 2022, i.e. +33% vs. 2014**
- Since 2018, the **fluctuations in production volumes** have been **more than compensated by price increases,** to reach **€1.18/kg on average, i.e. +46% vs. 2014**

European Investment Bank

*Sources: European Market Observatory For Fisheries And Aquaculture Products, The EU Fish Market, 2023 Edition*
*Eurostat data, fish_aq2a*
*European Market Observatory For Fisheries And Aquaculture Products, Mussel in the EU Case Study, 2022*
*The decline of mussel aquaculture in the European Union: causes, economic impacts and opportunities, Reviews in Aquaculture, 2021*

# EU market trends: EU-27 consumption mainly driven by top 3 producing countries (accounting for 3/4 of the consumption), with some smaller markets presenting high levels of consumption per capita



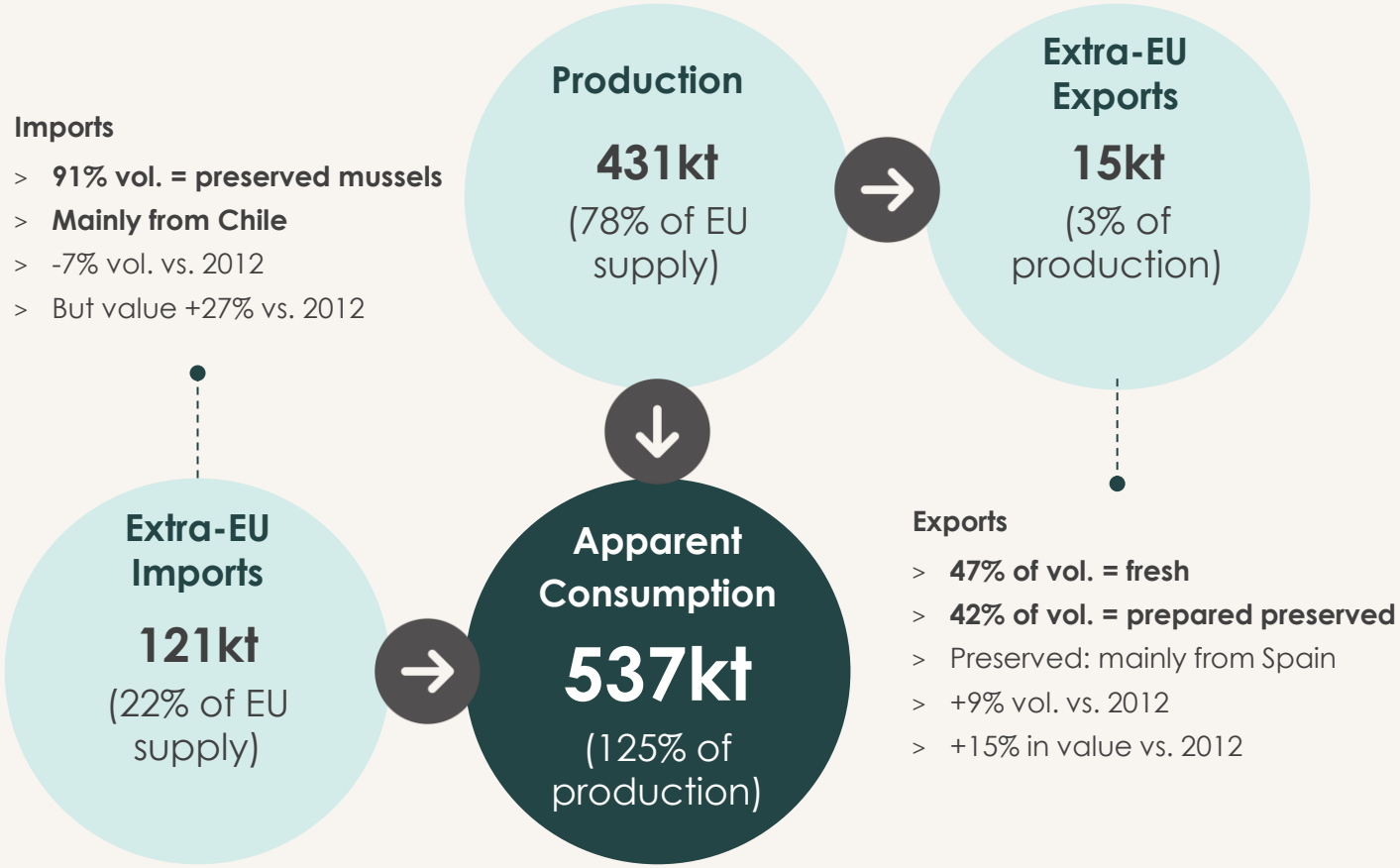

## Comments

- In 2020, the apparent consumption of mussels was **537ktonnes LWE in EU-27**
- The main countries in terms of apparent consumption are the **same as top 3 main producing countries, representing together about 3/4 of the production, and 3/4 of the consumption:**
  - **Spain,** 167kt LWE **(31% of EU-27)**
  - **France,** 127kt **(24%)**
  - **Italy,** 103kt **(19%)**
- **Highest per capita consumption** is observed **in Spain (3.5kg/year),** which is about **x3 the EU average**
- **Belgium and Denmark have also a significant per capita consumption,** but reported to smaller markets, they do account for a **minor share of total EU consumption**

*Sources: European Market Observatory For Fisheries And Aquaculture Products, The EU Fish Market, 2023 Edition*
*Eurostat data, fish_aq2a*
*European Market Observatory For Fisheries And Aquaculture Products, Mussel in the EU Case Study, 2022*

# EU market trends: EU-27 imports mainly preserved mussels (from Chile) to complement the production and intra-EU trade of mussels (mainly fresh); small export market (still in Europe)

## Volumes in LWE (2020)




## Comments

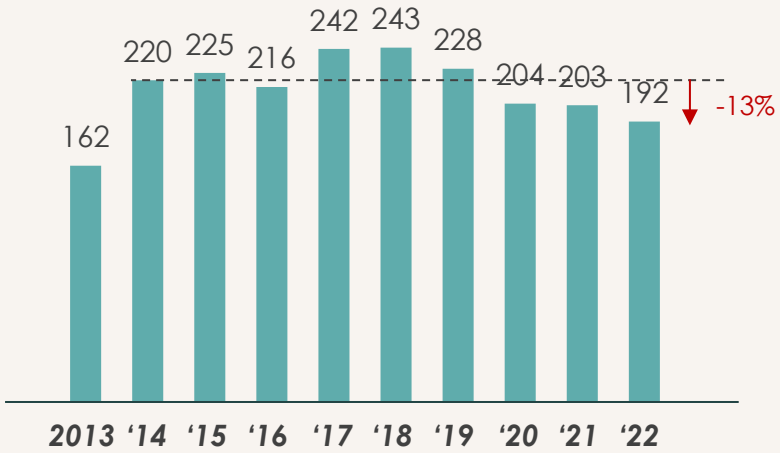
*Quoting: European Market Observatory For Fisheries And Aquaculture Products, Mussel in the EU Case Study, 2022*

- **Mussel's imports from third countries** concern mainly **preserved mussels (91% in volume and 87% in value in 2021).** Almost all prepared mussels imported to the EU come from **Chile**
- **Between 2012 and 2021, imports' value has increased by 27% (13% in real terms), while imports' volume has decreased by 7%.** The decrease in volume is related to the decrease of imports of fresh and frozen mussel. **In contrast, imports of preserved mussels have increased in volume by 25%.** Prices of imported preserved mussels have also increased by 21% (7% in real terms)
- **Extra-EU exports concern mainly fresh mussels** (47% of exports volume and 33% of their value), **followed by prepared-preserved mussels** (42% of exports volume and 57% of their value)
- **The main destinations were Switzerland and the UK** (resp. 30% and 20% of the extra-EU exports value). **Extra-EU exports increased by 9% in volume and 15% in value** (1% in real terms) between 2012 and 2021

*Sources: European Market Observatory For Fisheries And Aquaculture Products, The EU Fish Market, 2023 Edition*
*Eurostat data, fish_aq2a*
*European Market Observatory For Fisheries And Aquaculture Products, Mussel in the EU Case Study, 2022*

# Spain market trends: decreasing volumes over the past 5 years despite stable production capacity, compensated by strong price increases that reflect in decade-high production value in 2022

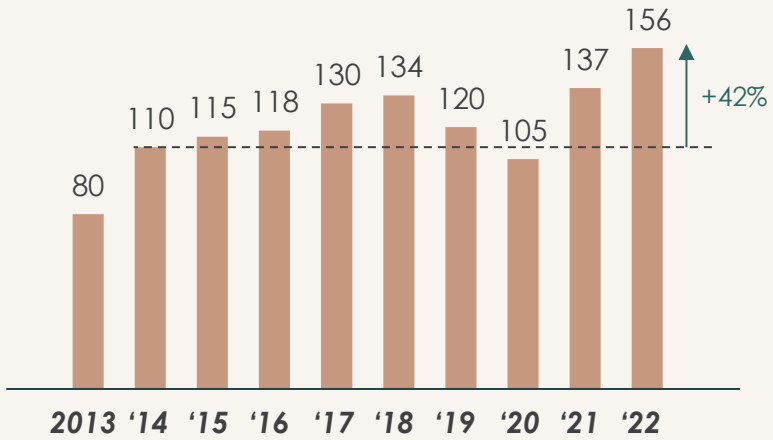
**Production volume (ktonnes)**




**Share of total EU mussel production (%)**

43 51 52 51 54 55 53 50 48 48

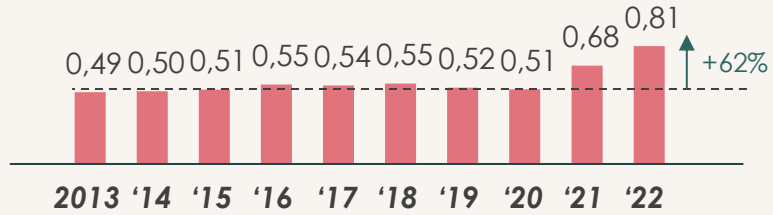
**Production value (€m)**




**Share of total EU mussel production (%)**

22 32 32 33 33 37 32 27 29 33

**Average price (€/kg)**




**vs. EU average price (€/kg)**

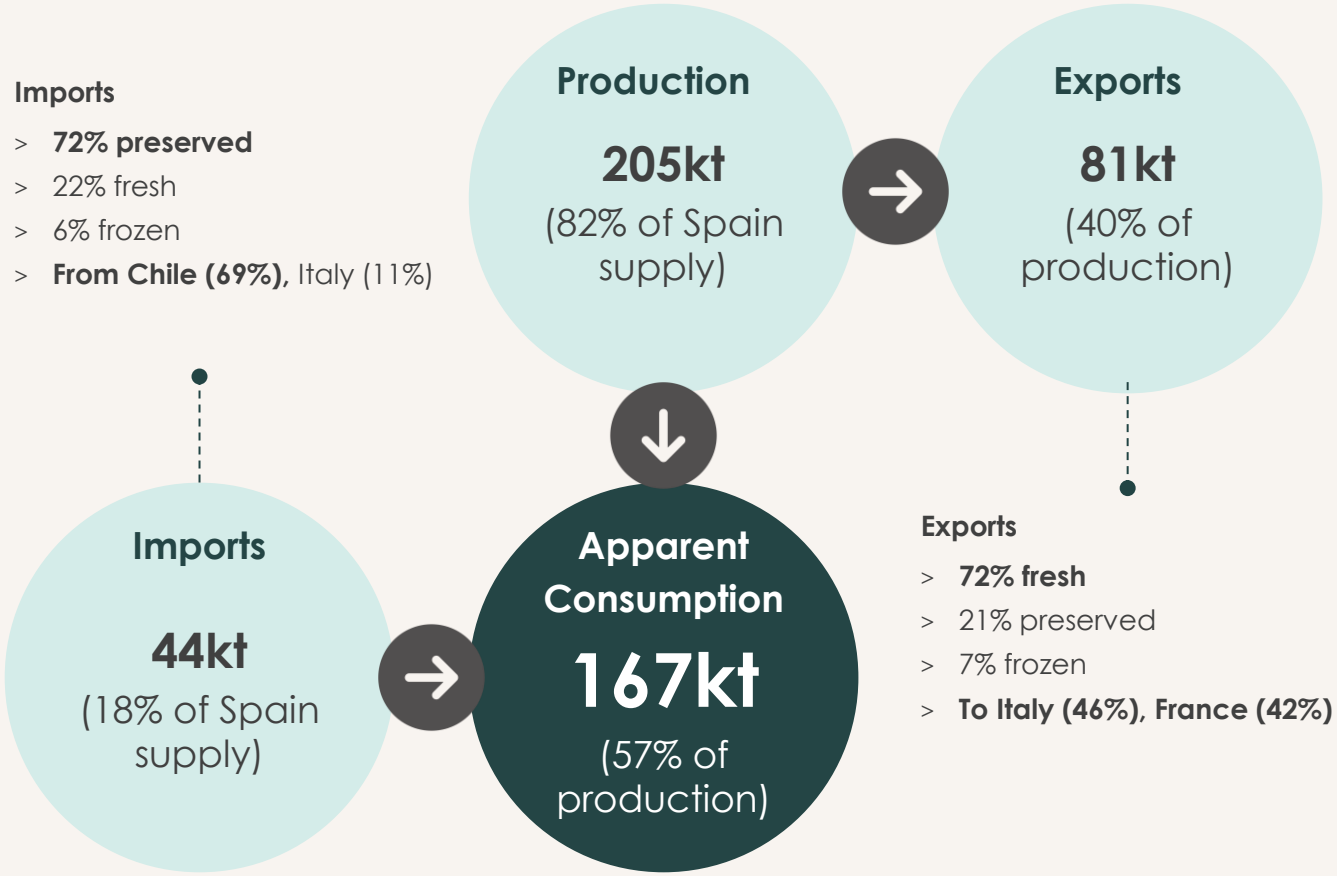
0.94 0.81 0.82 0.85 0.88 0.83 0.88 0.96 1.13 1.18 -31%

- Spain mainly produces **Mediterranean mussel (75% of Spanish production in volume), in Galicia** (97% of the Spanish prod. in 2020), **with ~3,400 rafts**
- Spain is the **most important mussel producing country in Europe,** but with a production facing a continuous **downward trend since 2019 (192kt in 2022, i.e. -13% vs. 2014)**
- **The production capacity is reported stable** and year-to-year variations in volumes would be **mainly related to red tides which prevent harvesting** mussels in affected areas
- Despite the decrease in volumes, **production value rose by 30% in 2021**, and **again by 14% in 2022, reaching a decade-high of €156m**
- After a **long period of price stability, ex-farm prices rose by 33% in 2021, then by another 19% in 2022, reaching €0.81/kg** (+62% vs. 2014; but -31% vs. EU average)
- Note: **62% of the harvest is sold fresh** to treatment plants which clients are wholesalers and retailers; the **remaining 38% goes to the processing sector** (vs. 61% in 2006)

*Sources: European Market Observatory For Fisheries And Aquaculture Products, The EU Fish Market, 2023 Edition*
*Eurostat data, fish_aq2a*
*European Market Observatory For Fisheries And Aquaculture Products, Mussel in the EU Case Study, 2022*

# Spain market trends: Spain imports mainly preserved mussels from Chile (for the processing industry); high exports of fresh mussels; high local consumption with fresh mussels progressively losing shares vs. canned

## Volumes in LWE (2020)




## Comments

*Quoting: European Market Observatory For Fisheries And Aquaculture Products, Mussel in the EU Case Study, 2022*

- **Consumers primarily purchase fresh or preserved mussels, with respectively 71% of the volumes** and 46% of the value, **and 25% of the volumes** (in product weight) and 49% of the value of mussels consumed at home
- Overall, the home **consumption of fresh mussels has decreased over the past ten years. It dropped in 2013** as a consequence of **decreased supply,** which was due to **algae pollution**
- **Prepared-preserved mussels** are mostly consumed as **"mejillón en escabeche"** (picked mussels **= about 80%-90% of the consumption of processed mussels,** consumed as appetizer, in bars or at-home
- **Consumption is currently reorganizing,** influenced by new factors like environmental impact, toxins, climate change, size variations, etc. **Consumption per capita of fresh mussels is on a decreasing trend (-15% over the 2016-2020 period), whereas it increased by 25% for canned mussels**

European Investment Bank

*Sources: European Market Observatory For Fisheries And Aquaculture Products, The EU Fish Market, 2023 Edition*
*Eurostat data, fish_aq2a*
*European Market Observatory For Fisheries And Aquaculture Products, Mussel in the EU Case Study, 2022*

# Spanish mussel producers: small, family-owned mussel farms that have been consolidating into producer associations since the 2000s

## Key insights

- **Historically,** the industry has had a **considerable number of small, family-owned mussel farms** that focus solely on the growing of mussels: **~3,400 rafts in Galicia** (97% of Spanish production in 2020), **owned by 2,000 to 2,300 families**
- **The growers sell their production to treatment plants** that specialize in purifying and packaging the mussels – these treatment plants are the **only organisations authorised to put fresh mussels on the market**
- **Since the 2000s,** there has been a **trend towards consolidation in the industry,** with **growers gathering into producer associations,** getting equipped with **purification plants** and establishing **shared marketing networks** (and sometimes processing plants)

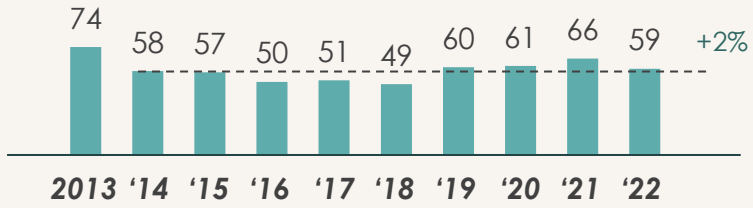
## e.g.

| Growers + Treatment plant | Treatment plants |
|---|---|
| Amegrove<br>~400 families / 335 rafts<br>22kt of mussels per year | Aurelio Silva<br>Mussels and clams |
| mares de galicia<br>Mussels, clams and oysters | José Mª Daporta Leiro e Hijos S.L.<br>Mussels, clams and oysters |
| mariscos malliño S.L.<br>Mussels, clams and oysters | Profer<br>Mussels, clams and oysters |

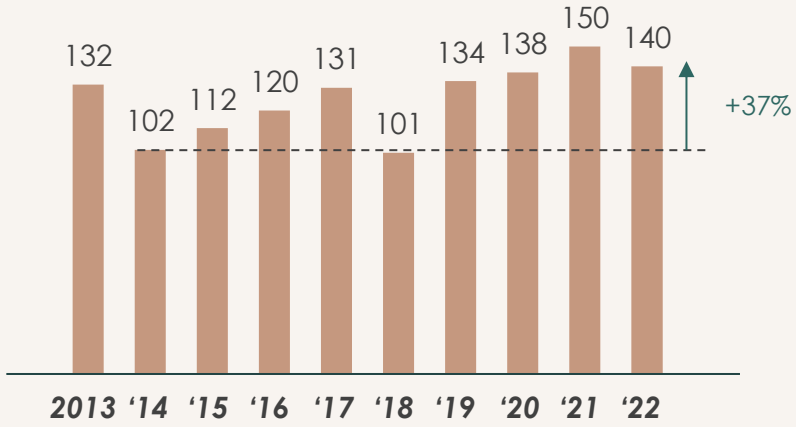
*Sources: European Market Observatory For Fisheries And Aquaculture Products, Mussel in the EU Case Study, 2022*
*Uxio Labarta and Maria-Jose Fernández-Reiriz, The Galician Mussel Industry: Innovation and changes in the last forty years, 2019*
*www.mexillondegalicia.org*

# France market trends: stable volumes at ~60kt since 2014 with products (Bouchot) valued 3x more vs. Spain and earlier price increases, representing a similar production overall value (~€140m)

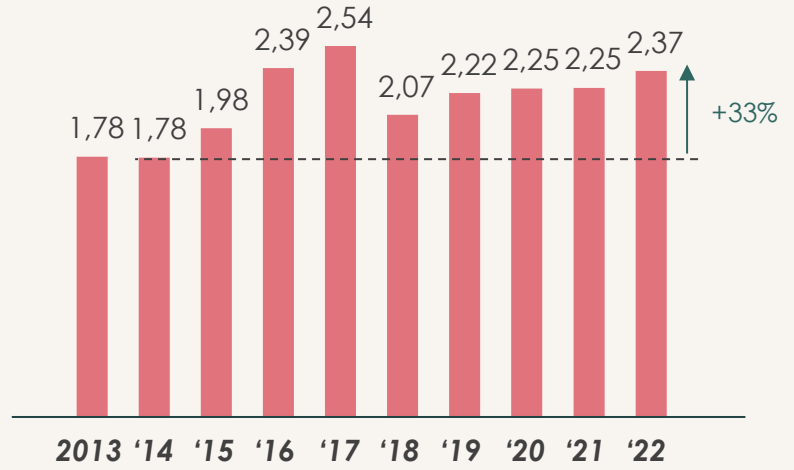
**Production volume (ktonnes)**




**Production value (€m)**




**Average price (€/kg)**




**Share of total EU mussel production (%)**

| 2013 | '14 | '15 | '16 | '17 | '18 | '19 | '20 | '21 | '22 |
|---|---|---|---|---|---|---|---|---|---|
| 20 | 13 | 13 | 12 | 12 | 11 | 14 | 15 | 16 | 15 |

**Share of total EU mussel production (%)**

| 2013 | '14 | '15 | '16 | '17 | '18 | '19 | '20 | '21 | '22 |
|---|---|---|---|---|---|---|---|---|---|
| 37 | 29 | 32 | 33 | 33 | 28 | 35 | 35 | 31 | 30 |

**vs. EU average price (€/kg)**

| 2013 | '14 | '15 | '16 | '17 | '18 | '19 | '20 | '21 | '22 |
|---|---|---|---|---|---|---|---|---|---|
| 0.94 | 0.81 | 0.82 | 0.85 | 0.88 | 0.83 | 0.88 | 0.96 | 1.13 | 1.18 |

+101%

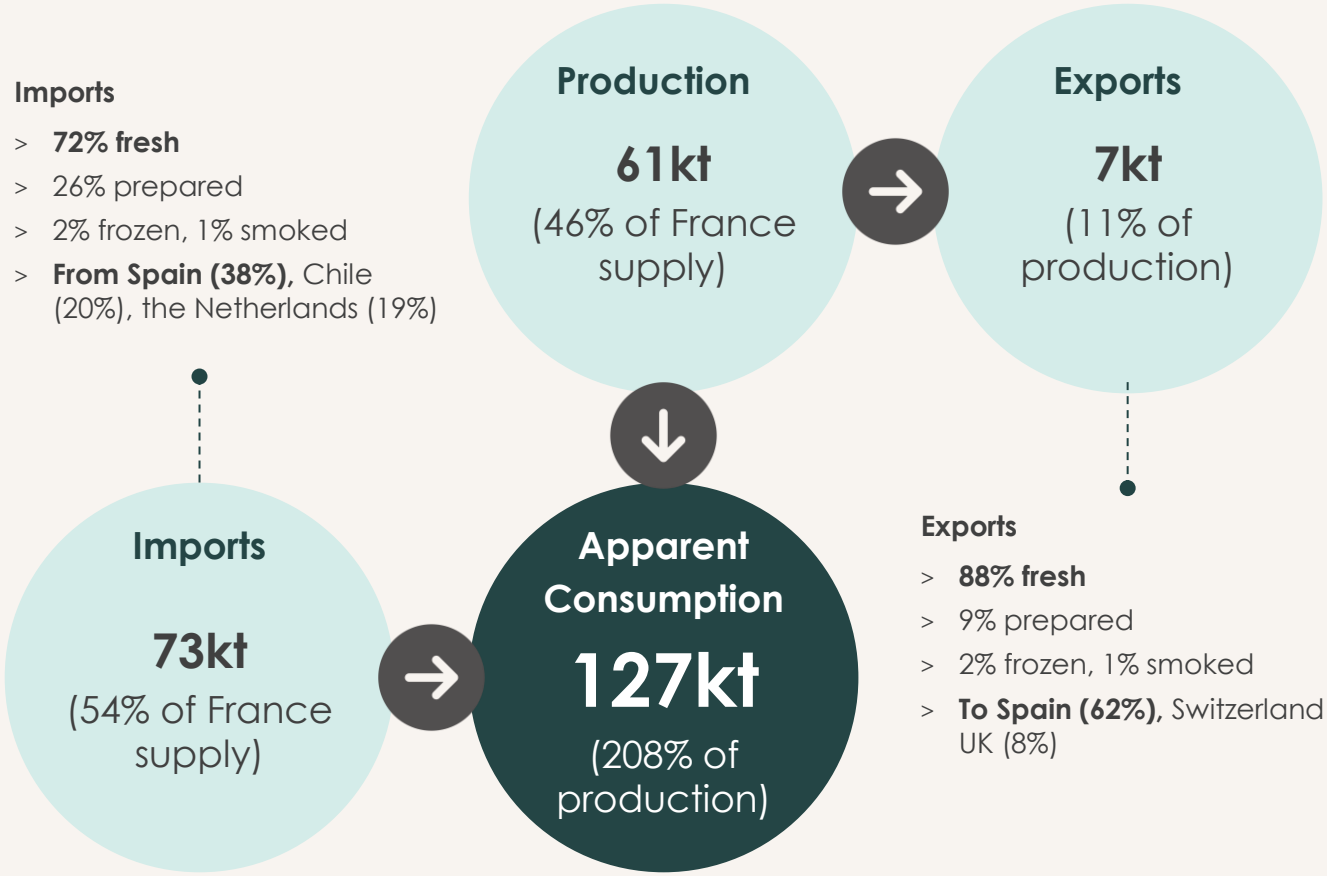
- France mainly produces **Blue mussel (90% of volume), on Bouchots (83% of French production)**
- Unlike Spain (with production developped in a single region), **mussel farming is present in all French coastlines** (North Brittany = concentrating 45% of the production)
- French **production has been stable over the past decade** (after a decade-high in 2013), remaining at **~60kt (about 1/3 of Spain volumes).** Still, as France produces the **more valuable blue mussel + using Bouchot production method,** it manages to reach **ex-farm prices about 3x higher vs. Spain,** hence representing a **similar overall production value (of about €140m to €150m).**
- **Bouchot price premium due to:** labour intensive production method, Protected Designation of Origin (PDO), quality and taste, high demand vs. limited production
- To the contrary of Spain, **price increases happened earlier in France (around 2016)** with a relative **stability over the past few years**

European Investment Bank

*Sources: European Market Observatory For Fisheries And Aquaculture Products, The EU Fish Market, 2023 Edition*
*Eurostat data, fish_aq2a*
*European Market Observatory For Fisheries And Aquaculture Products, Mussel in the EU Case Study, 2022*

# France market trends: France consumption ranks #2 in Europe with mussels being considered as a popular and traditional dish; high dependency on imports to cover local consumption

## Volumes in LWE (2020)




## Comments

*Quoting: European Market Observatory For Fisheries And Aquaculture Products, Mussel in the EU Case Study, 2022*

- France mussel market characterised by a **high level of consumption (1.9kg/capita in 2020),** as mussel is considered as a **popular aquatic product**
- Mussels are **often consumed cooked at home or at restaurants.** Mussels are **also consumed during summer festivals and events.** Associated with French fries, **"moule frites" is a popular dish for out-of-home consumption**
- Kantar data show that there is a **peak of consumption during summer (between July and September)**
- The French market is **highly dependent on imports (>70kt LWE in 2020): mainly fresh (72% in 2021, from other EU countries)** and prepared-preserved (26%, mainly from Chile – cooked mussels for the processing industry)
- **Imports of fresh mussels fluctuate throughout the year** (high demand in summer)

*Sources: European Market Observatory For Fisheries And Aquaculture Products, The EU Fish Market, 2023 Edition*
*Eurostat data, fish_aq2a*
*European Market Observatory For Fisheries And Aquaculture Products, Mussel in the EU Case Study, 2022*

# French mussel producers: 320 producers of Bouchot mussels registered into a professional union, with a large share of the prod. sold either by integrated players, or by associated producers

## Key insights

- **Bouchot mussels** represent **>80% of the French production;** any breeder and/or raiser and/or purifier and/or shipper of Bouchot mussels is **required to join a professional union known as "STG Moules de Bouchot"**
- STG Moules de Bouchot gathers **320 French producers involved in the Bouchot production**
- **All configurations are observed: from pure players** (spat collectors, growers, purificators or expeditors) **to fully integrated players** (covering the complete value chain from spat collection to purification)
- **Almost 40%** of the Bouchot mussel production is estimated to be **sold through associate producers' companies** (strictly speaking purificators + expeditors, but belonging to associated growers)

## e.g.

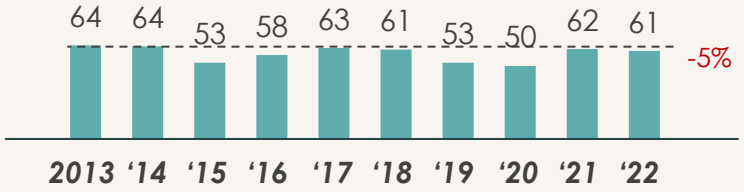
| Pure players | Associate producers | Integrated players |
|---|---|---|
| **SOURBIER**<br>*Spat collector* | | **CANCALE COQUILLAGES** |
| **VIVAMOULES**<br>*Grower* | CULTIMER PRODUCTEURS ASSOCIÉS | Mytilus |
| **JPM COQUILLAGES**<br>*Expeditor* | La Pénestin | La Vivaraise |

**Complete list of 320 French producers involved in the Bouchot production:**
www.moulesdebouchot.fr/uploads/2023/06/2306_Liste_habilitations_STG_moulesdebouchot_GMB.pdf

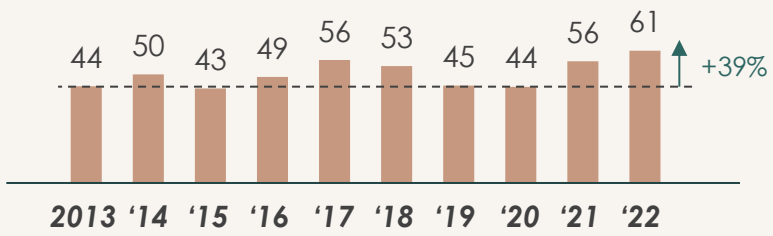
*Sources: European Market Observatory For Fisheries And Aquaculture Products, Mussel in the EU Case Study, 2022*
*External research (www.moulesdebouchot.fr/les-producteurs/)*

# Italy market trends: fluctuating (and uncertain) volumes of ~60kt, with a continuous increase in prices over the decade and some supply aggregation leading to a decade-high production val. of €61m

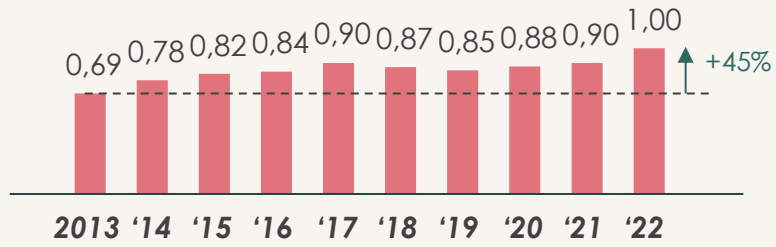
**Production volume (ktonnes)**




**Production value (€m)**




**Average price (€/kg)**




**Share of total EU mussel production (%)**

17 15 12 14 14 14 12 12 15 15

**Share of total EU mussel production (%)**

12 14 12 13 14 15 12 11 12 13

**vs. EU average price (€/kg)**

0.94 0.81 0.82 0.85 0.88 0.83 0.88 0.96 1.13 1.18 -15%

- **More than 85% of the Italian mussel production is located in 6 regions:** Emilia-Romagna, Marche, Veneto and Apulia account for the largest share of the volume produced (73%), the following regions are Sardinia and Campania
- **The Italian production of mussels has been fluctuating over the past decade** but seems to struggle to maintain **production volumes at ~60kt per year**
- Italian mussels are **sold by farmers under two presentations: ropes** ("treccia", containing impurities s.a. algae, other shellfish) **and bulk** ("sfuso", cleaned), with **between 15% and 50% loss between ropes and bulk** → total % of rope vs. bulk not exactly documented, making the **actual volume produced in Italy not certain**
- **Since 2018, mussel businesses have initiated efforts towards vertical integration** through the creation of **purification centers** and **processing of farm products,** with investments supported by **European Maritime and Fisheries Fund (EMFF) measures** in favor of aquaculture that contributed to **greater aggregation of supply**

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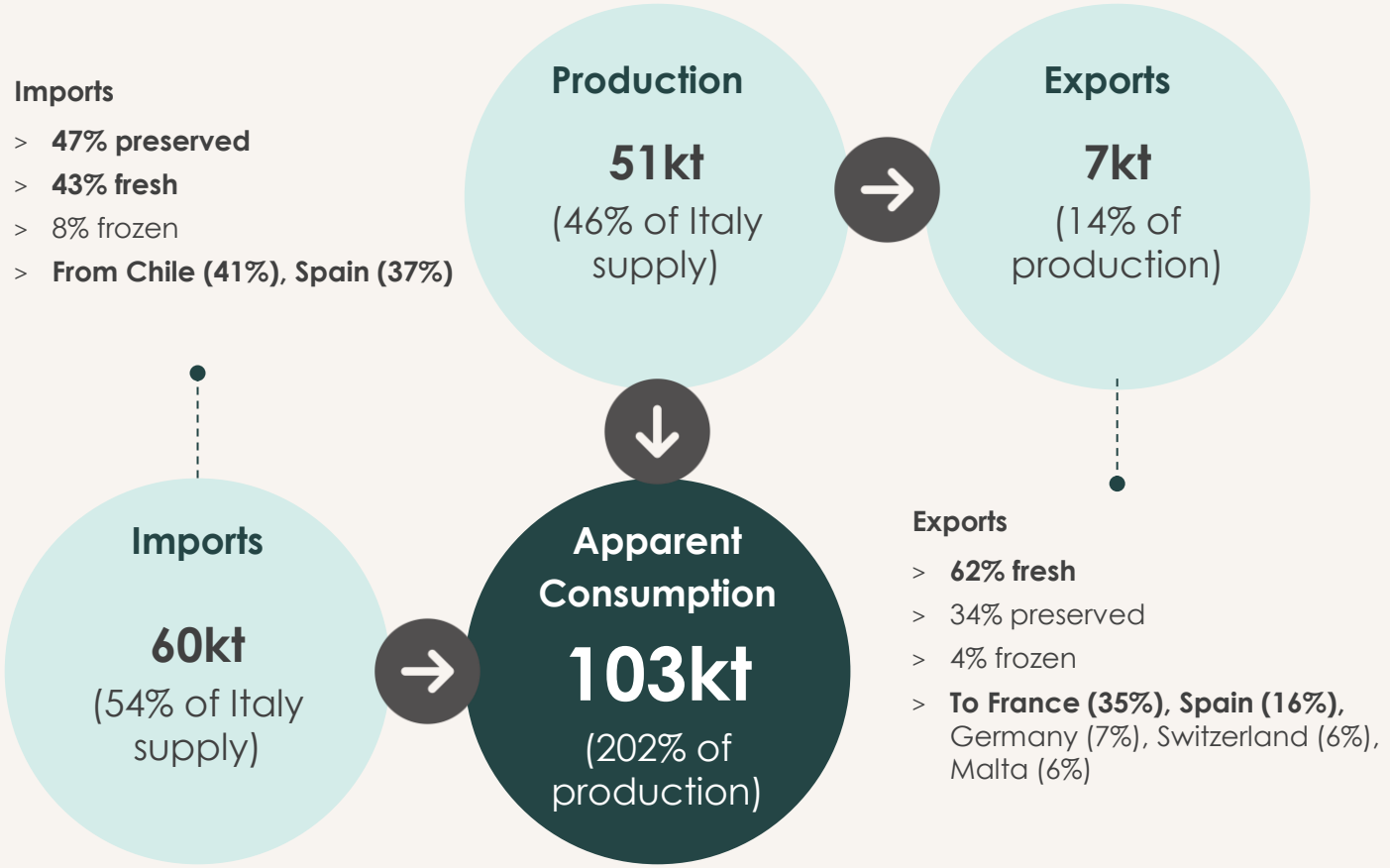
*Sources: European Market Observatory For Fisheries And Aquaculture Products, The EU Fish Market, 2023 Edition*
*Eurostat data, fish_aq2a*
*European Market Observatory For Fisheries And Aquaculture Products, Mussel in the EU Case Study, 2022*

# Italy market trends: Italy imports about half of its consumption level, that still ranks #3 in Europe despite a continuous decrease in household consumption (sensitivity to price increase?)

## Volumes in LWE (2020)




## Comments

*Quoting: European Market Observatory For Fisheries And Aquaculture Products, Mussel in the EU Case Study, 2022*

- Italian mussel market is characterised by a **high level of consumption (1.7kg/capita in 2020),** as mussels feature among the **cheapest seafood products** and are prepared in **many Italian dishes**
- The **Italian production fully supplies the demand in fresh mussels between April and September,** and is completed by imports from Spain and Greece between October and March. Thus, **the market relies on imports,** mostly from Spain and Greece for fresh mussels, and from Spain and Chile for frozen products
- Overall, the **home consumption of fresh mussels has continuously decreased over the past decade,** with a drop of 32% in volume and 26% in nominal value (33% in real terms) between 2012 and 2021
- Mussels **still account for 50% of the molluscs' consumption in volume in 2020 due to lower average prices** than clams and squids

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*Sources: European Market Observatory For Fisheries And Aquaculture Products, The EU Fish Market, 2023 Edition*
*Eurostat data, fish_aq2a*
*European Market Observatory For Fisheries And Aquaculture Products, Mussel in the EU Case Study, 2022*

# Italian mussel producers: largely fragmented sector, with poorly organised producers and bargaining power captured by wholesalers, although ongoing initiatives towards more vertical integration

## Key insights

- Italy mussel farming sector composed of **240 sites in 2019, exploited by ~550 enterprises**
- **The sector is largely fragmented,** and only few companies manage the entire supply chain, from production to sale. **Producers are poorly organised** and old traditions persist
- **The purification and packaging stages are most often carried out by wholesalers,** in their shipping centres (purification is rarely managed by producers themselves). STECF estimates that **>70% of mussels are sold through the marketing of wholesalers.** As a result, **many producers face poor revenues and economic performance**
- **Since 2018, mussel businesses have initiated efforts towards vertical integration,** supported by the European Maritime and Fisheries Fund (EMFF)

## e.g.

**Cooperatives**

Cozza di Cervia

FRATELLI D'ANDRIA

MITILICOLTORI COOPERATIVA SPEZZINI

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*Sources: European Market Observatory For Fisheries And Aquaculture Products, Mussel in the EU Case Study, 2022*

# Focus on Oysters:

- Detailed value chain
- EU production key facts and figures
- Market trends: EU and top producers
- Oysters producers

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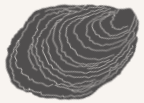
# Oyster production detailed value chain: 7 key steps, hatcheries common in the EU, 3 main production techniques, almost no processing



1 > 2 > 3 > 4 > 5 > 6 > 7

## 1 Spat collection / production

**Spat collection**

- ***Setting collectors*** in the water to naturally attract and collect wild oyster larvae
- ***Monitoring***
- ***Harvesting***

**Hatcheries**

**Increasingly used to ensure a steady supply of spat (33% of spat supply in FR):** in a controlled environment, adult oysters are induced to spawn. Larvae are nurtured in tanks until they become spat

## 2 Nursery / pre-growing phase

**Initial grow-out (2-6 months)**

Spat are placed in nursery systems s.a. wood frame trays with mesh bases or perforated plastic trays to grow **until they are large enough to be transferred to open water farms**

**Monitoring**

During this phase, **careful monitoring of water quality and spat health** is essential to ensure **high survival rates**

## 3 Grow-out phase

**Grow-out methods (12-36 months)**

- ***On-bottom culture:*** sown on intertidal or sub-tidal ground
- ***Off-bottom culture:*** contained in mesh bags or perforated plastic trays of various types, attached by rope or rubber bands to wood frame or rebar steel trestles (on tables)
- ***Suspended culture:*** hanging strings or wires of shells, or nets suspended from lines or rafts

## 4 Harvesting

**Harvesting methods**

- ***On-bottom culture:*** harvesting by hand (e.g. divers), or by dredging sub-tidal beds
- ***Off-bottom culture:*** using small boats, farmers manually remove the bags from the racks or table. Mechanical lifters may be used to raise the bags for collection
- ***Suspended culture:*** farmers pull the ropes and manually detach the oysters

## 5 Cleaning, sorting, depuration

**Cleaning and sorting**

- ***Cleaning:*** harvested oysters are cleaned to remove debris and impurities
- ***Sorting:*** based on size and quality

**Depuration**

***Oysters are held in clean, filtered seawater tanks*** to purge them of any sand, silt, or potential bacteria or viruses

**"Affinage" (in FR)**

Part of the harvest is moved to **high-quality, nutrient-rich waters** for 1-4 months to **improve quality**

## 6 Conditioning & marketing / processing

**Conditioning & distrib.**

- ***Some producers*** create their ***own commercial company***
- Others create ***associate producers trading companies***
- ***Independent treatment plants*** also ensuring oysters commercialisation

**Processing**

***EU almost exclusively produces (and exports) live-fresh oysters;*** still, some plants exist to e.g. smoke or freeze oysters

## 7 Distribution & Consumption

**Distribution**

***Via wholesalers, or directly***

- Fishmongers
- HORECA

***Via central purchasing bodies***

- Mass retailers

***Direct to consumers***

**Consumption**

- Fresh essentially

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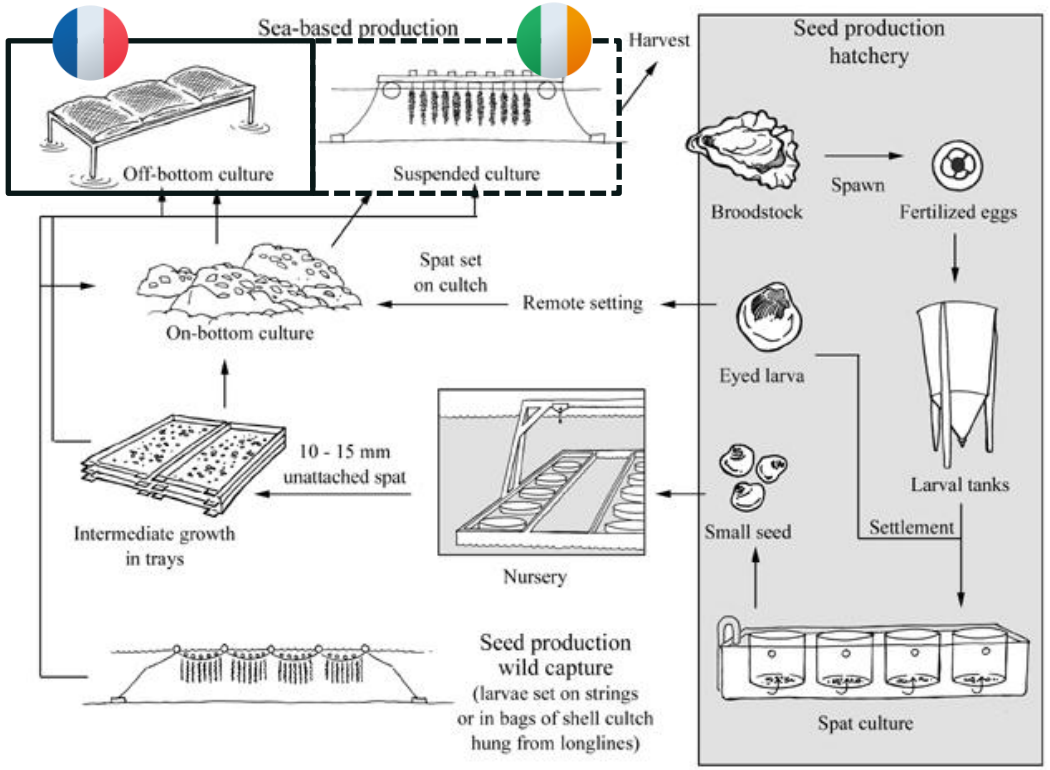
*Sources: European Market Observatory For Fisheries And Aquaculture Products, The EU Fish Market, 2023 Edition*
*European Market Observatory For Fisheries And Aquaculture Products, Oysters in the EU Case Study, 2022*

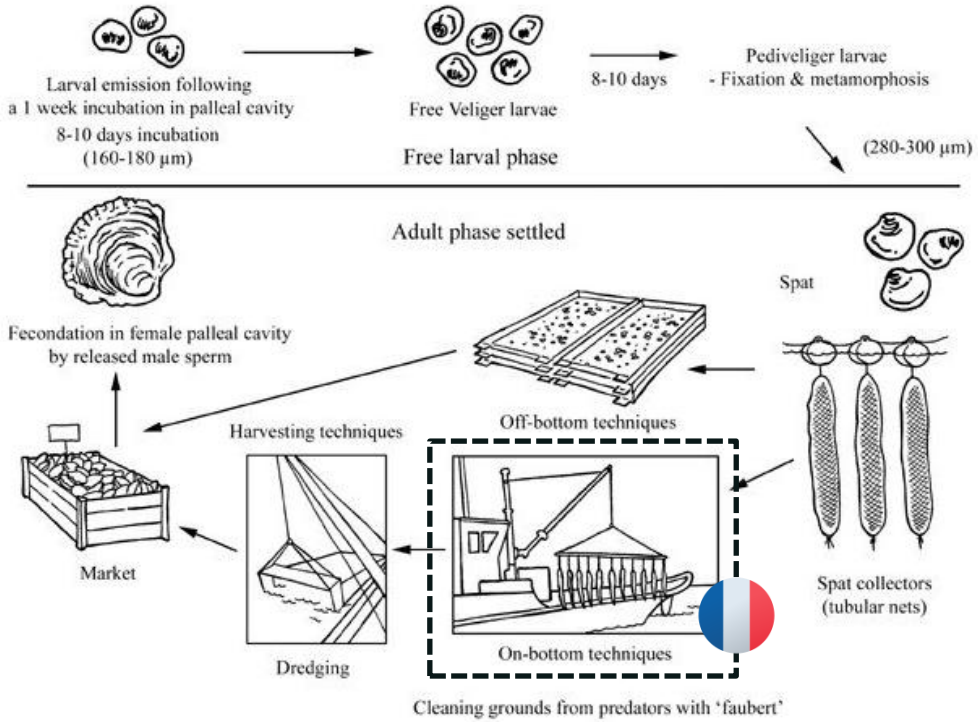
# Oyster production detailed value chain: illustrations of production methods for the 2 main species cultivated

## Crassostrea gigas
## (Pacific cupped oyster)




*Source: FAO*

## Ostrea edulis
## (European flat oyster)

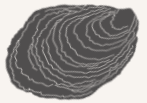


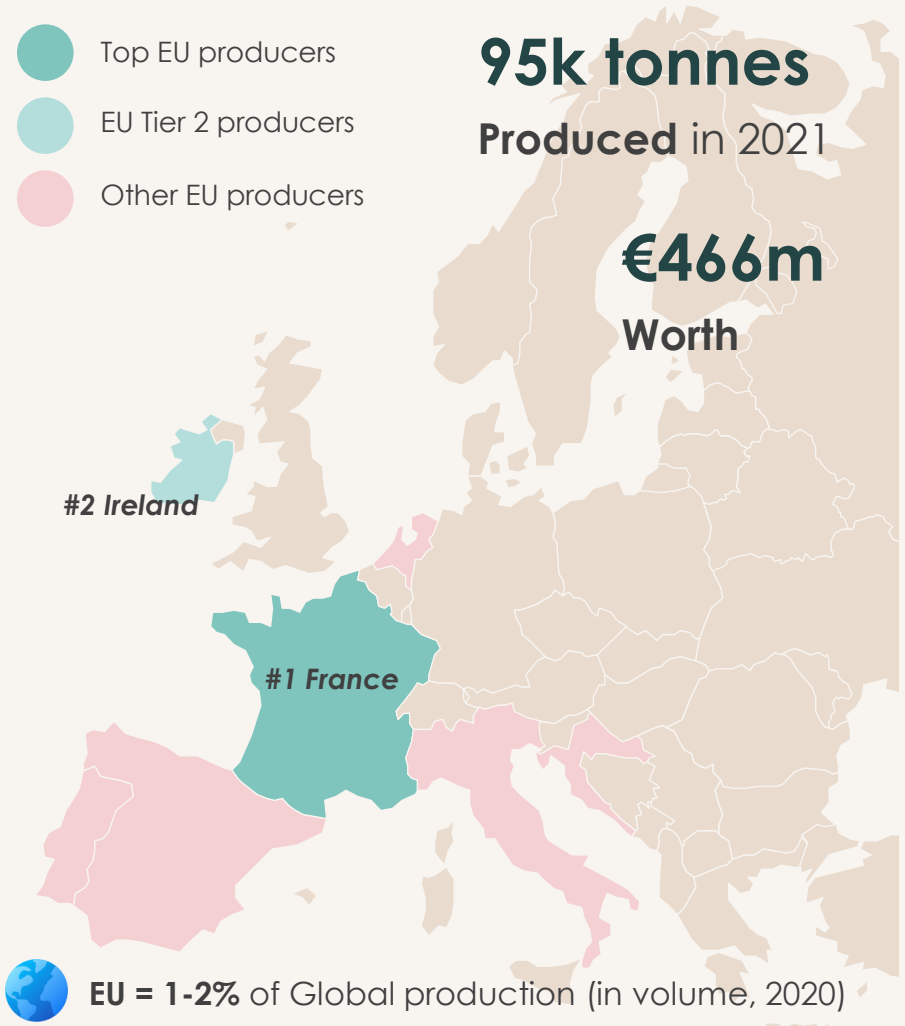

*Source: FAO*

**Note: Main production method illustrated by country, although several types of grow-out techniques usually coexist in every producing country**

*Sources: European Market Observatory For Fisheries And Aquaculture Products, Oysters in the EU Case Study, 2022*

# EU production key facts and figures: 95% of vol. and val. concentrated by 2 countries, with France alone accounting for ~85% of the production






**EU = 1-2%** of Global production (in volume, 2020)

95% val. / 94% vol.

### FRANCE
- **Volume 2021:** 81kt (85% of EU)
- **Value 2021:** €404m (87% of EU)
- **Avg €/kg:** €4.99 (vs. €4.91 EU average)
- **Main species:** Pacific cupped oyster
- **Main method:** off-bottom

### IRELAND
- **Volume 2021:** 8kt (8% of EU)
- **Value 2021:** €39m (8% of EU)
- **Avg €/kg:** €4.84 (vs. €4.91 EU average)
- **Main species:** Pacific cupped oyster
- **Main method:** off-bottom

### PORTUGAL
- **Volume 2021:** 2kt (2% of EU)
- **Value 2021:** €9m (2% of EU)
- **Avg €/kg:** €4.52 (vs. €4.91 EU average)
- **Main species:** Pacific cupped oyster
- **Main method:** -

### NETHERLANDS
- **Volume 2021:** 2kt (2% of EU)
- **Value 2021:** €6m (1% of EU)
- **Avg €/kg:** €2.95 (vs. €4.91 EU average)
- **Main species:** Pacific cupped oyster
- **Main method:** -

### SPAIN
- **Volume 2021:** 1kt (2% of EU)
- **Value 2021:** €5m (1% of EU)
- **Avg €/kg:** €3.35 (vs. €4.91 EU average)
- **Main species:** Pacific cupped oyster
- **Main method:** -

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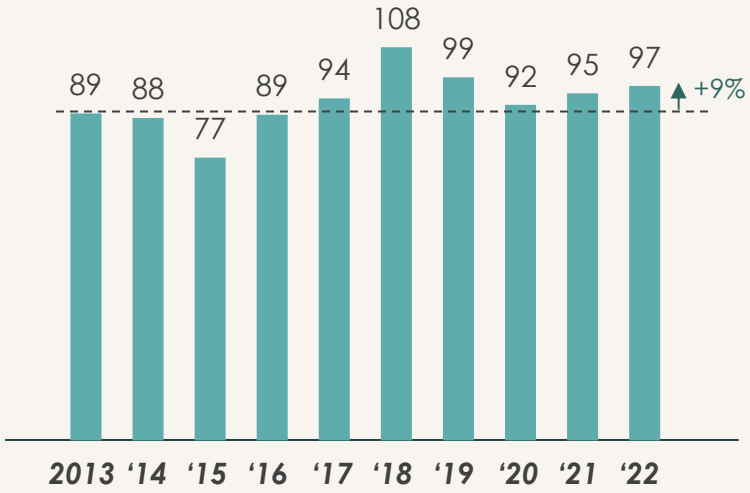
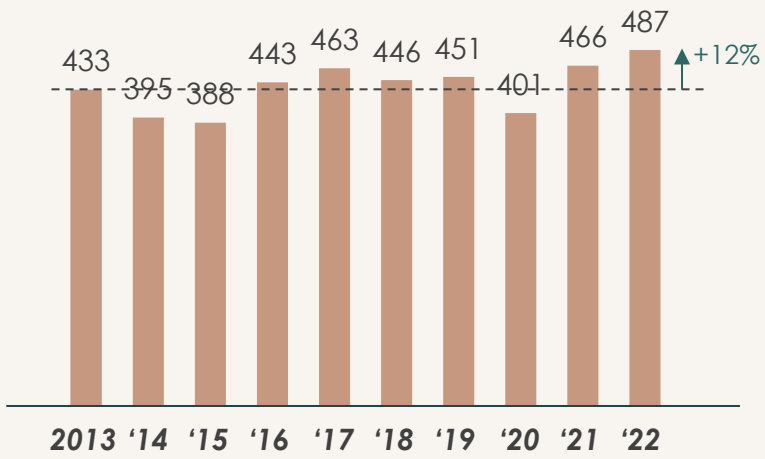
*Sources: European Market Observatory For Fisheries And Aquaculture Products, The EU Fish Market, 2023 Edition*
*Eurostat data, fish_aq2a*
*European Market Observatory For Fisheries And Aquaculture Products, Oysters in the EU Case Study, 2022*

# EU market trends: Relatively stable production over the last decade, with prices usually compensating variations in volumes; 2022 is a strong year both in terms of volume (97kt) and value (€487m)

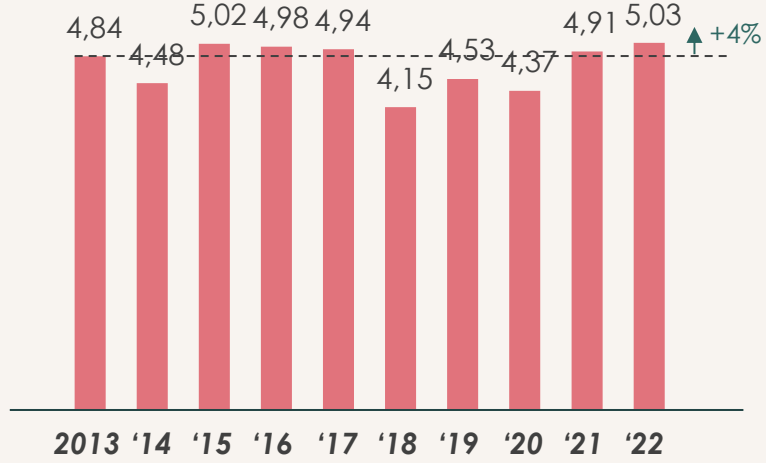
**Production volume (ktonnes)**




**Production value (€m)**




**Average price (€/kg)**




- Oysters cover **~17% of the total volume of bivalve production in Europe** (95kt / 553 kt in 2021)
- According to FAO statistics, **oyster aquaculture production has almost halved since 2000s,** where the incidence of **"summer" mortalities** (high water temperatures + reproductive cycles and stress) has been compounded by **mass mortalities of oyster spat from 2008 onwards** (principle factor being identified by the European Food Safety Authority (EFSA) as the **ostreid herpes virus + discharge of untreated seawater from depuration and oyster holding facilities** that could contribute to disease spread
- The EU production has been **relatively stable between 2013 and 2022, with 2022 representing an increase of 9% vs. 2013 production volume** (at 97kt vs. 89kt), and a **decade-high record registered in 2018 at 108kt** (after a low point in 2015, due to high oysters' mortality in France)
- **Average prices are not on a continuously increasing trend** (as e.g. mussels) but **variating between €4.15/kg and €5.03/kg, usually compensating variations in volumes** (e.g. high price in 2015, low price in 2018), **although 2022 is a relatively strong year both in terms of volumes and value**
- As a consequence of volumes x prices variations, **the EU oysters production worth has been fluctuating at around €400-€450m for the last decade, finally reaching a high point in 2022 at €487m (+12% vs. 2013)**

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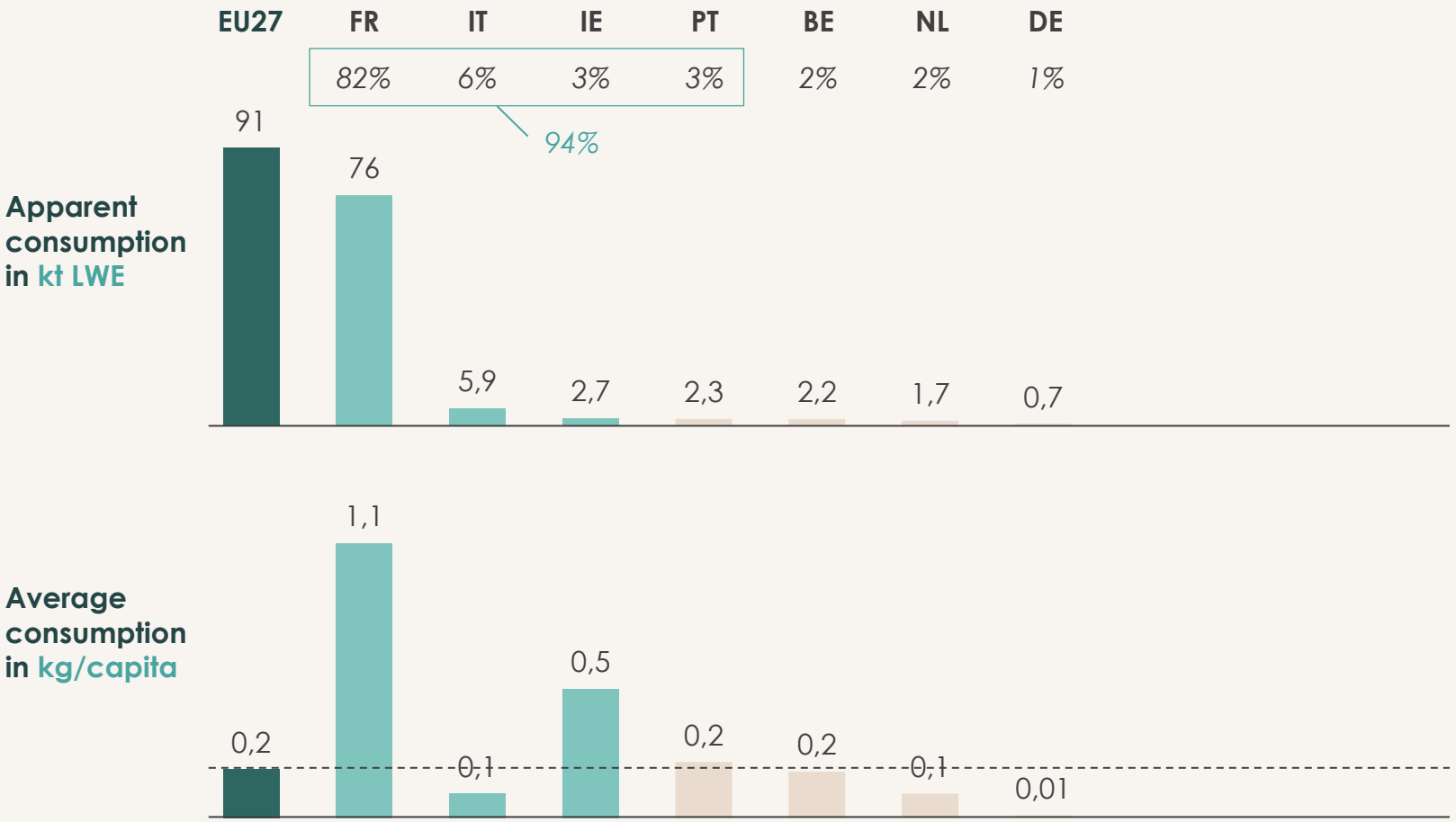
*Sources: European Market Observatory For Fisheries And Aquaculture Products, The EU Fish Market, 2023 Edition*
*Eurostat data, fish_aq2a*
*European Market Observatory For Fisheries And Aquaculture Products, Oysters in the EU Case Study, 2022*
*Regional review on status and trends in Aquaculture development in Europe, FAO, 2020*

# EU market trends: EU-27 consumption is mainly driven by France (>80%), with a short series of smaller markets following at a distance (Italy, Ireland, Portugal)



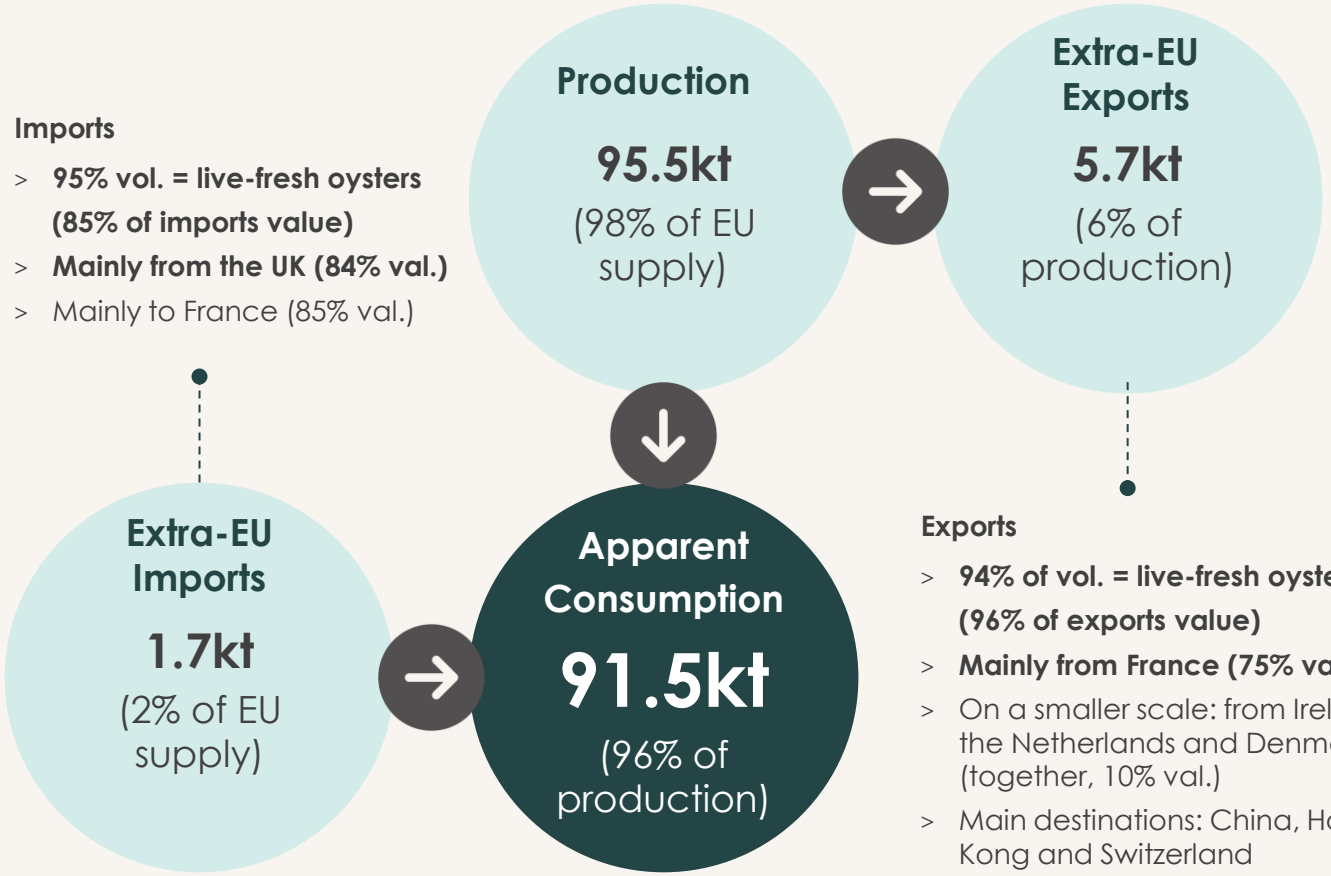

## Comments

- In 2020, the apparent consumption of oysters was **91ktonnes LWE in EU-27**
- The main country in terms of apparent consumption is, by far, France**, which alone represents about 85% of the production, and 82% of the consumption:**
  - **France,** 76kt LWE **(82% of EU-27)**
  - **Italy,** 6kt **(6%)**
  - **Ireland,** 3kt **(3%)**
- **Highest per capita consumption** is observed **in France (1.1kg/year),** which is about **x5 the EU average**
- **Ireland has also a significant per capita consumption** (0.5kg/year, x2.5 EU average), but a much smaller market, accounting for a **minor share of total EU consumption**

*Sources: European Market Observatory For Fisheries And Aquaculture Products, The EU Fish Market, 2023 Edition*
*Eurostat data, fish_aq2a*
*European Market Observatory For Fisheries And Aquaculture Products, Oysters in the EU Case Study, 2022*

# EU market trends: Very limited extra-EU imports (mainly directed from the UK to France); small (although increasing) export market, notably to Asian markets

## Volumes in LWE (2020)




## Comments

*Quoting: European Market Observatory For Fisheries And Aquaculture Products, Oysters in the EU Case Study, 2022*

- **EU imports have increased between 2012 and 2021: volumes grew by 80% while their total value grew by 36% in nominal terms** (20% in real terms) – meaning the **average price of extra-EU imports has decreased by 25% over the period:** from €4.52/kg in 2012 to €3.41/kg in 2021 (-33% in real terms)
- **In 2021, extra-EU exports of oysters were mainly directed to China** (33% of EU exports in value in 2021), **Hong Kong** (22%), and **Switzerland** (13%)
- **Recent years have been characterised by the increase of EU exports to Asian markets.** Specifically, the value of oysters' exports to China has increased by 451% between 2012 and 2021
- **Between 2012 and 2021, total EU exports of oysters have increased by 193% in volume and 212% in value in nominal terms** (176% in real terms). Prices have increased from 7,82 EUR/kg in 2012 to 8,34 EUR/kg in 2021, in nominal terms. **However, in real terms, it represented a 6%-decrease**

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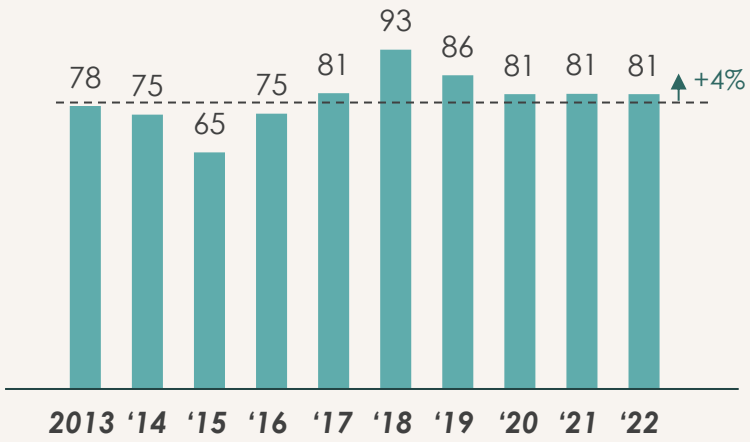
*Sources: European Market Observatory For Fisheries And Aquaculture Products, The EU Fish Market, 2023 Edition*
*Eurostat data, fish_aq2a*
*European Market Observatory For Fisheries And Aquaculture Products, Oysters in the EU Case Study, 2022*

# France market trends: relatively stable volumes at ~80kt since 2013 with prices partially compensating volumes variations, representing a total worth of ~€350-400m, exceeding €400m after the 2020 Covid decrease

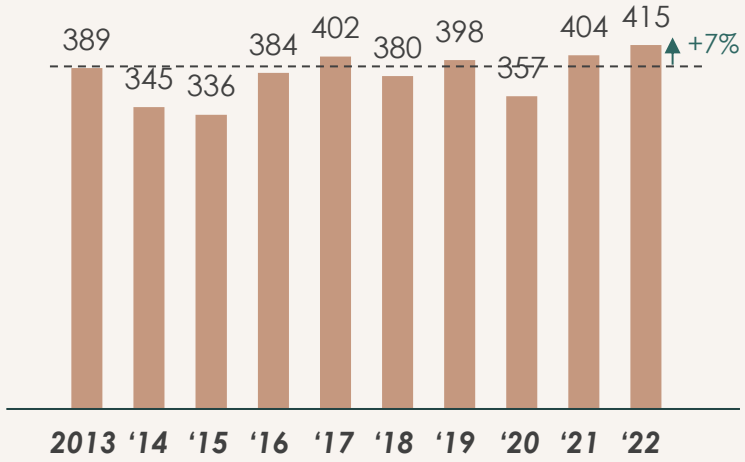
**Production volume (ktonnes)**




**Share of total EU oysters production (%)**

87 85 84 85 87 86 86 88 85 83

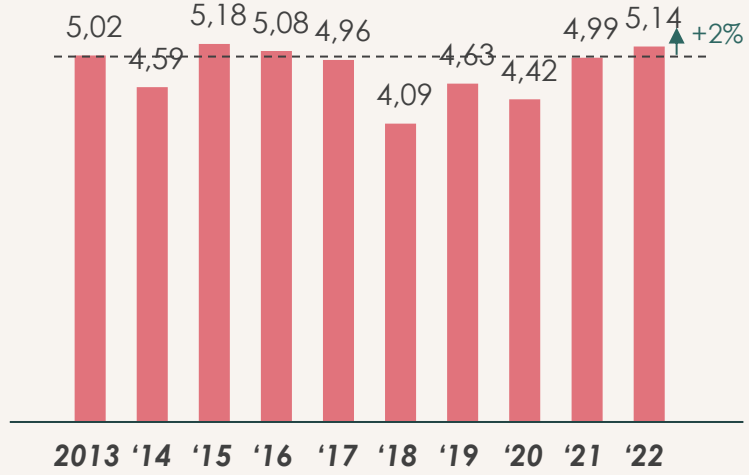
**Production value (€m)**




**Share of total EU oysters production (%)**

90 87 87 87 87 85 88 89 87 85

**Average price (€/kg)**




**vs. EU average price (€/kg)**

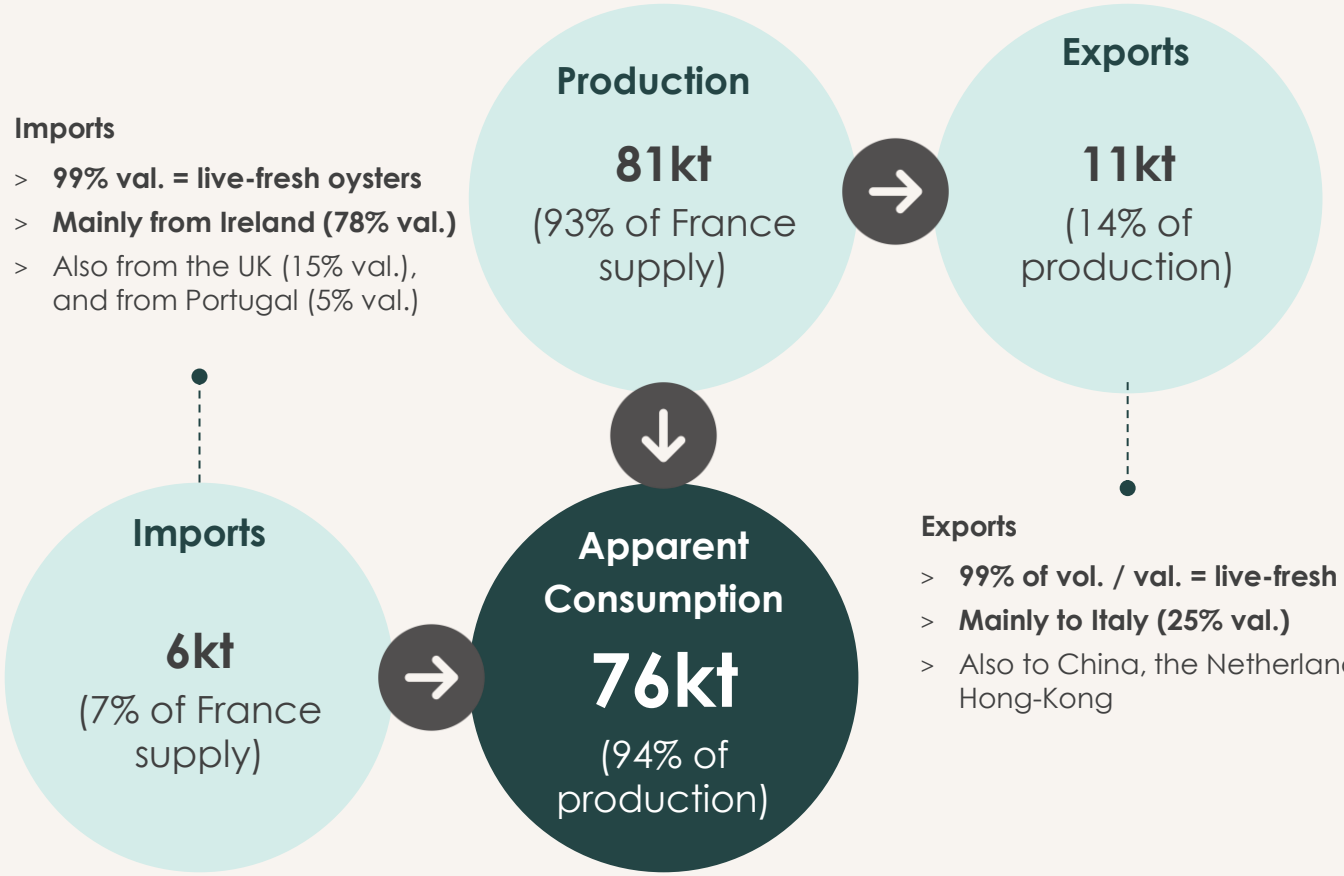
4.84 4.48 5.02 4.98 4.94 4.15 4.53 4.37 4.91 5.03

- In 2022, **France farmed 81kt of oysters for a value of €415m – a decade-high record** in terms of **production worth**
- **The production has decreased since the beginning of the 2000s due to mortalities** (production was ~105ktonnes in 2008); despite the decrease in production in volume (-23% in 2022 vs. 2008), the **sales value significantly increased in nominal terms over the period** (production worth €340m in 2008)
- **The particularity of the French oyster production** is that a share of the cycle may end with a **last phase called "affinage"** (i.e. "finishing"), consisting in ending the rearing of oysters by a **temporary immersion in marshland ponds ("claires")** that provide a **significant added-value to the product**
- The spat is supplied mainly by wild spat. Still, **about ~1/3 of the spat supply comes from hatcheries** (25% from triploid and 8% from diploid spat)
- **Oysters are farmed on all French coastlines; main producing area = Charente-Maritime (44% vol.),** followed by North Brittany (13%), Normandy (12%), South Brittany (11%)

*Sources: European Market Observatory For Fisheries And Aquaculture Products, The EU Fish Market, 2023 Edition*
*Eurostat data, fish_aq2a*
*European Market Observatory For Fisheries And Aquaculture Products, Oysters in the EU Case Study, 2022*

# France market trends: France completes its supply in oysters with imports from Ireland, and exports ~14% of its production to other EU countries (Italy, the Netherlands) as well as China or Hong-Kong

## Volumes in LWE (2020)




## Comments

*Quoting: European Market Observatory For Fisheries And Aquaculture Products, Oysters in the EU Case Study, 2022*

- **With 6kt LWE, imports represent 7% of the French supply in 2020:** oysters were almost exclusively imported **live-fresh,** mainly from **Ireland,** followed by the UK and Portugal
- **Between 2012 and 2021, the French imports of live-fresh oysters have more than doubled,** while imports prices have decreased by 9% in nominal terms (from €4.88/kg to €4.44/kg)
- **French exports** of oysters are almost exclusively composed of **live, fresh or chilled oysters (99% of vol. and val.)**
- **Beyond Italy** (25% of French exports value), **other export destinations are China (15%), the Netherlands (9%) and Hong-Kong (8%)**
- **Between 2012 and 2021, the French exports of live-fresh oysters have increased by 107% in volume** and 121% in value (95% in real terms)

*Sources: European Market Observatory For Fisheries And Aquaculture Products, The EU Fish Market, 2023 Edition*
*Eurostat data, fish_aq2a*
*European Market Observatory For Fisheries And Aquaculture Products, Oysters in the EU Case Study, 2022*

# French oysters producers: 1,500+ companies involved in oyster production, very heterogeneous in terms of size, production strategy (short cycle vs. full cycle) and level of consolidation

## Key insights

- **1,562 enterprises** involved in oyster production in France in 2020
- According to the latest STECF aquaculture report, companies involved in oyster production in France are **very heterogeneous in terms of size and production strategy: some farms focus on one stage of production (short cycle), while others ensure the whole rearing cycle**
- Farmers may **also have a packing activity**, oyster being generally packed in basket ("bourriches") of 12 or 24 oysters. Thus, **in production areas, there are farmers who produce bulk oyster** and **farmers-packers who produce, pack oyster and sell it to consumers (direct sale), wholesalers, restaurants, large-scale retailers, etc.**

## e.g.

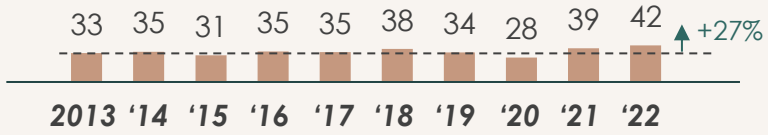
| Hatcheries | Farmers-packers (integrated) |
|---|---|
| france naissain | Gillardeau |
| Satmar<br>*Oysters and clams hatchery + clams grower* | 1952 Hélie HUITRES CO. |
| marinove<br>Exprimons ensemble votre nature | Laugier Depuis 1893<br>*Oysters, clams, shrimps* |

*Sources: European Market Observatory For Fisheries And Aquaculture Products, The EU Fish Market, 2023 Edition*
*European Market Observatory For Fisheries And Aquaculture Products, Oysters in the EU Case Study, 2022*
*Enquête Aquaculture 2020, Agreste, Novembre 2020*
*The EU Aquaculture Sector Economic Report, STECF, 2020*

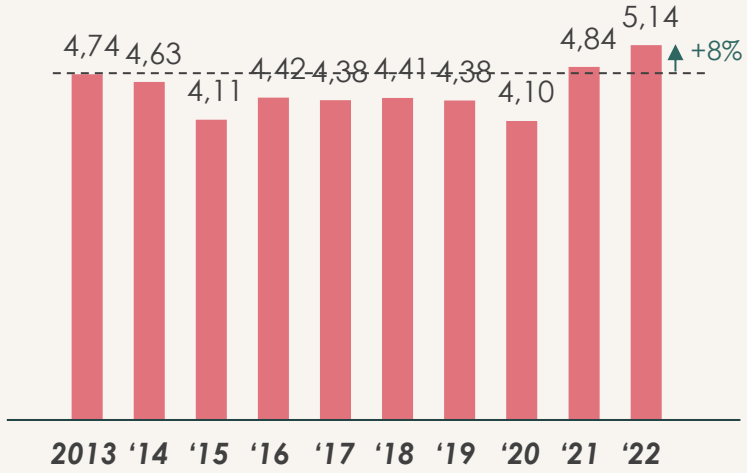
# Ireland market trends: stable volumes around ~8kt per year over the decade, with lower prices vs. France, although significantly increasing since 2021, representing a total worth of ~€40m

**Production volume (ktonnes)**


**Production value (€m)**

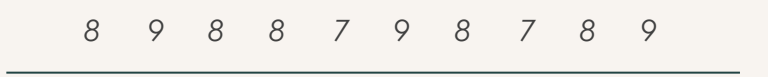



**Average price (€/kg)**

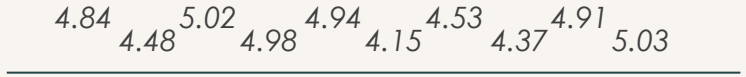



**Share of total EU oysters production (%)**


**Share of total EU oysters production (%)**




**vs. EU average price (€/kg)**



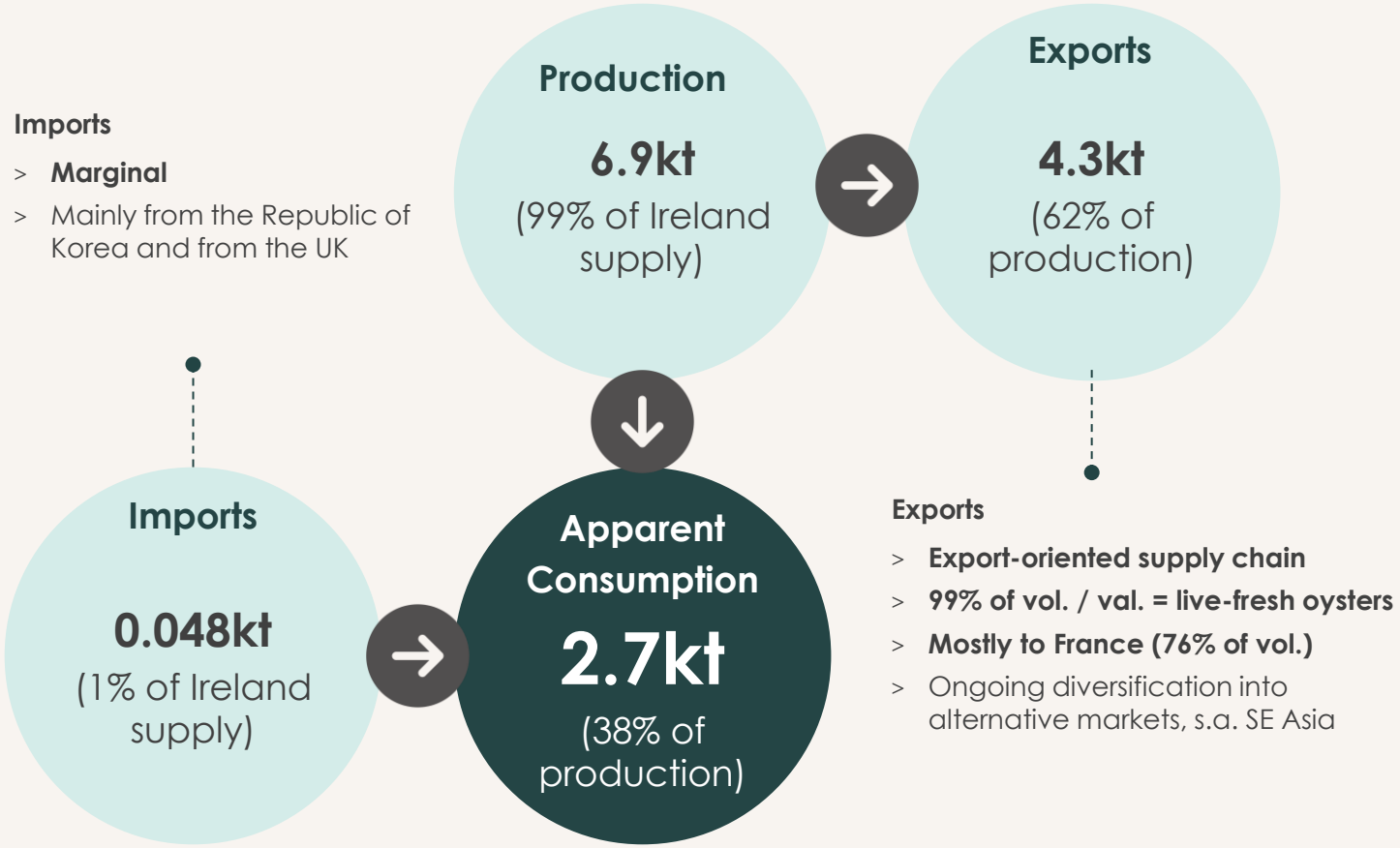

- In 2022, **Ireland farmed 8kt of oysters for a value of €42m – a decade-high record** in terms of **production worth** vs. stable volumes ranging from 7kt to 9kt
- The **current maximum capacity is reported at ~10.5kt** and is **restricted by available licensed ground**
- **The Pacific oyster production represents 97%** of the oyster production in Ireland. The production of the **European flat oyster decreased over the past years** because of increased availability of European flat oyster produced in France (negatively impacting export prices from Ireland to France) + recent lack of native spat supply
- **Triploid oysters represented 81% of the Irish production** in 2019, vs. 19% diploid oysters
- **Oysters are farmed on all Irish coastlines,** with a **concentration** of the production in the **South-East region (28%)** and the **North + North-West regions (35%)**

European Investment Bank

*Sources: European Market Observatory For Fisheries And Aquaculture Products, The EU Fish Market, 2023 Edition*
*Eurostat data, fish_aq2a*
*European Market Observatory For Fisheries And Aquaculture Products, Oysters in the EU Case Study, 2022*

# Ireland market trends: Almost all of Irish oyster supply comes from national production (>99%), the Irish production being mainly export-oriented (62% of the production) towards the French market

## Volumes in LWE (2020)




## Comments

*Quoting: European Market Observatory For Fisheries And Aquaculture Products, Oysters in the EU Case Study, 2022*

- **Oyster imports to Ireland are marginal.** In 2021, the main suppliers were the Republic of Korea (56% of the imports value) and the United Kingdom (31%)
- One of the main features of the **oyster's supply chain in Ireland** is that it is **export oriented.** Irish oysters are exported **almost exclusively live or fresh (99% of exports value in 2021).** The market for Irish oysters is **mainly the EU, mostly France** with 76% of Irish exports volume in 2021
- While France remains the largest export market, the **Irish industry continues to diversify into alternative markets,** such as **South-East Asia** (in particular Mainland China and Hong-Kong)
- In addition, the Irish producers have **started to target the Netherlands,** in relation to the **large investment in depuration and holding facilities** made by the Dutch stakeholders (in order to be reexported)

*Sources: European Market Observatory For Fisheries And Aquaculture Products, The EU Fish Market, 2023 Edition*
*Eurostat data, fish_aq2a*
*European Market Observatory For Fisheries And Aquaculture Products, Oysters in the EU Case Study, 2022*

# Irish oysters producers: ~160 production units with a majority of small companies, independent of each other (in terms of depurating, marketing and distribution)

## Key insights

- **In 2022,** there were **162 production units** involved in oyster production in Ireland
- **The majority of these, 103 units** in 2022 (64% of the total units), **are small and are employing up to 5 people.** 32 units (20%) employ between 6 and 10 people and 27 units (16%) employ more than 10 people
- **Total employment in the oyster sector** is 1,037 persons, which equals to **640 FTEs**
- Companies operating in oyster aquaculture in Ireland are **largely independent of each other in terms of depurating, marketing and distributing** their products. There is **only some cooperation in product marketing**

## e.g.

**Independent growers**

HARTY OYSTERS

GALLAGHERS IRISH PREMIUM OYSTERS IPOS

Carlingford OYSTER COMPANY

**Cooperatives**

Achill Oysters

*Sources: European Market Observatory For Fisheries And Aquaculture Products, Oysters in the EU Case Study, 2022*
*BIM Aquaculture Report, 2023*

# Focus on Clams:

- Detailed value chain
- EU production key facts and figures
- Market trends: EU and top producers
- Clams producers

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# Clams production detailed value chain: 7 key steps, common use of hatcheries (in-between mussels and oysters), usually cultivated on-bottom, some processing

1 > 2 > 3 > 4 > 5 > 6 > 7

## 1 Spat collection / production

### Spat collection

- ***Setting collectors*** in the water to naturally attract and collect wild clams larvae
- ***Monitoring***
- ***Harvesting***

### Hatcheries

**Ensure a substantial portion of clam spat production in Europe,** notably due to the need to protect spats and juveniles vs. predators (esp. crabs)

## 2 Nursery / pre-growing phase

### Initial grow-out (2-6 months)

Spat are placed in a controlled nursery environment s.a. upweller systems, floating trays, or mesh bags **until they are large enough to be planted in the field**

### Monitoring

During this phase, **careful monitoring of water quality and spat health** is essential to ensure **high survival rates**

## 3 Grow-out phase

### Grow-out methods (12-30 months)

***Clams of all species are generally bottom farmed in the EU***

- ***On-bottom culture:*** clams are placed directly on the seabed or intertidal zones, broadcast onto the substrate where they burrow and grow naturally. Areas are often netted to protect against predators

## 4 Harvesting

### Harvesting methods

- ***Rakes and hand tools:*** simple hand rakes and tongs are often used for small-scale operations
- **Tractor:** on sandy soil, a tractor equipped with a side conveyor belt allows clams to be unearthed and sorted by size
- ***Dredging:*** for larger operations, mechanical/ hydraulic dredges equipped with a cage to collect clams as they are dug out

## 5 Cleaning, sorting, depuration

### Cleaning and sorting

- ***Cleaning:*** harvested clams are cleaned to remove sediment (when cultivated on-bottom) debris and impurities
- ***Sorting:*** based on size and quality

### Depuration

***Clams are held in clean, filtered seawater tanks*** to purge them of any sand, silt, or potential bacteria or viruses

## 6 Conditioning & marketing / processing

### Conditioning & distrib.

- ***Some producers*** create their ***own commercial company***
- Others create ***associate producers trading companies***
- ***Independent treatment plants*** also ensuring clams commercialisation

### Processing

**Most of farmed clams are sold fresh; still, a significant share is processed** (incl. frozen, canned, preserved)

## 7 Distribution & Consumption

### Distribution

***Via wholesalers, or directly***

- Fishmongers
- HORECA

***Via central purchasing bodies***

- Mass retailers

***Direct to consumers***

### Consumption

- Fresh
- Prepared-preserved / canned
- Frozen

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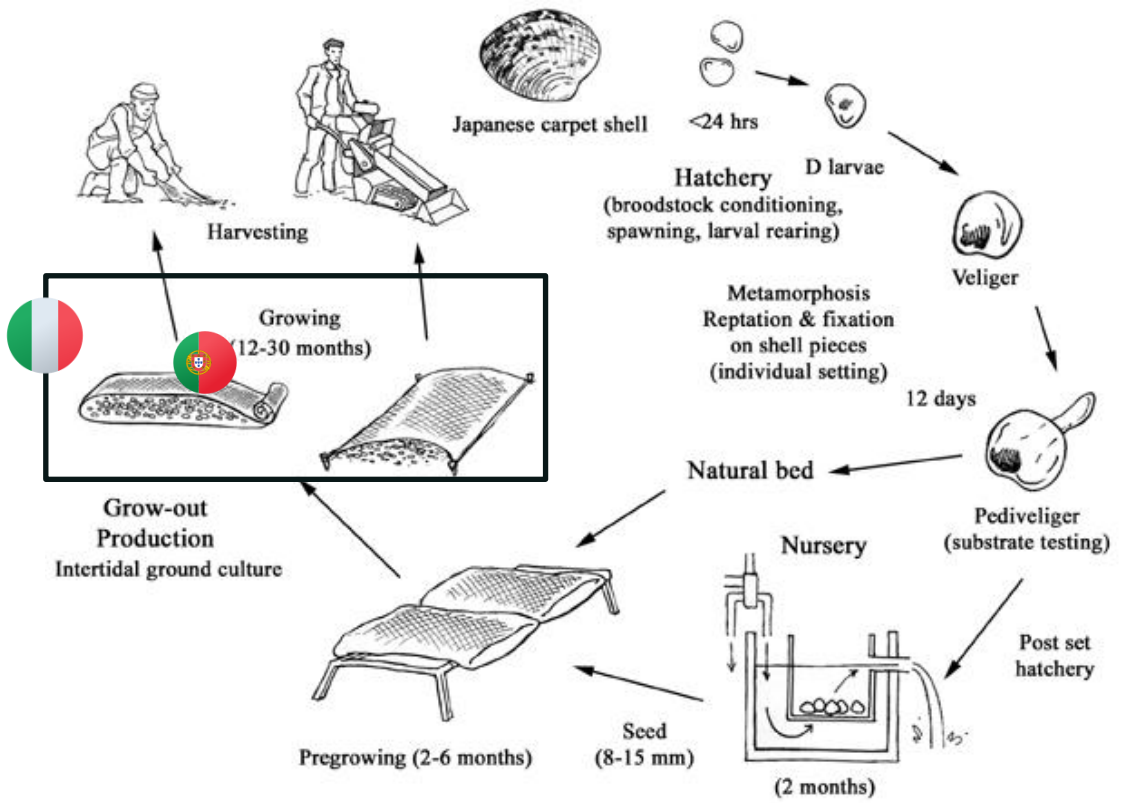
*Sources: European Market Observatory For Fisheries And Aquaculture Products, The EU Fish Market, 2023 Edition*
*UN FAO: https://firms.fao.org*

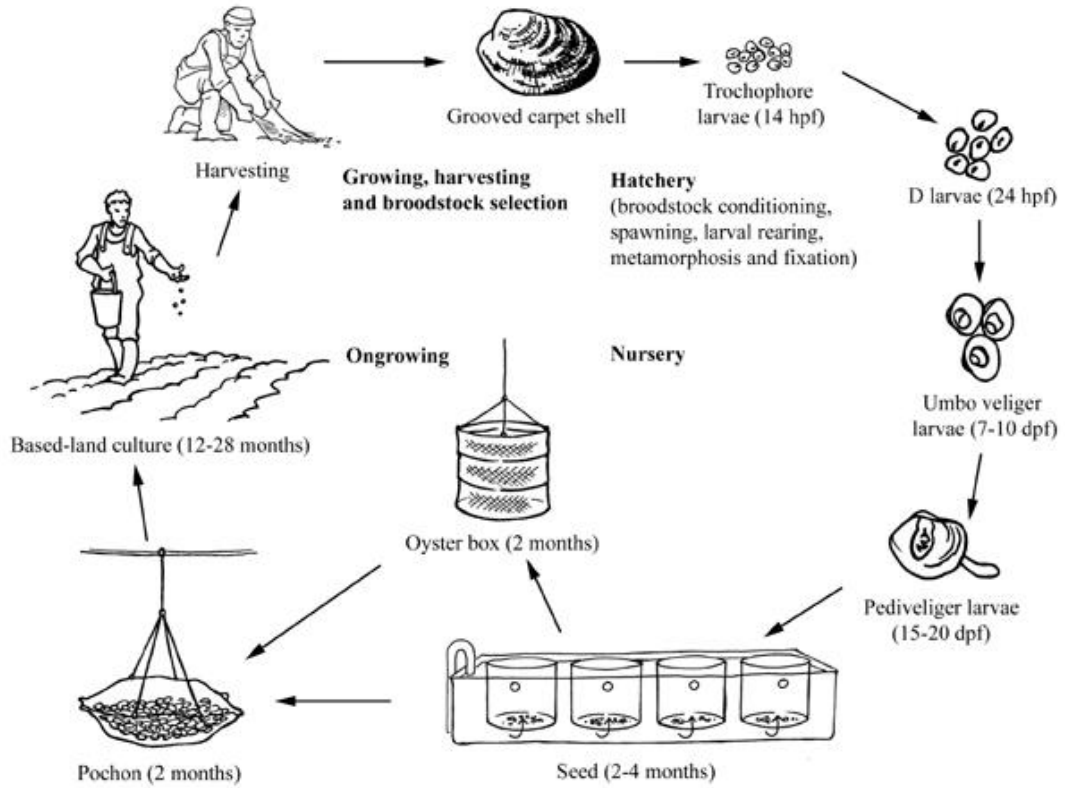
# Clams production detailed value chain: illustrations of production methods for the 2 main species cultivated

## Ruditapes philippinarum (Japanese clam)



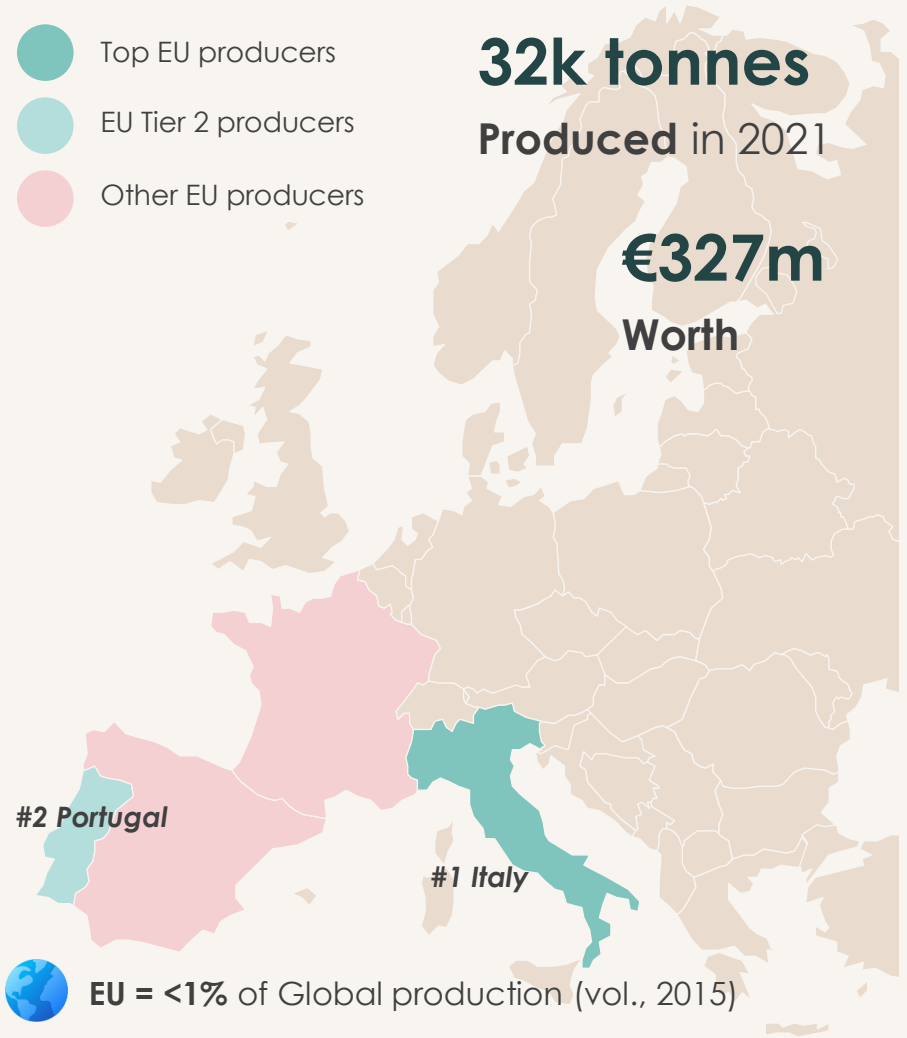

Source: FAO

## Ruditapes decussatus (Grooved carpet shell)




Source: FAO

# EU production key facts and figures: ~90% of vol. and val. concentrated by 2 countries, with Italy alone accounting for ~70% of the production




**EU = <1%** of Global production (vol., 2015)

91% val. / 88% vol.

## ITALY

- **Volume 2021:** 23kt (71% of EU)
- **Value 2021:** €212m (65% of EU)
- **Avg €/kg:** €9.20 (vs. €10.07 EU average)
- **Main species:** Japanese clam
- **Main method:** on-bottom

## PORTUGAL

- **Volume 2021:** 5kt (17% of EU)
- **Value 2021:** €86m (26% of EU)
- **Avg €/kg:** €15.59 (vs. €10.07 EU average)
- **Main species:** Grooved carpet shell
- **Main method:** on-bottom

## FRANCE

- **Volume 2021:** 2kt (7% of EU)
- **Value 2021:** €12m (4% of EU)
- **Avg €/kg:** €5.71 (vs. €10.07 EU average)
- **Main species:** -
- **Main method:** -

## SPAIN

- **Volume 2021:** 2kt (5% of EU)
- **Value 2021:** €16m (5% of EU)
- **Avg €/kg:** €9.71 (vs. €10.07 EU average)
- **Main species:** -
- **Main method:** -

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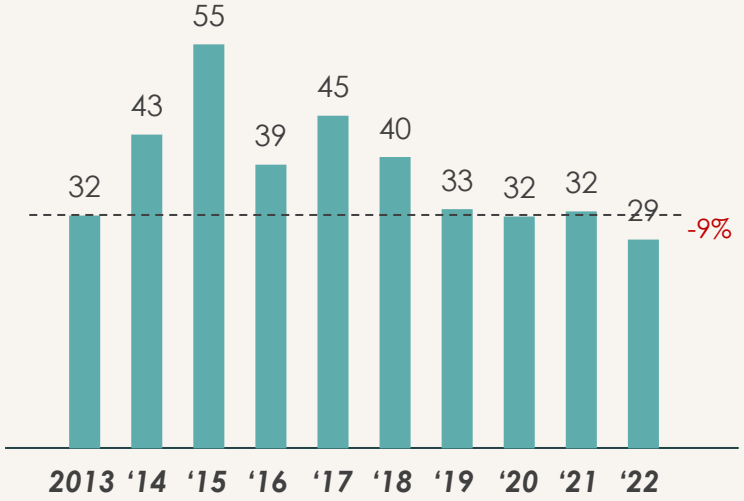
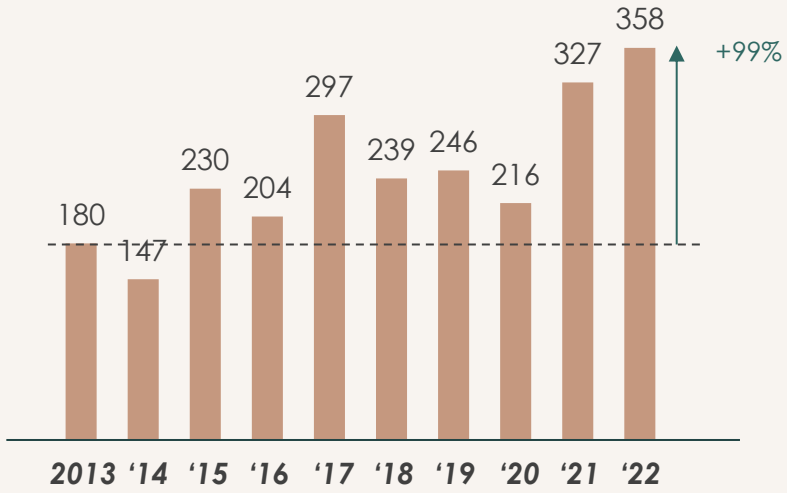
*Sources: European Market Observatory For Fisheries And Aquaculture Products, The EU Fish Market, 2023 Edition*
*Eurostat data, fish_aq2a*

# EU market trends: Continuously decreasing volumes since 2015, with a sustained demand leading to a strong increase in prices, hence a 2022 production worth 2x more vs. 2013 (despite 9% lower volumes)

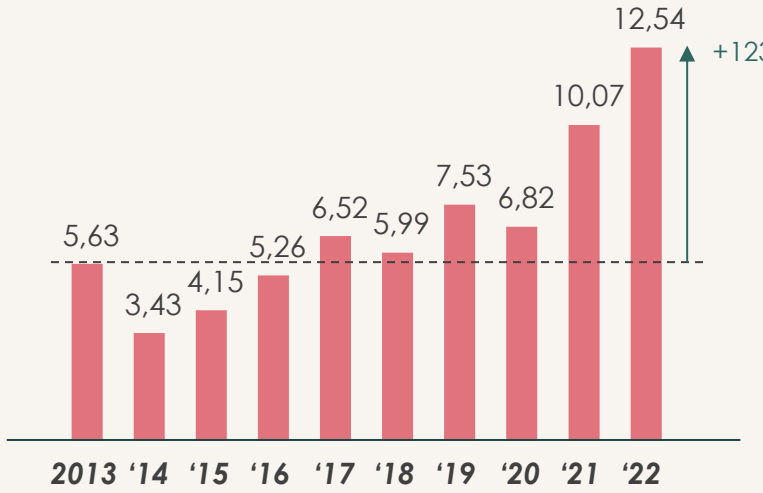
**Production volume (ktonnes)**




**Production value (m€)**




**Average price (€/kg)**



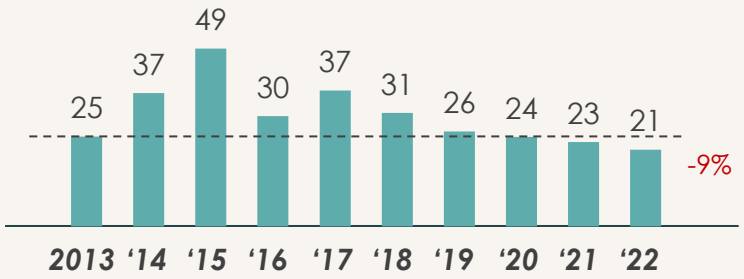

- Clams cover **~6% of the total volume of bivalve production in Europe** (32kt / 553 kt in 2021)
- The **EU production has been decreasing after a decade-high in 2015** (55kt), reaching a **historically low point in 2022 at 29kt**
- Despite the significant variations and decrease in volumes, there is a **tendential increase in production value** (with ups and downs), **reaching €360m in 2022,** which is **twice as much as 10 years earlier** (while production volume dropped by 9%)
- After a higher price point in 2023 vs. 2024, **average prices per kg have been increasing over the years, and skyrocketing after the 2020 pandemic,** reaching €12.54 per kg (i.e. +123% vs. 2013)

European Investment Bank

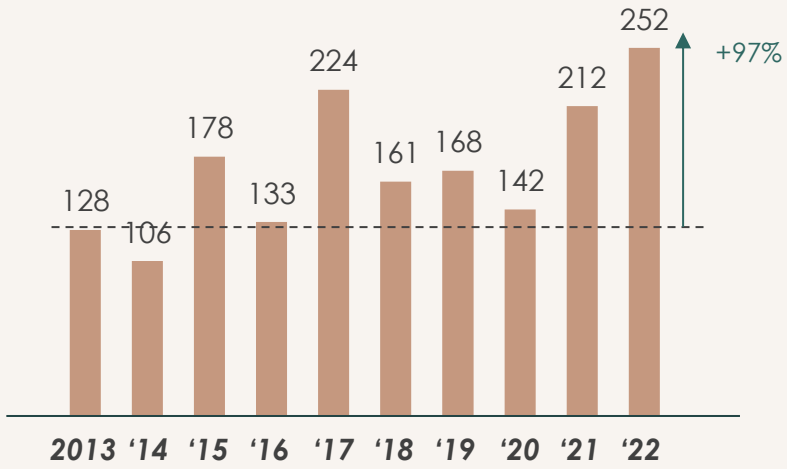
*Sources: European Market Observatory For Fisheries And Aquaculture Products, The EU Fish Market, 2023 Edition*
*Eurostat data, fish_aq2a*

# Italy market trends: Continuously decreasing volumes since 2015 (compensated by strong price increases after the 2020 pandemic), and an ongoing serious threat from a blue crab invasion

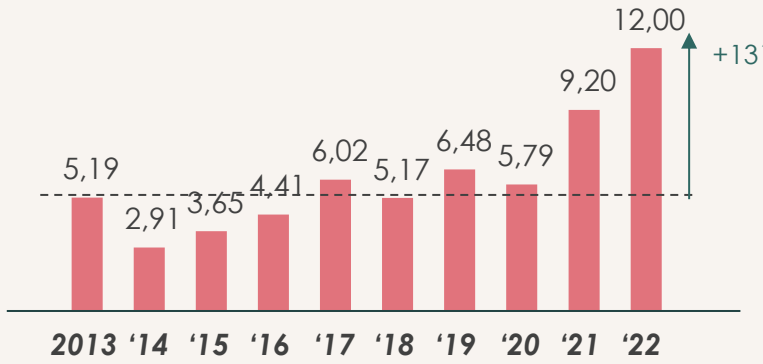
**Production volume (ktonnes)**




**Production value (m€)**




**Average price (€/kg)**




**Share of total EU clams production (%)**

| 2013 | '14 | '15 | '16 | '17 | '18 | '19 | '20 | '21 | '22 |
|---|---|---|---|---|---|---|---|---|---|
| 87 | 85 | 84 | 85 | 87 | 86 | 86 | 88 | 85 | 83 |

**Share of total EU clams production (%)**

| 2013 | '14 | '15 | '16 | '17 | '18 | '19 | '20 | '21 | '22 |
|---|---|---|---|---|---|---|---|---|---|
| 90 | 87 | 87 | 87 | 87 | 85 | 88 | 89 | 87 | 85 |

**vs. EU average price (€/kg)**

| 2013 | '14 | '15 | '16 | '17 | '18 | '19 | '20 | '21 | '22 |
|---|---|---|---|---|---|---|---|---|---|
| 5.63 | 3.43 | 4.15 | 5.26 | 6.52 | 5.99 | 7.53 | 6.82 | 10.07 | 12.54 |

- In 2022, **Italy farmed 21kt of clams for a value of €252m – a decade-high record** in terms of **production worth** (with the lowest volume recorded over the period)
- **From 2013 to 2020, ex-farm prices have fluctuated but remained in-between €4 and €6 per kg; after the pandemic, prices skyrocketed** (driven by a high demand vs. short supply) reaching a **historic record at €12.00 per kg in 2022**
- **Currently, blue crabs** (native to Americas) are **devastating clams production in Italy** (especially in Po delta), where it has **no natural predators.** Fedagripesca, a fishers' association, considers that **the species already caused economic damage of ~€100m across Italy,** and has **devoured up to 90% of young clams** in the **Po Delta** region

European Investment Bank

*Sources: European Market Observatory For Fisheries And Aquaculture Products, The EU Fish Market, 2023 Edition*
*Eurostat data, fish_aq2a*
*External research*

# Current trends leading to stable (although fluctuating) volumes, with stable to increasing production value over the years, driven by 5 key factors

| | DRIVERS | KEY INSIGHTS | MUSSELS | OYSTERS | CLAMS |
|---|---|---|---|---|---|
| 1 | **Robust traditional consumption and markets** | ***Some EU countries have traditional high levels of bivalve consumption (esp. Mediterranean countries).*** *e.g. in Spain mussel consumption shifted to home consumption when HORECA were closed during Covid* | ✓ *Spain, France, Italy* | ✓ *France* | ✓ *Italy, Spain* |
| 2 | **Increasing tendency to incorporate added value to the bivalves produced** | *Initially, most of mussel canned products / prepared dishes were not destined to traditional local markets, but* ***with the increase in frozen and canned imports + low ex-farm prices + changes in consumer behaviour → development of added value products*** *by the canning industry* | ✓ | *Almost no processing* | *?* |
| 3 | **Low environmental impact of bivalve production vs. health and nutritional benefits** | *Bivalve farming was highlighted as one of* ***the least impactful methods to produce animal-source food / protein, while consumers are increasingly cautious*** *about their environmental impact, and about the quality of their food* | ✓ *280x less GHG vs. beef* | ✓ | ✓ *Dredging* |
| 4 | **Inherent physical capacities, s.a. to clean water and (potentially) to sequestrate $CO_2$** | *Shellfish aquaculture does not release pollutants from farming, but* ***removes them from their production environment (high water filtration capacity) + potential carbon dioxide sequestration*** *subject to debate* | ✓ | ✓ | ✓ |
| 5 | **Scientific progress and technological advancements improving prod. methods and yields** | ***Ongoing developments in academic research*** *(e.g. on spat migration patterns), in* ***advanced technologies*** *(e.g. on precision aquaculture), in* ***genetic research*** *(e.g. for selective breeding, for traceability, or for biocontrol of invasive species)* | ✓ | ✓ | ✓ |

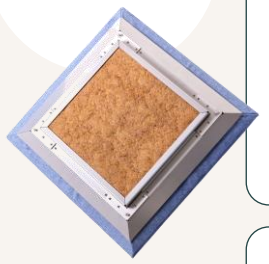
*Innovative use cases already being explored, see following pages*

European Investment Bank

*Sources: European Market Observatory For Fisheries And Aquaculture Products, The EU Fish Market, 2023 Edition*
*European Market Observatory For Fisheries And Aquaculture Products, Mussel in the EU Case Study, 2022*
*The decline of mussel aquaculture in the European Union: causes, economic impacts and opportunities, Reviews in Aquaculture, 2021*

# Several emerging use cases could represent growth opportunities and improvements to the mussel value chain

SEASTEX



### VALORISING BYSSUS

*Acoustic tiles by Seastex*

**Mussel byssus threads are natural fibres** (mussels use byssus to anchor themselves to rocks and substrates) sustainably obtained from aquaculture waste streams (during the cleaning process)

Seastex turn byssus into **100% recyclable, renewable and bio-degradable acoustic tiles**

Coastbusters

### MUSSEL REEF AS COASTAL PROTECTION

*Coastbusters Project by Blue Cluster*

**Self-growing mussel reefs** at the boundary of shallow water can **reduce coastal erosion**

New technique developed to build a mussel reef that acts as a **biologically-reinforced dune-by-dike underwater**, as the **first hurdle against storm surges**

Tested in the **Belgian part of the North Sea**

**e.g.**

### VALORISING UNDERSIZED PRODUCTS

*#Kerbone by Mytilimer*

In France, in the bay of Mont-Saint-Michel, **15% to 30% of the mussel production is scrapped, as undersized** vs. commercialisation criteria

Mytilimer invested in the creation of a 6,500sqm factory in Cancale, in order to **recycle 1.5k tonne of undersized mussels and turn them into flavours** for human and animal food, and **transform crushed shells into eco-materials**

### CHANGE IN BUSINESS MODEL

*Green Carbon Certificates in Italy*

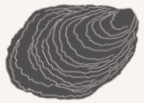
The issue **of whether mussel farming does result in a net sequestration of carbon dioxide is subject of scientific debate**

**In Italy, it has been awarded the first certificate of carbon credits** for the $CO_2$ uptake in the shells of mussels during production process

European Investment Bank

*Sources: External research*
*The decline of mussel aquaculture in the European Union: causes, economic impacts and opportunities, Reviews in Aquaculture, 2021*

# Several emerging use cases could represent growth opportunities and improvements to the oysters value chain



e.g.

### RESTORING OYSTER REEFS

*Billion Oyster Project in New-York*

**Restoring oyster reefs in NY harbour through public education initiatives: providing habitat** for various species, contributing to the **protection of the city from storm damage, improving water quality**

### COSMETICS

*e.g. Edulis*

Edulis is a **marine cosmetics brand** that offers **products made from natural ingredients,** specifically featuring **patented Cap Ferret oyster extract,** which helps **regenerate the skin**

### VALORISING OYSTER SHELLS AND BYPRODUCTS

*e.g. Alegina*

French company specializing in the **production of innovative materials and products derived from oyster shells,** with a **circular economy** approach.

Alegina's flagship product is **Kaomer: a high-quality oyster-based porcelain**

In addition, Alegina has developed **other products, including** p**aving stone for urban environment and a substrate for green roofs**

*Sources: External research*

# Several emerging use cases could represent growth opportunities and improvements to the clams value chain

e.g.

Warszawa

### BIO-INDICATORS OF ENVIRONMENTAL CONDITIONS

*Water pollution detection system in Warsaw*

The city of **Warsaw in Poland** gets its water from the Vistula river. The **main water pump has several detection systems** and alarms regarding water quality, **one of them being a pool of 8 clams with triggers attached to their shells.**

If a **significant part of them close** (for a certain amount of time), an **alarm** is triggered, allowing for **more in-depth analyses to be initiated**

### BIOCOMPOSITE FOR SYNTHETIC BONES

*Ongoing research on Hydroxyapatite (HA)*

**Hydroxyapatite (HA), a calcium precursor,** can be **synthesized using ark clam shells** through a wet chemical precipitation method

HA could be used in the creation of e.g. **synthetic bone**, as it **offers structural similarities with natural bone**

*Note: not new use case strictly speaking, but interesting field of applications for clams byproducts*

### VALORISATION OF CRUSHED SHELLS

*e.g. as animal feed or fertiliser*

Crushed clam shells are **rich in calcium,** making them an excellent **supplement in animal feed, particularly for poultry** (helping in the formation of strong eggshells)

**Natural fertiliser:** the shells are also used as a to **improve soil structure and pH levels.** The calcium carbonate in the shells helps neutralize acidic soils and provides **essential nutrients for plant growth**

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*Sources: External research*

# Although the EU production of bivalves benefits from actual strengths and opportunities, several factors still make it challenging for the years to come

## ECONOMIC FACTORS

| | |
|---|---|
| **Low ex-farm prices** | In some countries, due to the **atomized primary producer sector + import of cheaper products** from outside the EU (mainly from Chile) |
| **Atomisation of the production sector** | Most of EU mussel **farmers are small or microenterprises.** This atomization **offers the processing and depurating sector market/bargain power** |
| **Access to space** | Mussel production is **often extensive,** while **coastal space is busy and under increasing demand** (e.g. the prod. of mussels from rafts in Galicia reached a limit several years ago) |
| **Difficulty to obtain permits** | The **administrative burden,** the **long time** this process often takes and the **uncertainty** of the outcome are significant drawbacks in the **process of renewal or issuing of new permits** |

According to The 2016 Scientific, Technical and Economic Committee for Fisheries (STECF) Economic report on aquaculture, administrative issues are far more important to solve than the technical ones

Note: red tags by species based on occurrences in news during external research

## ENVIRONMENTAL FACTORS

| | |
|---|---|
| **Harmful algal blooms** | When harmful algal blooms occur, producers are **not allowed to sell their products (causing significant economic losses).** The distribution and effects of harmful algal blooms are **becoming more common** |
| **Climate change and ocean acidification** | **Temperature** increase in the ocean, **sea level rise**, **ocean acidification,** changes in rainfall and therefore **salinity,** and in the **concentration of nutrients** + increase in the **number and intensity of extreme weather events** |
| **Bad or unfavourable weather** | Severe weather events (becoming more frequent along the NW coast of Europe) can do **physical damage to stocks and to supporting structures + cause changes in the water column** (e.g. reduce salinity) |
| **Diseases, parasites and predation** | Parasites can cause **mass mortality of bivalves, or reduce their growth,** with causes long and hard to establish. **Crabs** are having a very **high impact (losses)** in clams productions **in Italy** |
| **Marine pollution** | The filtering nature of mussels makes them **vulnerable to the exposition to heavy metals and microplastics,** then transferring through the food web (e.g. Ria de Arousa affected by plastics, in Galicia) |
| **Lack or unreliability of natural spats** | Obtaining natural supply of spat is often **subject to large variations + hatcheries** are the most expensive method to produce spat, with the **price of mussels often being too low to make it economically viable** |

European Investment Bank

*Sources: The decline of mussel aquaculture in the European Union: causes, economic impacts and opportunities, Reviews in Aquaculture, 2021*
*Regional review on status and trends in Aquaculture development in Europe, FAO, 2020*
*External research*

# Chapter I

# Seaweed and bivalves: status and potential of regenerative mariculture in Europe


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**IMTA .....93**

# The case of IMTA

- Introduction to IMTA
- Positive impact
- Recent developments in the EU
- Versatility by design
- Remaining barriers

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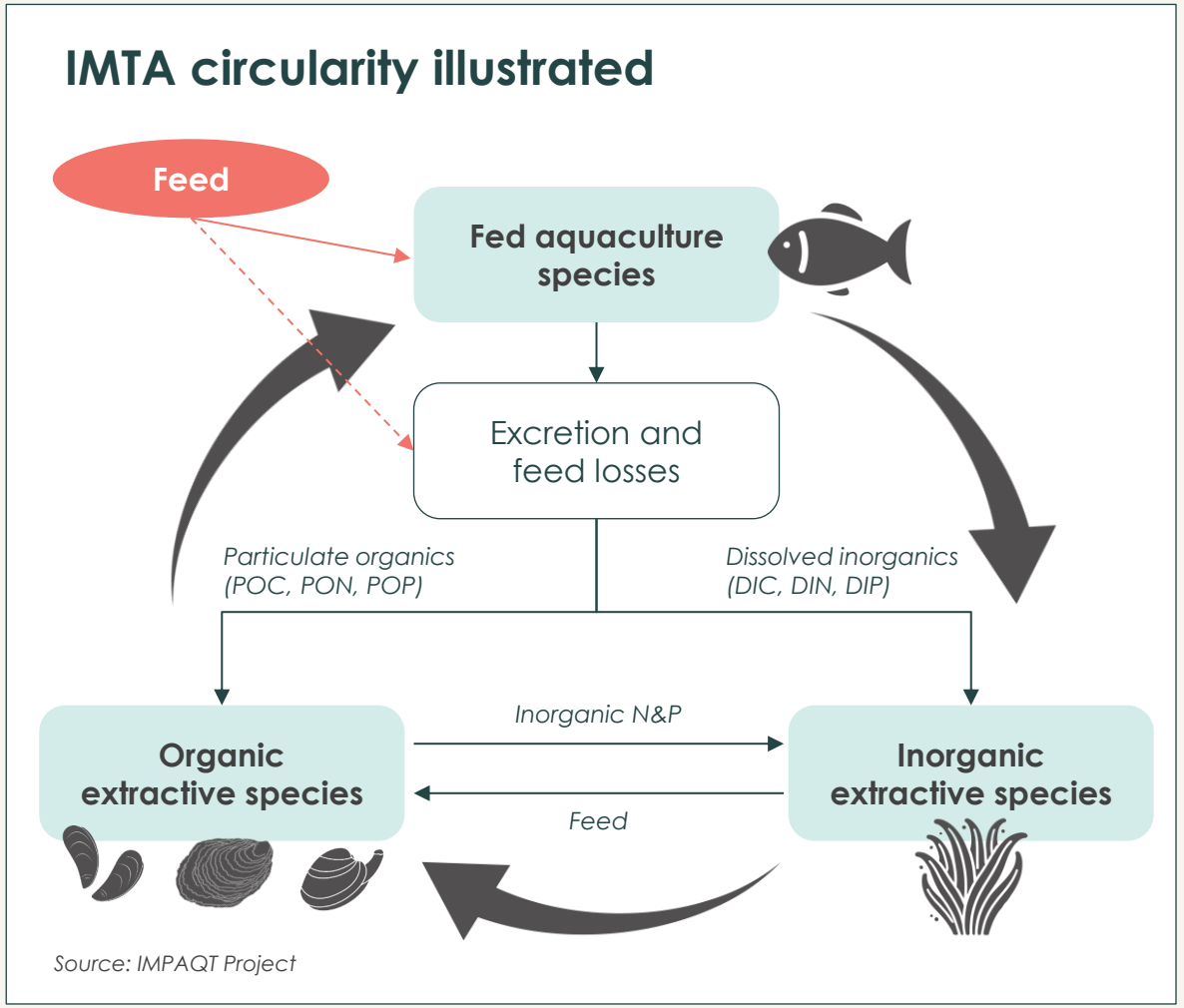
# Although IMTA represents a significant share of aquaculture in Asia (esp. in China), it is still in its early stages in Europe

- **Integrated Multi-Trophic Aquaculture (IMTA) is the practice of farming two or more aquatic species from different trophic levels in the same area,** based on their **complementary functions within an ecosystem.** It involves **fed species** (s.a. finfish or shrimp), which are supported by **extractive species** (s.a. shellfish, invertebrates or seaweed), feeding on the wastes of the fed species, extracting organic or inorganic matter
- The concept has **long been in use, and commercially successful in Asia, esp. in China,** where the polyculture and co-culture systems of fish with shellfish and seaweeds was **developed from 1980 to 2000 (and already practised for centuries), leading to a strong adoption of IMTA since the 2000s.** In China, the proportion of mariculture **production from IMTA is estimated at 40% in 2021,** and expected to keep on growing
- Western countries, including **Europe,** are **latecomers to the IMTA concept** (although it was discussed in the scientific literature in the 1970s already), now concretely entering **political and economic areas of interest for about a decade**

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*Sources: FAO, 2022, Integrated multitrophic aquaculture: lessons from China*
*Periklis Kleitou, Demetris Kletou, Jonathan David, Is Europe ready for integrated multi-trophic aquaculture? Aquaculture, Volume 490, 2018*
*Policy Brief, EU Potential for IMTA Development, Findings and recommendations from the IMPAQT Horizon 2020 Research and Innovation project*

# IMTA projects present significant environmental and economic advantages when compared to monoculture, with a positive impact yet to be scientifically tracked and quantified

> **Reduced environmental impacts**
- increased **ecological diversity**
- **uptake by extractive species of surplus nutrients and organic matter** (that would otherwise be lost to the open environment)
- potential on **euthrophication reduction**

> **Enhanced economic performance**
- **conversion of waste to food** for additional growth and end products
- **increase productivity** / yields
- **production all year around** versus seasonality in monoculture
- **reduced economic risk**
- increased **investment portfolio** (added economic value)
- **lower operating costs** for non-fed species
- **cost-effective capital investment** due to shared resources and technologies
- **increased consumer trust** and social license to operate due to improved environmental credentials

> **Increased spatial efficiency**
- more optimal **use of existing cultivation space**
- **increased biomass production**

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*Sources: Policy Brief, EU Potential for IMTA Development, Findings and recommendations from the IMPAQT Horizon 2020 Research and Innovation project External Research*

# Lately, several EU-funded projects are setting the stage for IMTA in Europe (and in the Atlantic)

- **IMTA did not develop suddenly but has been following a gradual progression,** starting with integrated fish farming practices. Over time, elements of ecological engineering were incorporated into polyculture practices, **progressively leading to the establishment of modern IMTA systems and ambitions**
- Because of IMTA positive environmental and economic potential, The ***"Strategic guidelines for a more sustainable and competitive EU aquaculture for the period 2021 to 2030",*** published by the **European Commission in 2021, promote IMTA** (among other types of aquaculture that are beneficial to the environment)…
- …with **EU funding / contributing to several projects on IMTA**

## Examples of EU-funded IMTA projects

AquaVitae

**Introduction of new low trophic species, products and processes** in marine aquaculture value chains across the Atlantic. **IMTA being one of the five chosen value chains**

ASTRAL

**Focus on IMTA,** with the aim of **defining its production chains and promoting it for the Atlantic markets,** bringing together labs in Ireland, Scotland, RSA, Brazil and Argentina

IMPAQT
Intelligent Management System for Integrated Multi-trophic Aquaculture

**Aiming to drive a paradigm shift in the EU industry** and its acceptance of IMTA as a viable approach, notably by **working to the improvement of monitoring and management systems** for IMTA production (consolidated into **one intelligent management platform)**

**Each project leading to a series of pilot projects, with common objectives:**

1. **Investigating environmental and operational synergies** among species, in defined environmental conditions
2. **Developing value chain and protocols** suited for commercial scale production and distribution
3. **Identifying, developing and integrating** relevant **information systems** and **production tools**
4. **Collecting and analyzing data** to benefit to the entire European IMTA ecosystem

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*Sources: Sinan Nissar, Yahya Bakhtiyar, Mohammad Yasir Arafat, Saima Andrabi, Zahoor Ahmad Mir, Niyaz Ali Khan, Seema Langer, The evolution of integrated multi-trophic aquaculture in context of its design and components paving way to valorization via optimization and diversification, Aquaculture, Volume 565, 2023*
*Policy Brief, EU Potential for IMTA Development, Findings and recommendations from the IMPAQT Horizon 2020 Research and Innovation project*

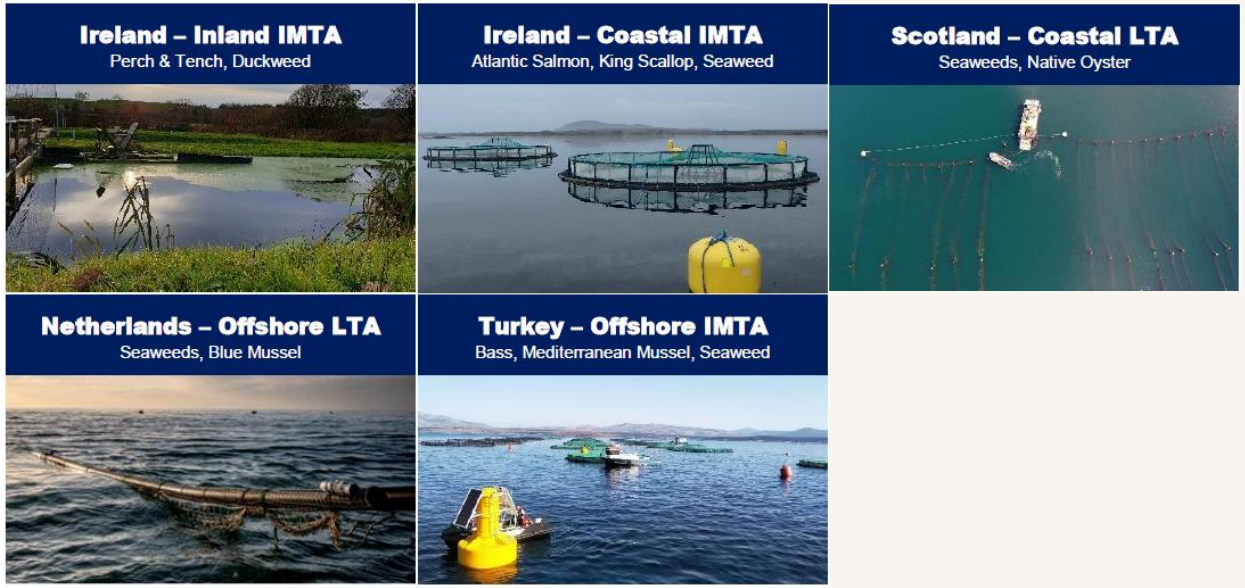
# Versatility by design: IMTA is a concept, not a standardized approach or product

## IMTA is a systemic combination based on numerous parameters, s.a.

- **Identified synergies between species: fed species** (e.g. salmon, perch, tench, bass) **x organic extractive species** (e.g. filter feeders such as mussels, oysters or clams, and deposit feeders such as sea urchins, sea cucumbers, lobsters) **x inorganic extractive species** (e.g. seaweed)
- **Farm location specificities**
- **Market** dynamics
- Available **technologies**
- Farm managers and **operators' skills**
- **Newbuild vs. add-on**

## …resulting in different setups on a project by project basis

**IMPAQT pilot sites** for demonstrating IMTA system configurations in Europe: **each project is implementing a different IMTA system**

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*Sources: Policy Brief, EU Potential for IMTA Development, Findings and recommendations from the IMPAQT Horizon 2020 Research and Innovation project*

# IMTA is a promising tool for the sustainable growth of aquaculture, yet it is still facing regulatory, technical and economic barriers in the EU

## NO STANDARDIZED APPROACH

**IMTA is a concept** (farming 2+ species of different trophic levels in the same area), with **no standardized formula** to it: **every new IMTA project** has to **set up a specifically balanced system** taking into account **the site, the species,** and **the production methods** to be integrated, making it **harder to industrialize at large scale**

## LACK OF INFORMATION

**Ongoing projects** currently working to fill the **lack of information for decision-makers in Europe,** be it **scientific information** (e.g. biosecurity, disease management, quantifying sustainability improvements), **economic information** (e.g. overall P&L vision compared to monoculture), and **technical information** (e.g. skills and experience of farmers regarding new cultures, installation and use of additional technical facilities for drying seaweed or de-purifying filter feeders)

## REGULATORY BURDEN

The regulatory framework in many EU Member States poses a **substantial challenge to the expansion of commercial-scale IMTA operations. Licensing processes** are often **overly complicated,** with **unpredictable timelines** and **uncertain outcomes. Commercial ventures** face **stricter requirements,** particularly regarding food safety, compared to experimental sites. Additionally, **modifying an existing license** to include a **new species** group remains a complex and **burdensome process**

## CHANGE IN PRODUCTION SCALE

When **added to existing farming facilities,** it might require **new largescale production and/or refining facilities,** hence **significant capex.** For example, both Norway and Canada's **salmon industries** have conducted **IMTA trials** involving salmon, seaweed, and bivalves. It is estimated that **for every kilogram of salmon produced, between 7 and 13 kilograms of seaweed would be needed** to absorb the resulting waste

European Investment Bank

*Sources: Global Seafood Alliance, Conscious coupling: can IMTA gain a foothold in Europe?, Bonnie Waycott, 2021*
*FAO, 2022, Integrated multitrophic aquaculture: lessons from China*
*Policy Brief, EU Potential for IMTA Development, Findings and recommendations from the IMPAQT Horizon 2020 Research and Innovation project*

# Chapter II

# Investment opportunities for the EIB in the seaweed and bivalve sectors in Europe


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# Investment opportunities for the EIB in the seaweed and bivalve sectors in Europe


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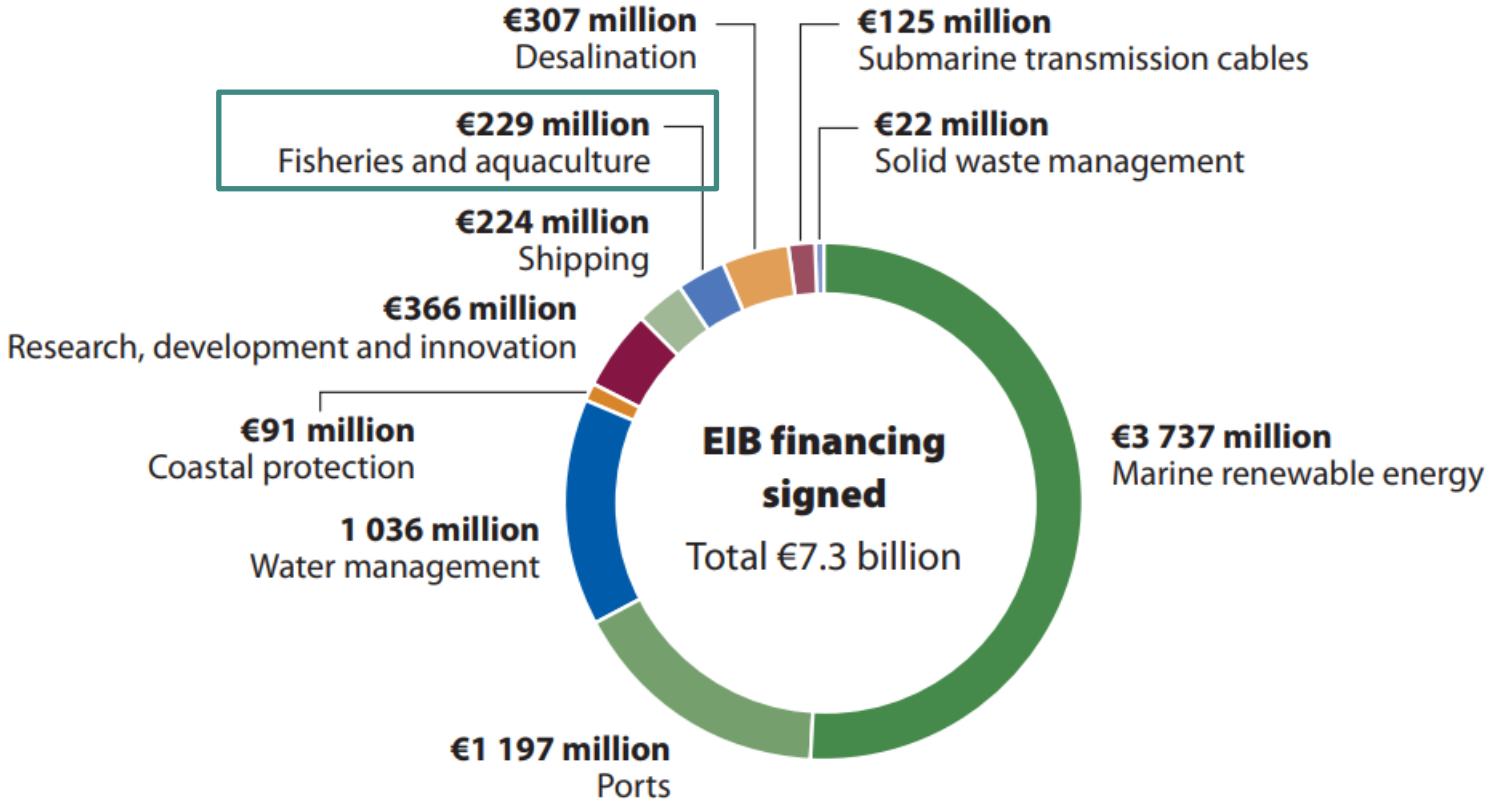
# The EIB has begun to step up its lending and advisory activities in marine-related sectors, including €229 million for fisheries and aquaculture

**EIB support for the blue economy by sector during the period 2019-2023**




Source: EIB - Clean oceans and the blue economy OVERVIEW 2024

# 2 of the 20 Blue Champions announced in 2024 by the EIB belong to the seaweed and bivalve industry


## alginor

**Overview**: Company specialized in the sustainable processing of seaweed through a biorefinery approach, aiming to fully utilize seaweed biomass for various applications in food, pharmaceuticals, and materials. Their focus is on extracting high-value ingredients from seaweed harvested in Arctic waters.

**Size:** Around **55 employees**

**Funding:** Alginor has raised approximately **$37.5 million** in venture capital funding to date, supporting its efforts to establish and expand its production facilities and technology capabilities

## oceano fresco

**Overview:** Company dedicated to the sustainable cultivation of native European clam species. They use advanced breeding techniques at their BioMarine Center and operate a large-scale offshore clam farm in the Algarve region.

**Size:** Around 50 employees

**Funding:** Oceano Fresco has raised about **€17 million** in recent funding rounds, backed by investors like Indico Capital Partners, Aqua-Spark, and BlueCrow Capital, to expand its production capacity and market reach



Source: press clips, pitch book, craft.co

# This chapter aims at identifying debt financing opportunities in the European seaweed and bivalve industries

## The EIB has identified seaweed and bivalve industries as promising and impactful investment opportunities…

> *The EIB created a partnership with the Global Seaweed Coalition […] with the aim to* ***seek financing opportunities for the EIB in support of seaweed and bivalve aquaculture****, […] and to increase EIB investments in projects that improve and protect the health of the ocean and the sustainable exploitation of its resources, including sustainable seafood production, in line with the EIB's Blue Economy strategy.*

**European Investment Bank's engagement with civil society 2023 highlights**

## …but needs a better understanding of the needs and the fit with its investment requirements

The minimum (direct) EIB investment in a project is **€15m** (but typically around €50m)

EIB is **typically not able to provide more than 50% of total funding** for a project (though can increase to 75% in certain areas, such as climate adaptation)

Consequently, total project size would need **to be at least €20m and generally more than €30m to be eligible to EIB** direct investment

## This chapter aims at identifying the key debt financing opportunities in the European seaweed and bivalve industries

**5 debt financing opportunities identified for seaweed and 5 for bivalves, through 20+ interviews with sector experts and desktop research**

Each opportunity is reviewed under the following dimensions:

- Rationale for the financing need/ expected use of proceeds
- Typical profile for the investee
- Average deal size
- Contribution to sustainable development of the sector and increased positive impact on ocean health
- Risks and possible mitigation strategies



Source: https://www.eib.org/attachments/general/events/civil-society-highlights-2023-leaflet.pdf; https://finance.earth/wp-content/uploads/2024/01/EIB-Report-Investment-Opportunities-in-Fishery-Sustainability-vFinal.pdf

# Chapter II

# Investment opportunities for the EIB in the seaweed and bivalve sectors in Europe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# 5 debt financing opportunities identified for the seaweed industry in Europe

| Opportunities | Key features | Average deal size |
|---|---|---|
| Revolving loan | Access to working capital to manage seasonality of spends, payment delays from public grants and subsidies | €200k – €1.5 m |
| Seaweed farming infrastructure | Financing of new lines, moorings, boats, basins, etc. to increase seaweed production; or sensors, software or hatchery to optimize it | €500k – €2 m |
| Seaweed processing and logistics | Financing of capex for primary processing (e.g., dryer), single application processing (e.g., bio-stimulants) or logistics (e.g., warehouse) | €500k – €5 m |
| Biorefinery | Financing of construction and first years of operation of seaweed biorefinery facility, demo plant or commercial-scale plant | €20m - €50 m |
| M&A | Financing of consolidation between players, vertical integration (e.g., production + products) or horizontal (massification of production/ processing) | €1m - €10 m |

European Investment Bank

Source: Global Seaweed Coalition analysis, expert interviews

# Opportunity 1 : Revolving loan

**Average deal size** **€200k – €1.5 m**

## Rationale for the financing need/ expected use of proceeds

- **Seasonal Upfront Costs:** To cover the upfront purchase of growing materials, seeds, and equipment, which are needed at the start of the growing season but do not align with the company's revenue cycle, creating a cash flow gap.
- **Bridge Public Grant Delays:** To absorb delays in receiving awarded public grants, which often require expenses to be incurred upfront before reimbursement is made, ensuring the farm can continue operations without disruption.
- **Working Capital for Expansion**: To finance ongoing operational expenses and expand production capacity during high-growth periods, enabling the company to meet market demand while awaiting payment from customers or partners.

## Typical profile for the investee

- **European seaweed farm – land or ocean-based**
- **Usually SME profile (in some cases presented as start-ups)**
- **Examples:** Algolesko (France), Algaplus (Portugal), The Seaweed Company (Ireland), Dutch Seaweed Group (Netherlands)

## Contribution to sustainable development of the sector and increased positive impact on ocean health

- Working capital is a recurring issue for most European seaweed farms
- Enabling easier access/ lower interest rate revolving loans could help them scale faster and get the most of the catalytic funding received from public grants, while reinforcing their negotiation positions with buyers too often disadvantaged because of cash shortage

## Potential risks

- Market risk (e.g., drop in prices)
- Production risk (e.g., storms, crop failure)



Source: Global Seaweed Coalition analysis, expert interviews

# Opportunity 2 : Seaweed farming infrastructure

**Average deal size** **€500k – €2 m**

## Rationale for the financing need/ expected use of proceeds

- **Ocean-based farming infrastructure :** To cover the upfront at-scale purchase of buoys, lines, moorings, boat(s) for the exploitation of a new area where a seaweed farming licence has been granted
- **Land-based farming infrastructure :** To finance acquisition of land/ construction of ponds for the expansion of production
- **Transversal enablers to optimise production** : To finance the creation of an in-house hatchery to improve selection of strains and optimise yield/ resilience, and/or to finance the deployment of remote sensors and associated software to improve management of crops and early detection of crop failure risks

## Typical profile for the investee

- **European seaweed farm – land or ocean-based**
- **Usually SME profile (in some cases presented as start-ups)**
- Algolesko (France), Algaplus (Portugal), The Seaweed Company (Ireland), Dutch Seaweed Group (Netherlands)

## Contribution to sustainable development of the sector and increased positive impact on ocean health

- Most Europeans farms are struggling to raise equity funding that would allow them to invest in farming capacity expansion and farming production optimisation
- Debt funding, with adapted conditions for repayment, would allow farms to finance their expansion and repay the loan with production sales of following years

## Potential risks

- Supply chain risk (e.g., delay in receiving equipment/ materials)
- Regulatory risk (e.g., unexpected delay in obtaining license or land utilisation authorisation)
- Unclear collateral, as financed assets are not always easy to valorise in another context (e.g., moorings)

Source: Global Seaweed Coalition analysis, expert interviews

# Opportunity 3 : Seaweed processing and logistics

**Average deal size** **€500k – €5 m**

## Rationale for the financing need/ expected use of proceeds

- **Pre-processing infrastructure :** To finance construction of infrastructure for the immediate treatment of seaweed freshly harvested, which could include washing, drying, shredding, freezing
- **Single application processing infrastructure:** To finance construction of infrastructure for transformation and packaging of seaweed into a single application (i.e. simpler than biorefinery). This could be a facility that transforms seaweed into bio-stimulants, or into food products
- **Logistics** : To allow the acquisition of warehouses (basic or refrigerated) next to production site or decentralised to better serve target markets located far away from production site

## Typical profile for the investee

- **European seaweed farm – land or ocean-based**
- **Usually SME profile (in some cases presented as start-ups)**
- Algolesko (France), Algaplus (Portugal), The Seaweed Company (Ireland), Dutch Seaweed Group (Netherlands)

## Contribution to sustainable development of the sector and increased positive impact on ocean health

- Seaweed farms selling fresh seaweed without any processing do not capture enough value, and therefore need to add a minimum of transformation to increase revenues, guarantee higher quality and facilitate logistics for distribution.

## Potential risks

- Supply chain risk (e.g., delay in receiving equipment/ materials)
- Regulatory risk (e.g., unexpected delay in obtaining permit for a new construction)
- Market risk (e.g., surge in energy price having cost implications for a dryer for instance)

Source: Global Seaweed Coalition analysis, expert interviews

# Opportunity 4 : Biorefinery

**Average deal size** **€20m - €50 m**

## Rationale for the financing need/ expected use of proceeds

- **Upfront Capital for Infrastructure:** Debt financing would cover the substantial upfront costs associated with building the plant infrastructure, including land acquisition, construction, and purchasing specialized equipment for processing seaweed.
- **Bridging Cash Flow Gaps:** Loans would provide liquidity during the construction phase, enabling the biorefinery to pay contractors and suppliers while awaiting revenue generation from the eventual sale of bio-products or public grants tied to project milestones.
- **Scaling Production Capacity:** For commercial-scale plants, debt financing allows the company to expand its production capabilities to meet market demand, fund additional working capital needs, and manage the operational costs of scaling up from a demo facility to full production.

## Typical profile for the investee

- **European seaweed industrial deeptech start-ups**
- **Examples:** Oceanium (Scotland), Origin by Ocean (Finland), Alginor (Norway)

## Contribution to sustainable development of the sector and increased positive impact on ocean health

- With higher labour and production costs than emerging markets, biorefinery could be a key enabler for the European seaweed industry to generate maximum value out of the feedstock, while valorising all byproducts and creating a zero-waste industry

## Potential risks

- Supply chain risk (e.g., delay in receiving equipment/ materials)
- Regulatory risk (e.g., unexpected delay in obtaining permit for a new construction)
- Technology risk (underperformance of biorefinery process when scaling to larger size)
- Market risk (e.g., surge in energy price having cost implications for a dryer for instance)

Source: Global Seaweed Coalition analysis, expert interviews

# Opportunity 5 : M&A

**Average deal size** **€1m - €10 m**

## Rationale for the financing need/ expected use of proceeds

- **Vertical integration :** Many farms have been focusing on mastering the production process over the past years but struggle to generate enough value out of the seaweed feedstock, while many companies have in parallel focused on transforming, marketing and selling innovative seaweed products. Vertical integration (e.g., a farm acquiring a seaweed food product brand, or vice-versa) could allow to limit fees from intermediaries while securing feedstock supply, properly valorized and distributed.
- **Horizontal integration:** Many seaweed product companies have been pioneering a narrow portfolio of innovative products and could benefit from massification of their portfolio and distribution networks through merger or acquisition of adjacent players/ competitors. Alternatively, seaweed small-scale farms could be consolidated and share hatchery or processing infrastructure.

## Typical profile for the investee

- **European seaweed farm – land or ocean-based - Examples:** Algolesko (France), Algaplus (Portugal), The Seaweed Company (Ireland), Dutch Seaweed Group (Netherlands)
- **European seaweed product start-ups or SMEs - Examples:** Marinoe (France), Bettafish (Germany), Wavy Wonders (Netherlands)

## Contribution to sustainable development of the sector and increased positive impact on ocean health

- With the mushrooming of new seaweed start-ups and SMEs observed in Europe over the past decade, the industry is approaching a turning point where consolidation is likely to become necessary to help solid players to emerge and become more competitive, and in capacity to scale to another level.

## Potential risks

- Operational risk (e.g., cultural differences, IT and process integration)
- Overestimated synergies during valuation and business planning for post-merger financial model
- Commercial risks (e.g., overestimated cross selling potential to the clients of both companies in case of horizontal integration)

Source: Global Seaweed Coalition analysis, expert interviews

# Several strategies can be envisioned to reduce the risk associated with those debt financing opportunities

## Risks identified across the opportunities

- **Market risk** (e.g., drop in seaweed prices, surge in energy price)
- **Production risk** (e.g., storms, crop failure)
- **Supply chain risk** (e.g., delay in receiving equipment/ materials)
- **Regulatory risk** (e.g., unexpected delay in obtaining license or land utilisation authorisation, or construction permit for infrastructure)
- **Technology risk** (underperformance of biorefinery process when scaling to larger size)
- **Unclear collateral**, as financed assets are not always easy to valorise in another context (e.g., moorings, ponds)

## Risk mitigation strategies

- **Guarantees** provided by a third party (e.g., EIF) to minimizing the loss for the lender in case of default
- **Multiyear offtake agreements** secured by seaweed farmers with buyers, with pre-agreed volumes and prices
- **Crop insurance** to be subscribed by seaweed farmers to cover a range of risks including weather-related events, plant diseases, and price drops.
- **Commitment letters** from grants and subsidies donors to demonstrate upcoming funding already secured
- **Technical assistance** financed and provided by the lender (e.g., EIB) or through national or European grants (e.g., EMFAF)

Source: Global Seaweed Coalition analysis, expert interviews

# Chapter II

# Investment opportunities for the EIB in the seaweed and bivalve sectors in Europe


Context ..... 101

Debt financing opportunities – seaweed ..... 105

Debt financing opportunities – Bivalves ..... 113

# 5 debt financing opportunities identified for the bivalve industry in Europe

| Opportunities | Key features | Average deal size |
|---|---|---|
| **Revolving loan** | **Access to working capital to manage seasonality of spends, payment delays** from public grants and subsidies, **as well as temporary drops in activity** | **€100k – €1m** |
| **Farming infrastructure and green transition** | **Financing of land-based basins** for adaptation to viruses / heat waves, **new farming infrastructure, hatchery** to optimize spat resilience; and **solutions to renew equipment and farm sites with climate-friendly alternatives** | **€100k – €2m** |
| **Mechanization** | **Financing of new equipment to mechanize** seeding / bivalve management and handling / harvesting | **€20k – €500k** |
| **Buyout and rehabilitation** | **Financing the takeover of a business,** e.g. in the case of a transfer during retirement, and/or **the rehabilitation of disused shellfish farming sites** | **€500k - €3m** |
| **IMTA** | **Financing of diversification of activities** to include for instance seaweed farming as additional income stream – cf. seaweed financing opportunities | **€200k - €1m** |

*The demand for grants will **probably cover several of these use cases** and require **customized financing structures***

European Investment Bank

Source: Global Seaweed Coalition analysis, expert interviews

# Opportunity 1: Revolving loan

**Average deal size** **€100k – €1m**

## Rationale for the financing need / expected use of proceeds

**In addition to the use cases presented in the Seaweed section, revolving loans could be useful to bivalve farmers for:**

- **Working Capital management:** as bivalve farming income is seasonal, a revolving loan bridges cash flow gaps between harvests (to cover day-to-day expenses) and provides liquidity when revenue is temporarily low (e.g. during pre-harvest preparation, which is resource-intensive and occurs before income is generated), while avoiding the need to sell assets of take on longer-term debt for short-term cash needs
- **Buffer against temporary drops in activity:** offset temporary drops in revenue during adverse events like severe weather events, harmful algal blooms or market downturns, allowing to maintain staff and equipment to ensure critical operations for the next harvest
- **Emergency response:** acting as a financial safety net to address unforeseen challenges, such as equipment failure or sudden regulatory changes requiring compliance upgrades (minimized operational disruptions thanks to flexibility)
- **Exploratory investments:** trial new farming techniques, purchase experimental equipment or pilot sustainability initiatives before committing to larger-scale investments

## Typical profile for the investee

- **Small scale farmers** (family-run or independently operated farms)
- **Medium-sized farmers** with larger operations and stronger volume effects
- **Cooperatives and producer organizations**
- **Hatcheries and nurseries**

## Contribution to sustainable development of the sector and increased positive impact on ocean health

- By providing short-term working capital, revolving loans ensure farmers can maintain operation during lean revenue periods, **helping them to avoid unsustainable practices** (s.a. overharvesting or delaying critical investments in maintenance and env. compliance)
- **Revolving loans allow quick access to funds, and quick answers to unexpected challenges,** hence protecting both the farm's productivity and ecosystem

## Potential risks

- **Economic risk: market price volatility** for bivalves may reduce profitability, tightening cash flow
- **Environmental risk: continued series of adverse events** could jeopardize several harvests in a row, straining liquidity
- **Regulatory risk: sudden changes in food safety or environmental regulations** might increase compliance costs, reducing repayment capacity
- **Management risk: poor cash flow management** could lead to over-reliance on the revolving facility



Source: External research; Experts interviews

# Opportunity 2: Farming infrastructure and green transition

**Average deal size** **€100k – €2m**

## Rationale for the financing need / expected use of proceeds

**Debt financing would be an efficient tool for bivalve farmers to invest in key infrastructures, such as:**

- **Shellfish beds and rafts:** Expansion or rehabilitation of bivalve farming areas (as farming areas directly increases production capacity), including shellfish racks, rafts or cages for suspended cultures
- **Hatcheries and nurseries:** Facilities for breeding and growing spat, enhancing control over supply chain with a steady supply of spat, reduced dependency on external suppliers and stabilized/more predictable costs
- **Depuration facilities:** Depuration systems (e.g. tanks, filtration, UV disinfection units) can be expensive for SMEs
- **Cold storage and processing units:** On-site facilities to preserve freshness, increase processing capabilities and meet food safety standards (aiming at adding value to the product, and reduce losses due to spoilage)
- **Renewable energy integration:** installing solar panels, wind turbines, or tidal energy systems to power farm operations

## Typical profile for the investee

- **Small scale farmers** (family-run or independently operated farms)
- **Medium-sized farmers**
- **Large-scale farmers** to fund larger-scale projects (s.a. hatcheries and nurseries)
- **Cooperatives and producer organizations**

## Contribution to sustainable development of the sector and increased positive impact on ocean health

- **Infrastructure upgrades not only improve productivity, but also reduce reliance on unsustainable, ad-hoc solutions** (e.g. poorly maintained gears that degrade ecosystems)
- **Capacity building for sustainable growth:** high-quality infrastructure allows expansion of production in a controlled, sustainable way, minimizing ecological strain
- **Green energy solutions reduce dependence on fossil fuels,** contributing to decarbonization and climate resilience in the sector

## Potential risks

- **Economic risk: rising material costs** during construction or installation could inflate project budgets
- **Technological risk: infrastructure may underperform** (or fail), reducing operational efficiency
- **Environmental risk: natural disasters or pollution** could damage new infrastructure, delaying ROI
- **Regulatory risk: delays or difficulties in obtaining permits for infrastructure upgrades** might postpone project completion and revenue generation

Source: External research; Experts interviews

# Opportunity 3: Mechanization

**Average deal size** **€20k – €500k**

## Rationale for the financing need / expected use of proceeds

**Debt financing is an interesting lever to modernize and help scale traditional labor-intensive activities:**

- **Automated grading and sorting machines:** automated systems reduce the time and labor costs associated with manual sorting, allowing farmers to handle larger volumes and scale operations more efficiently
- **Mechanized harvesting equipment:** purchase of conveyor or harvesting systems for more efficient and less labor-intensive harvesting, addressing labor shortages and minimizing losses due to environmental factors (e.g. storms or temperature spikes) – specific attention needed here on environmental impact (e.g. dredgers)
- **Water treatment, and monitoring / data systems:** Infrastructure to monitor and improve water quality (critical for healthy bivalve production), and technology / IoT devices and software to track water conditions (e.g. temperature, pH, salinity) and improve farm management (with better growth and survival rates)
- **Replacement of gears with more eco-friendly materials or farming equipment** (e.g. ropes, nets, every plastic material)

## Typical profile for the investee

- **Medium-sized farmers** to increase operational efficiency and output
- **Large-scale farmers** to generalize automated systems for harvesting, processing and packaging
- **Cooperatives and producer organizations** to collectively purchase automated systems

## Contribution to sustainable development of the sector and increased positive impact on ocean health

- **Efficiency gains with lower impact:** mechanized tools, if chosen properly, can reduce the environmental impact of operations by optimizing the use of resources and minimizing waste
- **Eco-friendly farming practices**, such as transitioning to biodegradable farming gear **reduce plastic waste and ghost gear in marine environments**
- **Investments in real-time monitoring systems for water conditions improve farm resilience to environmental shocks,** protecting both the farm and surrounding marine life

## Potential risks

- **Technological risk: operators may lack the technical expertise** to effectively use new systems, reducing their potential ROI
- **Supply chain risk: delays in sourcing specialized machinery** could increase costs and delay repayment capacity
- **Regulatory risk: new environmental regulations** might increase compliance expenses

Source: External research; Experts interviews

# Opportunity 4: Buyout and rehabilitation

**Average deal size** **€500k – €3m**

## Rationale for the financing need / expected use of proceeds

**Debt financing is a highly relevant tool to support bivalve farmers in financing business takeovers:**

- **Financing the takeover of a business:** acquiring an established bivalve farming business or financing the transfer of a farm from one generation to the next may require significant upfront investment, while future cash flow can be established based on proven track record
- **Purchasing assets tied to a buyout:** debt can finance the acquisition of assets tied to a buyout, such as equipment, processing facilities and harvesting/transportation vehicles, with lower risk associated to the loan as the purchased equipment serves as collateral
- **Rehabilitating disused shellfish farming sites:** compared to setting up a new farm, restore an existing site (including repairs, upgrades, re-certifications) can often be a cost-effective solution (also needed as the availability of brand new sites can be very rare in some regions)

## Typical profile for the investee

- **Small to mid-size businesses:** family-owned farms, entrepreneurs or first-time farmers
- **Mid- to large-scale existing farmers** expanding their operations by rehabilitating disused sites, or being investment oriented
- **Cooperatives and Producer organizations**

## Contribution to sustainable development of the sector and increased positive impact on ocean health

- **Ease installation** of young aqua culturists
- **Generational buyouts or farm acquisitions are the occasion to support ongoing stewardship of sustainably managed farms,** preventing neglect or abandonment that could harm local ecosystems
- **Acquiring sites provides opportunities to modernize farming practices,** implementing more sustainable methods that prevent e.g. nutrient overloading or habitat degradation
- **Rehabilitating abandoned or underutilized farming areas reduces pressure to exploit pristine marine environments,** aligning with sustainable spatial planning for aquaculture

## Potential risks

- **Economic risk:** revenues from the acquired or rehabilitated site may take a **longer period to stabilize vs. expectations / BP**
- **Regulatory risk:** newly acquired sites may have **hidden regulatory non-compliance issues,** requiring costly remediation
- **Operational risk: the buyer may lack experience managing the acquired farm,** leading to lower productivity

Source: External research; Experts interviews

# Opportunity 5: IMTA

**Average deal size** **€200k – €1m**

## Rationale for the financing need / expected use of proceeds

**IMTA projects can be a way for bivalve farmers to diversify operations, increase sustainability and improve profitability:**

- **Addition of Seaweed farming:** establishing seaweed farming alongside bivalves to absorb excess nutrients and increase revenue streams, with seaweed relatively fast growth cycles generating cash flows to support short- or mid-terms debt repayment
- **Fish farming integration:** introducing fed species to capitalize on unused space and nutrient recycling
- **Infrastructure for waste management and water quality:** installing systems to recycle waste and improve water quality across the IMTA system, supporting faster growth rates and higher yields for all species
- **Processing and storage facilities:** shared processing facilities reduce per-unit cost across species, while processed or preserved seaweed, fish and bivalves command premium prices
- **Certifications and market access:** financing sustainability certifications (e.g. ASC, Global GAP…) and marketing campaigns to position IMTA products in markets that value efforts towards more sustainability

## Typical profile for the investee

- **Typically small- to medium-scale operators** with a strong interest in revenue diversification
- **Farmers focused on sustainability** (e.g. already be engaged in sustainability certifications)
- **Farmers operating in sensitive environments**, looking for solutions to protect their farms
- **Cooperatives and Producer organizations**

## Contribution to sustainable development of the sector and increased positive impact on ocean health

- **IMTA mimics natural ecosystems, enhancing nutrient recycling** with bivalves and seaweed reducing excess nitrogen and organic waste from fish farming
- **IMTA reduces reliance on monoculture, spreading risk across multiple species** and creating a more stable economic and ecological system
- **Seaweed farming in IMTA systems contributes to carbon capture** and supports ocean acidification mitigation efforts
- **IMTA facilitates access to eco-conscious markets,** incentivizing farmers to adopt sustainable practices that align with consumer demand

## Potential risks

- **Technological risk:** difficulty integrating multiple species
- **Environmental risk: adverse events** could disrupt the system
- **Economic risk: markets** for products like seaweed may not develop as quickly as anticipated
- **Supply chain risk: acquiring specialized inputs** (e.g. seaweed farming equipment, or fish feed) could be delayed / costlier
- **Regulatory risk: IMTA operations face complex permitting processes,** with delays or restrictions impacting the project timeline and profitability

Source: External research; Experts interviews

# Chapter III

# Operationalizing investment opportunities

Deployment strategies identified for the EIB ..... 121

Criteria to ensure sustainability of investees ..... 128

# Chapter III

# Operationalizing investment opportunities

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# Previous chapters confirmed the relevance of the seaweed and bivalve sectors for EIB to deploy debt funding

## Positive impact on ocean health and alignment with EU priorities

- Positive impact on **ocean health** through regenerative nature of these industries
- Positive impact on **EU citizens health**
- Potential for **job creation**/ maintenance in EU coastal areas
- Potential **positive contribution to EU commercial balance** through reduced dependency on imports on a variety of products (e.g., food, feed, fertilisers) and potential to develop export

## Established and scaled industry (bivalve) or promising one (seaweed)

- Stable market for **bivalve** representing **€1.27B and 49% of EU aquaculture volumes**, but **needing to adapt** to increasing threats linked to climate change
- **Double digit CAGR expected for seaweed applications** markets over the next 20 years, reaching € billions, and **growing and innovative European ecosystem** to build upon

## Industry needs perfectly aligned with debt financing

- Seaweed and bivalve aquaculture **need funding to scale up and become more efficient / resilient** to climate change
- Typology of seaweed and bivalve companies (mostly SME) made them **more likely to benefit from debt funding** than equity (except high growth start-up profile exception)
- **10 clear opportunities for debt financing well identified**


Source: Global Seaweed Coalition analysis, expert interviews

# 4 deployment strategies identified for the EIB to invest debt into the European bivalve and seaweed industries

| Possible deployment strategy for EIB | Key features |
|---|---|
| **Direct EIB investment** | • Direct deployment, on a deal-by-deal basis, by existing investment structures within the EIB<br>• EIB ticket in a project would be minimum €15m (but typically around €50m) |
| **Deployment through MBIL[1] mechanism** | • Deployment via a commercial bank partnering with the EIB through a Multiple Beneficiary Intermediated Loan (MBIL), with a portion of the funds being earmarked for investment into seaweed/ bivalve sectors with clear sustainability criteria |
| **Deployment through blended finance vehicle** | • Creation of a dedicated blended fund vehicle managed by a third party, blending debt (from EIB), guarantees (from EIF for instance), grants (from EMFAF or other grant schemes)<br>• Deployment of debt, backed by a guarantee and de-risked through capacity building/ technical assistance funded through the grants, aligning EIB/ EIF sustainability criteria |
| **Deployment through matching of crowdlending** | • Partnership with crowdlending platform (or platforms) to match every euro raised through crowdlending with one euro of EIB debt |

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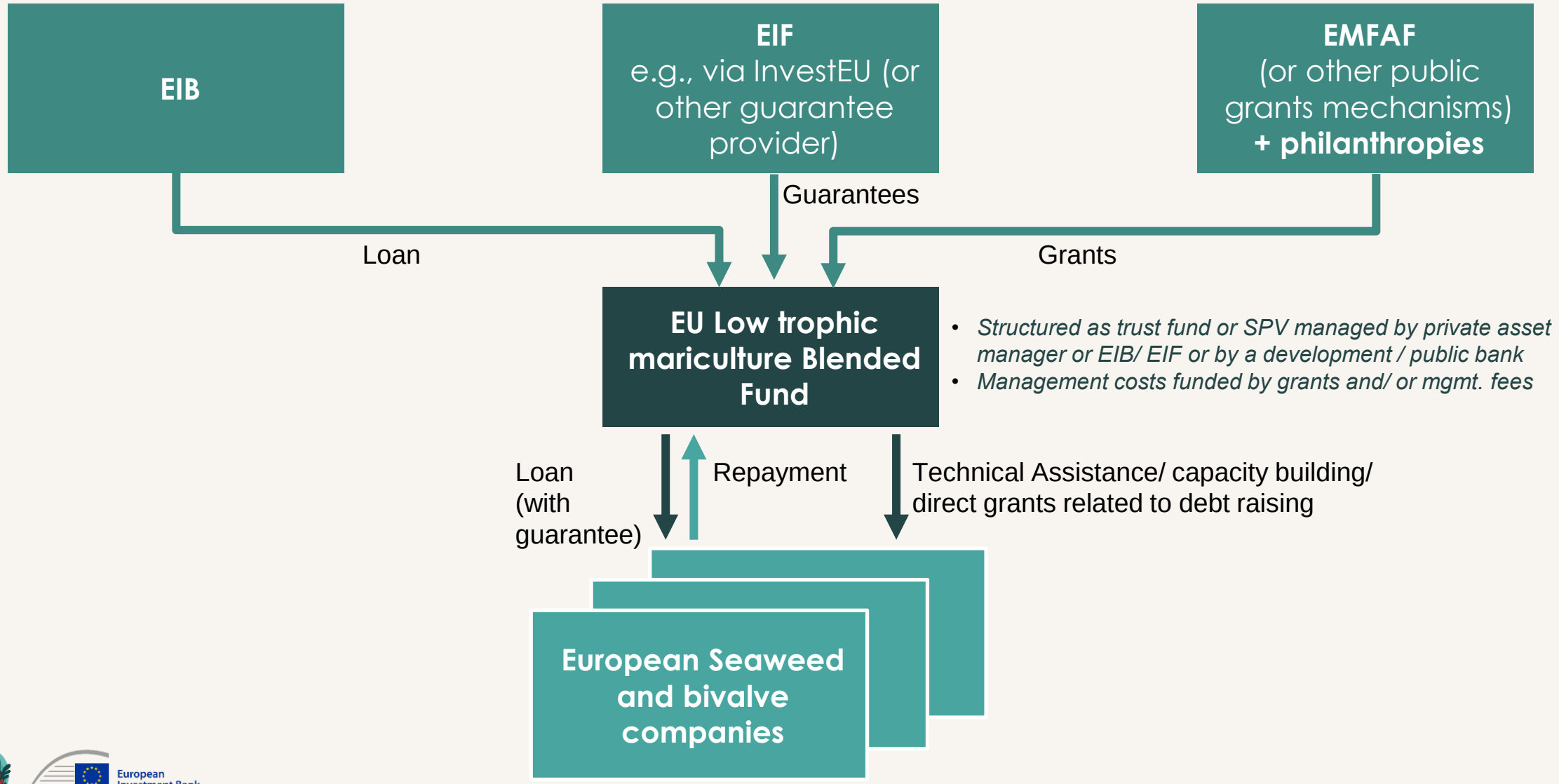
1: Multiple Beneficiary Intermediated Loan
Source: Global Seaweed Coalition analysis, expert interviews

# Deep dive blended finance vehicle – High level concept




1: Multiple Beneficiary Intermediated Loan
Source: Global Seaweed Coalition analysis, expert interviews

# No obvious winning deployment strategy, preferred route will have to be decided by EIB

| Possible deployment strategy for EIB | Depth of eligible deal flow | Relevance/ fit with investment opportunities | Feasibility/ ease of deployment |
|---|---|---|---|
| **Direct EIB investment** | Only a handful of bivalve/ seaweed companies in Europe will raise €20m + debt in the near future | This deployment strategy could be used for instance for biorefinery financing | Easy to deploy Opportunistically, through current EIB activities |
| **Deployment through MBIL[1] mechanism** | Most companies from bivalve and seaweed sector would be eligible, but relevance and eligibility will depend on commercial bank managing the MBIL | Some opportunities might be perceived as too risky for a commercial bank, even through a MBIL mechanism | Dedicated seaweed and bivalve MBIL would be sub-scale – needs to be integrated within broader Blue economy or SME MBIL |
| **Deployment through blended finance vehicle** | Most companies from bivalve and seaweed sector would be eligible, depending on geographic scope of the BF vehicle | Most opportunities would be eligible to funding through a blended vehicle with an appropriate thesis targeting tickets < €10m | Need to be established by a third party, in collaboration with EIB/ EIF Need to align EIB/ EIF sustainability criteria |
| **Deployment through matching of crowdlending** | Only a handful of bivalve/ seaweed companies in Europe will raise €20m + debt in the near future | More likely would be applicable for revolving loans/ opportunistic fundraising but other opportunities (e.g., infrastructure financing) could be eligible | New mechanism, feasibility to be explored |

European Investment Bank

1: Multiple Beneficiary Intermediated Loan
Source: Global Seaweed Coalition analysis, expert interviews

# A rich ecosystem of potential partners for the EIB to deploy debt funding into low trophic mariculture in the EU (1/2)

## COMMERCIAL BANKS ACTIVE IN THE BLUE ECONOMY IN EUROPE [1]


1 Source Blue Invest report 2024 + Global Seaweed Coalition

Source: Global Seaweed Coalition analysis, expert interviews

# A rich ecosystem of potential partners for the EIB to deploy debt funding into low trophic mariculture in the EU (2/2)

## EUROPEAN SUPPORT ORGANIZATIONS FOCUSING ON SEAWEED/ BIVALVES

EU4ALGAE

A.E.P.M. ~ E.M.P.A.

European Molluscs' Producers Association

EABA

NORTH SEA FARMERS

## NATIONAL INDUSTRY ASSOCIATIONS / ORGANIZATIONS (EXAMPLES FROM SELECTED COUNTRIES)

**France:**

- Comité National de la Conchyliculture (CNC)
- Chambre Syndicale des Algues et Végétaux Marins
- Cluster Algues Bretagne
- Merci les Algues

**Ireland**

- Irish Shellfish Association (ISA)
- Irish Seaweed Industry Organisation (ISIO)

**Spain**

- Asociación Nacional de Fabricantes de Conservas de Pescados y Mariscos (ANFACO-CECOPESCA)

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Source: Global Seaweed Coalition analysis, expert interviews

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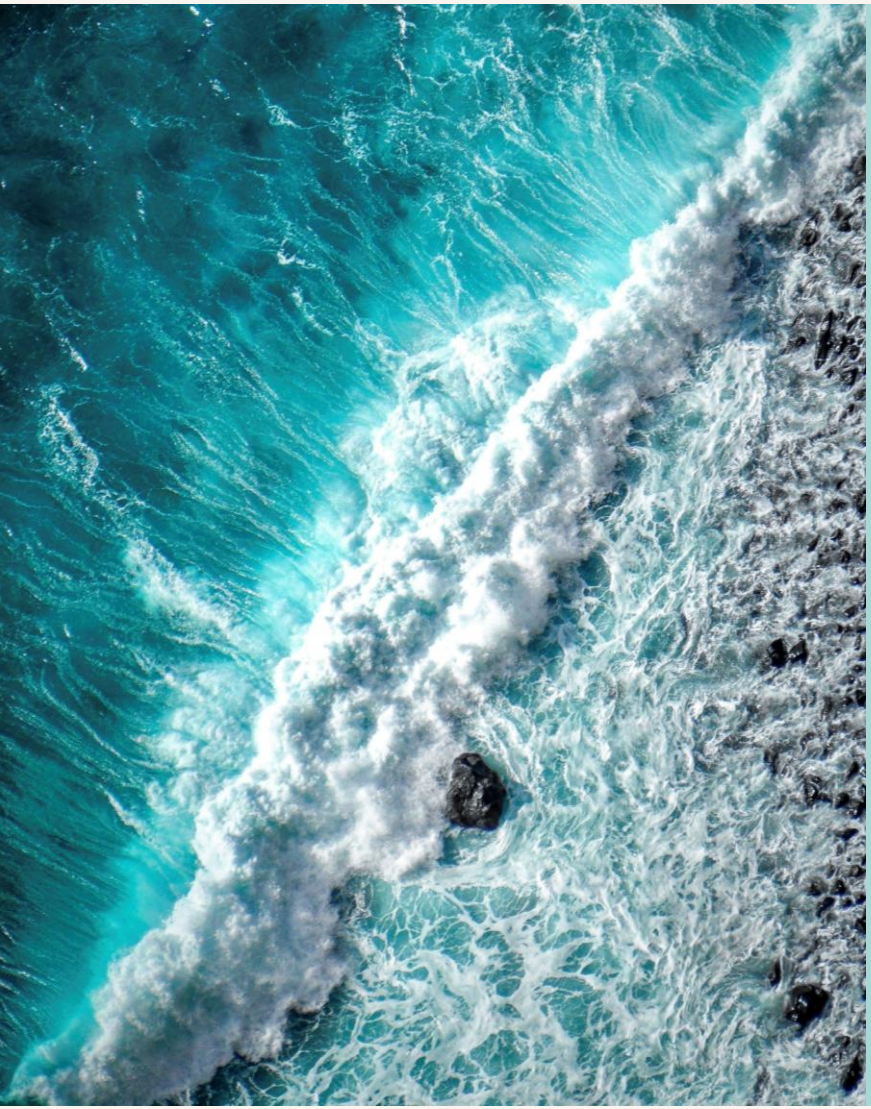
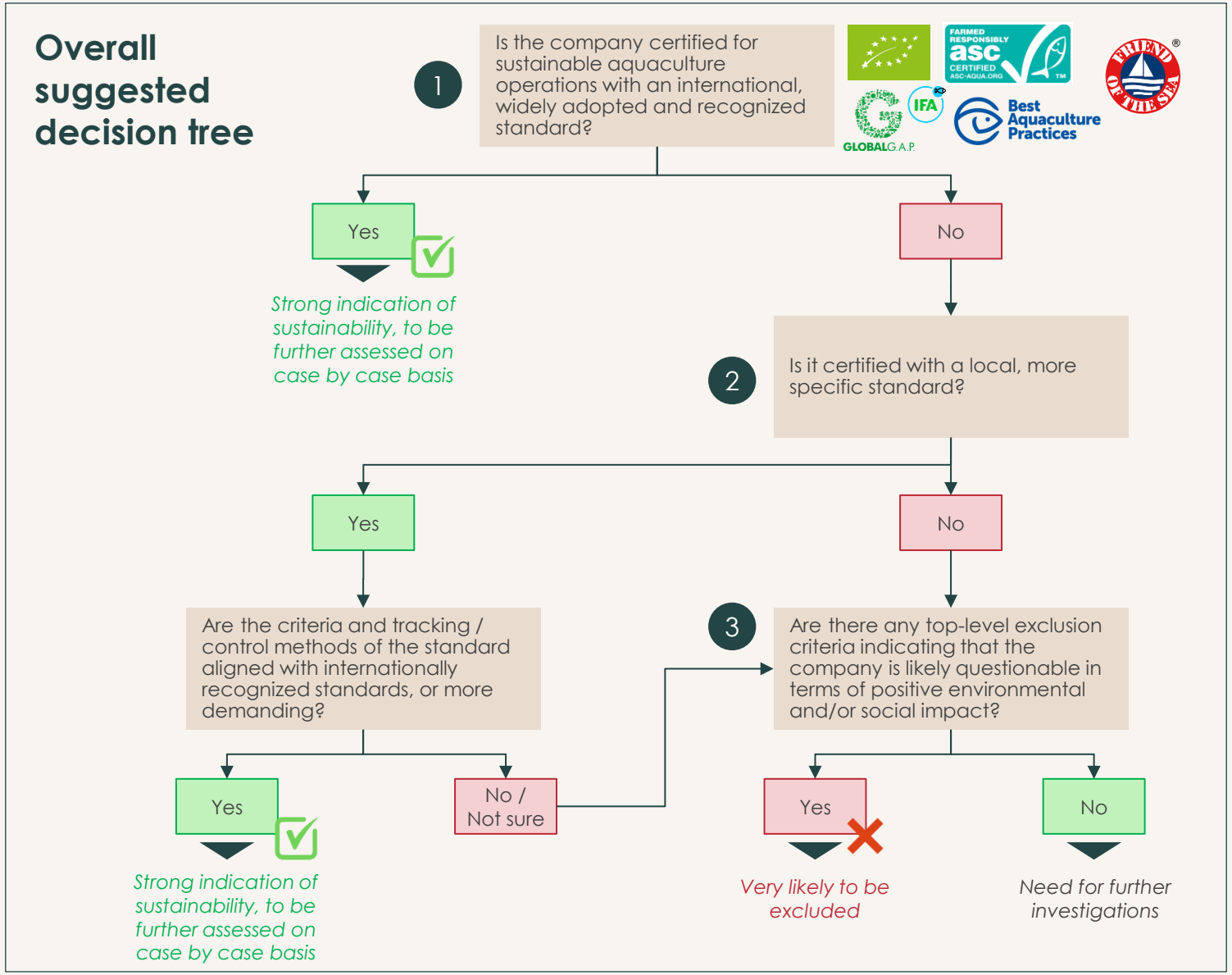


# Sustainability assessment strategy for efficient impact due diligence

# How to ensure sustainability of potential EIB's investees

**Once the EIB will have identified the most suited deployment strategy(ies) for debt funding in the seaweed and bivalve sectors,** it will be to ensure that the operations of the target investees align with regulatory and EIB's standards in terms of sustainability and positive impact

**We recommend three-step methodology to inform this sustainability assessment,** detailed in the following pages



# 1 5 main international standards, with EU Organic certified prevalent in the EU

- **Not starting from scratch:** several certifications are already used and recognized for sustainable aquaculture in Europe, reflecting the industry's awareness and existing efforts on environmental responsibility, animal welfare and social equity
- **5 "tier-1" international certifications are likely to be met in the EU,** all of them covering fish farming, bivalves and seaweed with specific methods and criteria detailed for every certificate / type of activity
- **Keeping a critical look:** these certifications are often the result of negotiations with various stakeholders / interest groups and can be understood as what is an "acceptable compromise", rather than a "full sustainability seal" → complementary information and analyses may be required

| *Certifications* | *Geographical scope* | *Description* |
|---|---|---|
| EU Organic Certified | **EU-focused** (74k tonnes, i.e. 6.4% of EU aquaculture production in 2020) | • **Introduced in 2009, further refined in 2018/2022 with updated standards**<br>• **Focused on minimizing environmental impact,** including animal welfare, feed regulations, prohibition of GMOs, health management<br>• **No focus on social impacts** (assumed to comply with EU labor laws)<br>• **Provide a standardized/unified framework in the EU,** aiming at aligning (best) practices across Member States |
| Global G.A.P. IFA | **Global,** widely used in Europe (2.5m tonnes worldwide, EU share not communicated) | • **1996: EUREPGAP, a B2B initiative / 2003-05 : first aquaculture standards**<br>• Aligned with GFSI, GSSI and FAO guidelines<br>• Focused on food safety, environmental sustainability, animal welfare, workers' well-being and traceability |
| Aquaculture Stewardship Council | **Global,** used in Europe: 566 reported farms in 2024 (incl. Norway) | • **Co-founded by the WWF in 2010 ; independent NPO**<br>• **Focused on minimizing environmental and social impacts,** including responsible feed use, water quality, and community engagement<br>• Detailed and evolving standards, with **strong market recognition** |
| Friend of the Sea | **Global,** used in Europe | • **Founded in 2008 ;** project of the World Sustainability Organization (WSO)<br>• Similar areas of focus, **similar to other certifications:** no impact on habitat, reduction of escapes and bycatch, water quality, no GMO, social accountability, waste management, carbon footprint reduction, fish welfare |
| Best Aquaculture Practices — Global Seafood Alliance | **Global,** with a relatively low footprint in Europe | • GSA is an **independent NPO, founded in 1997**<br>• First BAP standard on shrimp farms in 2003 ; **BAP standards on salmon, finfish, crustacean and mussel farms in 2013 ; seaweed in 2022 (status?)**<br>• BAP standards are built upon **4 pillars of responsibility:** environmental responsibility, social accountability, animal welfare, and food safety<br>• **"Most complete" certification:** also focusing on hatcheries, feed mills… |

# 2 4 local, more specific certification schemes to have in scope as well

- **Several national or regional certification schemes** also exist across the EU in addition to internationally recognized "tier-1" certifications
- **Local certifications address regional consumer expectations and more niche sustainability concerns** vs. international schemes (e.g. in Germany and Sweden, consumer demand for stricter organic standards has driven the creation of Naturland and KRAV, which are reported to exceed EU Organic regulations)
- **Local certification schemes also result from industry negotiations:** in case of doubt (see "red flags" presented in the next page), complementary due diligence may be necessary

| *Certifications* | *Geographical scope* | *Description* |
|---|---|---|
| Organic Soil Association | **UK** with some international presence | • Founded in 1946, with first organic aquaculture standards in the late 1990s<br>• Organic certification delivered for finfish, bivalve and seaweed production<br>• Continuous dev. to align with leading organic standard-setters in Europe |
| Naturland | **Germany** with some international presence | • First certification for organic aquaculture in 1996<br>• Organic certification delivered for finfish, bivalve and seaweed production<br>• The Naturland standards are reported to go beyond the legal requirements for organic production in the EU |
| KRAV | **Sweden** with recognition in other Nordic countries | • Founded in 1985<br>• Organic certification delivered for finfish, bivalve and seaweed production<br>• "KRAV-certified aquaculture is entirely according to the EU regulation for organic production with the addition of KRAV's general standards" |
| Debio | **Norway** | • First organic aquaculture operations certification in 2006<br>• Organic certification delivered for finfish, bivalve and seaweed production<br>• Mussel aquaculture standard aligned with EU regulation for organic production; seaweed production aligned with national (NO) organic production regulations |
| Bioland | **Germany** | • Current standards by Bioland focus on non-predatory fish species<br>• Bivalves and/or seaweed to come?<br>• Bioland members and contract partners engage to comply with the EU organic regulation: in case of discrepancies between the standards published and the EU organic regulation, the specs of the latter prevail |

# 3 Top-level exclusion criteria to be considered prior to/during a DD

- **As detailed in Chapter 1 of the report, seaweed and bivalve aquaculture are activities that inherently provide numerous environmental benefits,** e.g. biodiversity enhancement, water quality improvement, coastal protection, carbon sequestration, food quality, job creation…
- **However, certain specific practices need to be examined in more detail** and may represent red flags when assessing the overall impact of a target investee operations
- **These red flags can become genuine exclusion criteria** if a more in-depth due diligence determines an actual negative impact on local environmental and/or social conditions

**Illustrative examples of red flags criteria** *(not exhaustive, to be refined with scientists, sector representatives and experts)*

| | |
|---|---|
| **Destructive harvesting practices** | **Dredging for bivalve harvesting can cause severe habitat destruction,** disrupt seabed ecosystems and lead to biodiversity loss |
| **Unsustainable seed or juvenile sourcing** | **Some businesses may extract wild juvenile bivalves or seaweed spores in an unsustainable way,** affecting natural populations |
| **Excessive use of artificial inputs** | **Some seaweed farms may use chemical fertilizers** to boost growth, leading to eutrophication and negative water quality impacts |
| **Habitat displacement and conflict with protected areas** | **Farms located in e.g. seagrass meadows or key fish nursery areas may harm critical ecosystems** instead of enhancing them |
| **Poor waste and biosecurity management** | **Some farms may have inadequate waste handling,** leading to plastic pollution (e.g. from lines), invasive species spread, or disease outbreaks (e.g. bivalve pathogens) |
| **Lack of local benefit-sharing** | **If farms disrupt traditional fishing of fail to involve local communities,** they can create livelihood conflicts |

# Synthesis: operationalizing EIB's sustainability assessment strategy

**The Impact Due Diligence process will depend on the deployment strategy(ies) selected by the EIB for a specific investment**

| | |
|---|---|
| ***Direct EIB investment*** | In addition to specificities linked to bivalve and seaweed farming, to be aligned with broader existing EIB assessment methodologies |
| ***Deployment through MBIL mechanism*** | On a case-by-case basis, to be adapted to the sustainability framework agreed between the commercial bank and the EIB |
| ***Deployment through blended finance vehicle*** | Dedicate methodology to be developed by the fund management |
| ***Deployment through matching of crowdlending*** | In addition to specificities linked to bivalve and seaweed farming, to be aligned with broader existing EIB assessment methodologies |

**In any case, recognized certification standards provide a solid foundation on which to build the EIB's sustainability assessment strategy**

**5 international schemes** are used and recognized across the EU

**Additionnaly, 4 other schemes involved in bivalve and seaweed farming certification,** more specific in terms of geographical scopes, **are reported to have requirements aligned or superior to the EU Organic regulations**

**In the absence of certification or in case of doubt regarding a specific aspect for a certified company, more in-depth DD can assess the alignment of the target investee with the EIB's strategy**

**A first step here is to ensure that no red flag constitutes a genuine exclusion criterion.** Key red flags notably including *(to be refined with scientists, sector representatives and experts):*

- Destructive harvesting practices
- Habitat displacement and conflict with protected areas
- Unsustainable seed or juvenile sourcing
- Poor waste and biosecurity management
- Excessive use of artificial inputs
- Lack of local benefit-sharing

# Financing opportunities for EIB in support of sustainable seaweed and bivalve sectors in the EU, and criteria to ensure their sustainability

## APPENDIX

**March 2025**

Photo: Ocean Rainforest

# About the project team

## GSC Project team

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