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Deliverable 5.2

Summary of main challenges by subsector

Funded by the European Union under the Grant Agreement ID 101060703. Views and options expressed are however those of the author(s) only and do not necessarily reflect those of the European Union.

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Grant Agreement number	101060703
Project title	BlueBioClusters - Supporting European Coastal Regions in their transition to a sustainable blue bioeconomy
Deliverable title	Summary of main challenges by subsector
Deliverable number	D5.2
Deliverable version	Version I
Contractual date of delivery	31.01.2024
Actual date of delivery	31.01.2024
Document status	Final
Document version	1.0
Online access	Available in MS Teams for all project partners
Diffusion	Internal document
Nature of deliverable	Public
Work Package	5
Partner responsible	BBA - Associação Nacional para os Biorecursos Marinhos e Biotecnologia Azul
Contributing Partners	All partners
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Abstract	The summary of the challenges by subsector presents a joint baseline of data from several blue bioeconomy subsectors identified across regions and the identified main challenges and barriers for their growth and development
Keywords	Challenges, Blue Bioeconomy, Value Chain, Startups, Small & Medium Enterprise

HISTORY OF CHANGES		
Version	**Publication date**	**Changes**
1.0	31.01.2024	Initial version

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Table of contents

Acronyms

AKR	ASSOCIATION KLAIPEDA REGION
BBA	BLUEBIO ALLIANCE
BBC	BlueBioClusters
BioPark	TARTU BIOPARK
D	Deliverable
DBC	DE BLAUWE CLUSTER
EU	European Union
GDPR	General Data Protection Regulation
INNO	INNOVATUM
IOC	ICELAND OCEAN CLUSTER
KDMP	Knowledge and Data Management Plan
KU	KLAIPEDA UNIVERSITY
LEGASEA	BLUE LEGASEA
PMBA	POLE MER BRETAGNE ATLANTIQUE
PU	Public
R&D	Research & Development
SAMS	THE SCOTTISH ASSOCIATION FOR MARINE SCIENCE
SEN	Sensitive
SME	Small & Medium Enterprises
SUBNet	SUBMARINER Network for Blue Growth EEIG
T	Task
TRL	Technology Readiness Level
UTartu	UNIVERSITY OF TARTU
WP	Work package

Executive Summary

D5.2 presents a detailed list of challenges and barriers across blue biosector that hinder the growth of startups and SMEs operating in the field. The 'Summary of main challenges by subsector' shows the main constraints per subsector of blue bio startups and SMEs operating in the BBC regions.

This report is a joint effort of all BBC partners and external stakeholders operating in the blue bio subsectors. Desk research, collection of available literature, data from surveys conducted by BBC Partners and interviews under the BBC project have been included. The collected information was analysed and categorised to summarise the main challenges clearly.

D5.2 is an output of T5.2 of WP5 – '*5.2 – Understand Startups/SMEs needs/challenges in regions'* led by BBA and BioPark, with contributions from all BBC partners.

D5.2 aims to offer an overview of barriers to development and growth and to support further work in WP5 that is connected to the support of blue bio startups and SMEs through matchmaking and mentoring activities.

D5.2 includes the database, which is accessible to all BBC partners. While the database is grounded in WP5's tasks, it will provide other WPs with relevant data and an overview of the existing challenges in all BBC regions, which are relevant for the regional work on developing blue vision.

Introduction

Following the previous work developed under D5.1 that provided information about startups and SMEs operating in the blue bioeconomy sector, this report presents an overview of the challenges per blue bioeconomy subsector. This work will allow a better understanding of the obstacles to the subsectors' development and growth and promote effective matchmaking and mentoring in the upcoming tasks under WP5.

This report is based on T5.2, 'Understand Startups/SMEs needs/challenges in regions', and analyses the critical aspects of the relevant subsectors in each region to create a baseline to compare challenges and highlight the most critical ones in each subsector.

Understanding the main challenges and barriers is key to developing effective matchmaking and mentoring strategies and supporting regions in transitioning to more sustainable activities in blue bioeconomy sectors.

To properly perform BBC tasks and activities under WP5 in terms of (1) understanding startups/SMEs challenges in their regions, (2) creating a network to support them, (3) planning mentorship/matchmaking, and (4) creating capacity-building activities and co-creation workshops, there is a need to understand challenges and barriers across the subsectors operating in the targeted field. This allows us to go deeper into the analysis of the challenges faced by startups and SMEs to find their need for support.

Methodology

The methodology used to create this report is based on internal and external information. All partners collected information through their networks and regions, with the support of the task leader.

At the onset, it was necessary to standardise the nomenclature used during T5.2 in terms of 'type of challenges' and 'subsectors' to establish a common language and clarify concepts between all partners and external participants. The terminology used supports a clear categorisation and understanding of data and thus leads to more comparable results. A common categorisation is also very helpful in supporting decision- and policy-making, contributing to more effective implementation of strategies and plans to empower innovation agents in different EU countries.

Table 1. Terminology for subsectors and challenges

Subsectors	Challenges
Wild cultivation and harvesting	Legal & Regulatory
Aquaculture	Science
Processing	Technological needs
Blue biotechnology	Cooperation & Partnership
Research & development	Communication & Marketing
Industrial (equipment/services suppliers)	Market & Consumer Demand
	Funding & Investment
	Cost of Operations & Infraestructures
	Skills & Labour
	Environmental

Subsectors

Subsectors were identified based on the performed activities that are most representative across target regions in the BBC project. Therefore, subsectors were defined considering activities within value chains. Extra information regarding the bioresources used was added to contextualise the activities better and based on BBC D2.1, Report on Understanding Blue Bioeconomy Value Chains: fish, microalgae, macroalgae, bivalves, crustaceans, and marine bacteria.

Subsectors were identified as shown below:

- Wild cultivation and harvesting
- Aquaculture
- Processing
- Blue biotechnology
- Research & Development
- Industrial (equipment/services suppliers)

This approach, composed of subsector activities and bioresources, was applied to better understand the challenges within BBC regions: Belgium, Estonia, France, Iceland, Lithuania, Norway, Portugal, Scotland, and Sweden.

Challenges identified

Following this, challenge categories were defined as:

- **Legal & Regulatory**

This category encompasses legal frameworks and guidelines that can support (or hinder) and regulate the sector and its activities. These legal frameworks can be either regional, national, or transnational.

- **Science**

Challenges related to science are diverse and can occur in all subsectors and in different phases of the value chain but manifest mainly at the initial stage. These challenges can derive from innovative activities and new developments and be closely related to training, technology, and knowledge.

- **Technological needs**

This category of challenges is related to the available technological tools, methods, and infrastructures that can support the evolvement of the subsectors; these can be tangible or intangible, depending on internal or external sources impacting players that operate in the subsectors.

- **Cooperation & Partnership**

Cooperation and partnership include relations between different types of stakeholders operating in each subsector and its value chains, with direct or indirect impact on the activities in the sector. These partnerships and cooperation relations between stakeholders can be established at different levels in the sector and between subsectors, leading to more collaborative and joint strategies.

- **Communication & Marketing**

Communication and marketing activities are more related to the internal departments of the entities operating in the sector, such as communicating the added value of products to clients and markets and using marketing tools and strategies.

- **Market & Consumer Demand**

This category is external to companies and impacts the economic level of blue bio startups and SMEs. Understanding and matching the market is key to the success and growth of the blue bioeconomy sector.

- **Funding & Investment**

This category includes external financial aspects related to available funds dedicated to the blue bioeconomy sector that consider its needs and revenue streams from a short and long-term perspective. It includes regional, national, or transnational funds coming from private or public entities.

- **Cost of Operations & Infrastructures**

This category relies on company-internal economic and financial aspects linked to developing and adapting activities to match subsector and market needs, such as high installation costs, infrastructure, equipment, and operations.

- **Skills & Labour**

In this category, both internal and external perspectives can be considered. Internally, it includes human resources management, careers, and training. From an external perspective, it includes labour market rules and regulations.

- **Environmental**

This section includes environmental aspects that can constrain the activity of blue bio companies, as well as the challenges faced in the transition to more sustainable activities and strategies to reduce environmental impacts.

The information used in this summary was based on:

1) Previous work in the BBC project: D3.1 Data collection & monitoring for ES.
2) Ongoing work in the BBC project: D2.3 - Blue Bio Value Chains & Social Enterprises Cases' interviews.
3) Ongoing work in the BBC project: Ecosystem Services Knowledge Gaps in the Blue Bioeconomy's survey developed under T3.2. - Review valuation strategies for ecosystem services of blue bioeconomy.
4) Ongoing work in T4.3 – Establish Technology Needs in Regions.
5) Literature available per region and collected by all partners.
6) Partners' knowledge and experience are obtained from their work within BBC regions through a shared database.

For conducting the data collection, an Excel file and a shared folder were made available to all partners. Creating the matrix above to map all challenges allowed for better clarification and standardisation of all entries by each partner, providing a more accurate data analysis and more understandable results to form a common base and to compare results across partner regions.

T5.2 developed a joint baseline of data from selected blue bioeconomy subsectors in the regions to identify/understand the main challenges and barriers to development and growth. No specific surveys were created for this task to avoid task overload and stakeholder fatigue; however, it was assured that necessary information was collected in surveys performed in other BBC tasks, as previously mentioned. Additionally,

interviews done under other BBC tasks included specific questions to tackle the collection of challenges in subsectors.

A key success factor in pursuing T5.2 was the experience of each partner in their region. All partners have a broad perspective of their region and gave a broad overview of it based on their close work and mission within the region.

Along with developing the BBC project and the activities under WP5, this list will be further developed through an active engagement with the regions and a matchmaking process with new players operating in each region. Thus, this summary represents an ongoing database.

Summary of challenges

This chapter will present an overview of the main challenges identified in the BBC regions per subsectors based on the database included in Annex I. The presented results will highlight the main challenges faced per subsector across regions, including an additional summary per region. By having this complementary information per region, all partners will be given more concrete details on the specific challenges in the different regions and will be able to invest efforts in mitigating challenges per subsector. Furthermore, partners will be able to assess similarities and differences in the challenges faced by their region vis-à-vis other regions.

Legal & Regulatory

Regions face various legal and regulatory challenges, including the absence of a framework for seaweed cultivation, complex permitting processes, inequality among sectors, resistance to co-existence with offshore wind parks, and difficulties in addressing IP issues and regulatory constraints. Overcoming these challenges will necessitate streamlined regulations, increased coordination among authorities, and a supportive legal framework for sustainable blue bioeconomy development. Multiple factors are contributors to specific legal and regulatory hurdles in the regions, which are presented below:

Belgium:

- Sanitary zone regulations impose high sampling costs, complex and costly permitting procedures, and safety breaches by sailors/fishermen.
- Administrative complexity as responsibilities are scattered among regional and federal agencies.
- Very restrictive water use and discharge regulations for land-based aquaculture.
- Belgium is a small country with a high population, leading to a dense concentration of stakeholders in a small area. Also, the Belgian North Sea coastline is small but hosts multiple competing activities, leading to conflicts between stakeholders.
- Legal criteria for food restrictions for seaweed need to be revised to better correspond to reality.
- “Novel Food” Regulations can be demanding (time & financial) for new products.

Estonia:

- Need for establishing a carbon and nutrient quota system for aquaculture.
- Lack of political interest and will in supporting new economic sectors focused on restoring the natural environment.
- Unequal treatment of different sectors with sea-based aquaculture banned due to nutrient loading.
- Overregulation, slow licensing processes, and lack of support for small and medium-sized enterprises.
- Quotas setting upper production limits, lack of equality and slow environmental impact assessment processes.
- Coastal seas' management by local authorities faces resistance, and a lack of a clear, holistic view hampers the environmental impact assessment process.
- Need for (online) decision support tools is hindered by scarcity of necessary investment measures.

France:

- By-catch issues, strong sanitary and regulatory constraints, international competition, cumbersome regulations and coordination difficulties between national and regional levels.

Iceland:

- Lack of a legal framework for seaweed cultivation in Iceland's Exclusive Economic Zone (EEZ), hindering innovation and industry progress.

Lithuania:

- Uneven distribution of quotas, fishery restrictions, and a complicated management system with divisions between the Ministry of Agriculture and the Ministry of Environment.

Portugal:

- Complex licensing and legal/IP constraints hinder innovation and product development.
- Intellectual property issues, compliance difficulties, and complex certification schemes pose additional challenges.
- Lack of financial sector knowledge on blue bioeconomy aspects, difficulties in dealing with IP issues, and complex international or regional regulatory issues.

Norway:

- Consumer protection rules and regulations align with a traditional linear economic model, hindering the growth of circular value chains.
- Challenges in finding suitable support schemes for new forms of production.

Sweden:

- Limitations in the oyster industry due to restrictions on commercially harvested wild oysters. Export challenges due to the lack of testing resources for diseases like bonamiosis.

- Complicated permitting processes, lack of coordination among authorities and the need for a developed regulatory framework, particularly for co-existence with offshore wind parks.

Science

Across regions, the blue bioeconomy faces challenges in optimising resource utilisation. In Estonia and Sweden, issues include inefficient waste management and the need for advanced harvesting methods. Portugal encounters hurdles in replicating bioresources and faces human resource shortages. France struggles with intellectual property concerns and competitiveness, while Iceland and Norway grapple with technological gaps and environmental impacts. Streamlining processes, enhancing innovation, and fostering collaboration are vital for advancing sustainable practices.

Belgium:

- Difficulty finding valorisation for oyster shell waste.
- Finding the missing key between identification and understanding of the bio-activity mechanism of specific elements in blue organisms and their application for a high-end purpose (health, chemistry, agriculture, etc.).

Estonia:

- Challenges in developing low-trophic aquaculture solutions due to a scarcity of necessary investment measures.
- Emphasis on utilising all fish raw materials but hindered by a lack of information on waste management.
- Limited utilisation of furcellaran due to insufficient knowledge.
- Difficulties in fully utilising research and development efforts.
- Ineffectiveness in reducing nutrient flows from agriculture to the marine environment.

France:

- The confidentiality of intellectual property locks some solutions.
- Difficulty in ensuring the integration of innovation.

Lithuania:

- Low application of innovations and a lack of know-how at the development stage.
- Seasonality and unpredictability of production.

Portugal:

- Lack of capacity for bioresource replication and challenges in accessing water test facilities.
- Difficulty with separation and purification of downstream protocols, determining specific modes of action, discovering novel marine natural products and bioactives, safety and efficacy testing protocols and timeframes, innovating on

screening technologies and platforms, and determining correct formulation for future desired/predicted route of administration.
- Missing capacity to replicate bioresources in the laboratory, difficulty accessing water test facilities. Harvesting and sampling approaches are inadequate for biodiscovery.

Sweden:

- Struggles with waste valorisation and a need for technology to extract valuable products from side streams.
- Issues in mussel harvest methods and a necessity for research on reducing fouling.
- Testing challenges for algae blooms and the need for automated systems.
- Management of invasive species affecting mussel cultivation.
- Research gaps in understanding changing marine biological processes.

Technological needs

Several technological needs and challenges are evident across regions. Estonia faces a lack of appropriate technological solutions for nature-friendly aquaculture systems and fishing gear. Issues in fish stocks and the development of offshore wind farms highlight the need for advanced technologies. Hybrid parks integrating various aquaculture farms require increased transmission capacity for power lines. Additionally, Estonia emphasises the scarcity of necessary investment measures for sustainable technologies, including seaweed utilisation for fertiliser and agricultural growth substrate production.

Estonia:

- Lack of appropriate technological solutions hinders the development of nature-friendly aquaculture systems and fishing gears.
- Increasing the transmission capacity of power lines is crucial for the development of offshore wind farms and hybrid parks, combining different aquaculture farms.
- There is a need to develop sustainable technologies that allow the use of seaweed piled on the beach for fertiliser production.

France:

- Shellfish residues are difficult to mobilise, as these products are usually sold "whole".
- Loss of competitiveness for French companies: insufficient level of qualification in emerging technologies and insufficient transfer to industry.

Iceland:

- The scale of marine bacteria cultivation is currently low, and technology is challenging for scale-up of cultivation, although some of the research at the pilot scale is very advanced.
- Sea cage salmon farming challenges with fish escapes and the need for technological development.

Lithuania:

- Lithuania faces challenges in aquaculture due to the low diversity of cultured species, particularly catfish dominating in recirculating aquaculture systems (RAS), and low growth potential in pond aquaculture.

Portugal:

- Difficulty accessing robotics, ROVs, drones, sensor materials, and expertise.
- Difficulty accessing manufacturing facilities.
- Difficulty getting sustainable and reproducible batch supply (adequate culture/harvest, adequate manufacturing technologies, adequate volumes yield).
- Difficulty accessing facilities for prototyping and pilot scale units in local laboratory facilities for product development and prototyping.

Norway:

- Challenges in utilising fish stomach contents and technological innovations require significant investments.

Cooperation & Partnership

Challenges in cooperation and partnership are similar in some respects. Estonia faces challenges such as monopolistic business influence and lack of stakeholder cooperation, highlighting the need for an integrated approach across the blue economy sector; therefore, encouraging the development of a diverse range of blue economy companies is vital for sustainable growth. In Portugal, penetrating existing value chains and partnering with national and international players is challenging. Meanwhile, Lithuania and Belgium struggle with communication gaps and opposition from various local entities. Finally, France grapples with low equity for SMEs/startups, underscoring the importance of fostering horizontal integration throughout the industry chain.

Belgium:

- Complex interaction between stakeholders: fishermen, sailors, harbours, and municipalities, including potential legal actions.
- Fragmentation on production site (aquaculture, low number of companies, low number of productions), but high diversity of species (shrimps, fish, macroalgae, microalgae).

Estonia:

- Monopoly firms define business conditions.
- Lack of cooperation among many stakeholders.
- Non-integrated approach for forestry, agriculture, and blue economy.

France:

- Lack of vertical and horizontal integration.

- Need for promoting horizontal integration between all players in the industry chain, including research, innovation/transfer, industry, and consumers.

Lithuania:

- Difficulty bridging communication gaps and fostering collaboration between industry and scientific stakeholders.

Portugal:

- Difficulty penetrating existing value chains, need to create new value chains.
- Difficulty finding national and international cooperation partners.
- Lack of international business development support.
- Difficulty accessing incubation/office services and spaces.
- Barriers to national and international cooperation.

Communication & Marketing

When it comes to communication and marketing, regions face different challenges. Elevating the appeal of novel dishes that include blue bioresources is needed through marketing strategies. A lack of effective communication to establish a clear understanding between stakeholders is also observed.

Belgium:

- An onsite information portal on oyster farming for tourists would require investment in technology and educational content to enhance tourists' understanding of oyster farming.
- Making aquaculture products more well-known and appealing to consumers.

Estonia:

- Elevating the appeal and popularity of fish dishes requires a comprehensive marketing strategy to highlight their nutritional benefits and cultural significance.

Iceland:

- Hurdles in the transformation, purification, and marketing of pelagic fisheries involve addressing taste and smell profiles to meet consumer preferences.

Lithuania:

- Lack of communication and collaboration with science and other stakeholders.
- Gaps in communication between scientific communities to foster collaborations.

Norway:

- Consumers lack reliable information about the environmental properties of products, leading to potential greenwashing.

Portugal:

- Difficulty reaching out to clients (implementing targeted digital marketing campaigns and forming partnerships with local outlets).
- Difficulty in communicating the added value of the product to clients.
- Lack of marketing tools and capacity development.
- Lack of effective communication and strategic messaging to convey unique selling points about the added value of products.
- Underdeveloped marketing tools to enhance the ability to effectively reach and engage with clients.
- Need for transparent communication about new packaging and eco-friendly alternatives to influence consumer behaviour.

Sweden:

- The absence of collaboration among producers for effective communication causes misinformation that could hinder market uptake.
- Clear guidelines on iodine and cadmium content are lacking, requiring collaboration between authorities and the industry to develop relevant food safety guidelines.
- Non-accurate information to consumers about the health aspects of macroalgae and nutritional guidelines.

Market & Consumer Demand

Challenges in market demand and consumer awareness vary across regions, including issues related to the perception of specific products, packaging, knowledge gaps, social recognition, international competition, and the need for regulatory adjustments to accommodate emerging production forms. Addressing these challenges involves targeted marketing strategies, consumer education, and adaptation of regulatory frameworks to support innovation and growth in the blue bioeconomy.

Belgium:

- The small, diverse composition of producers makes it difficult to support a wider marketing campaign, while financial budget is limiting for those local producers to have specific marketing.
- Belgium imports a very high number of their seafood (covering 80% of consumption) and Belgian production scale is small making it difficult to compete with foreign produce. The perception of local aquaculture is mostly influenced by foreign aquaculture.

Estonia:

- Developing the mussel market within the feed industry: market pathways and applications are at an early stage.
- Lack of social recognition in rewarding the environmental and health benefits of macroalgae cultivation.

France:

- International competition in mass value-added products, particularly in animal feed and pet food.
- The replacement of piscicultural materials with those of plant, algae, and insect origin.

Iceland:

- Iceland's small market size poses challenges for companies looking to scale up and develop an international consumer segment.
- Challenges in the transformation, purification, and marketing of pelagic fisheries include addressing taste and smell profiles to meet consumer preferences.

Lithuania:

- Low local market capacity for both aquaculture and fisheries production. Lack of social recognition in aquaculture production.
- Public awareness.

Norway:

- Limited demand, particularly for local oil and flour mills.
- Small volumes and lack of profitability necessitate more stable and larger supply for successful utilisation.
- New forms of production struggle within the existing regulatory framework, requiring adjustments to facilitate their integration.

Portugal:

- Lack of market demand for innovative added-value products. Difficulty in determining real market needs, building consumer awareness, developing business plans and aligning consumer/market demands with production limitations. Competition from similar products adds to the challenge.
- Need for assistance in defining and developing business models.

Sweden:

- Low demand due to public perception of oysters as "luxury" food, along with low consumer awareness of the local native species. Packaging materials like plastic nets for sale to final consumers pose challenges such as leaking and emitting odours. Testing various consumer packaging alternatives to enhance attractiveness and ease of use is necessary.
- Limited consumer knowledge about macroalgae as a blue food, including preparation and consumption methods. A shortage of growers and manual cultivation methods hinder large-scale production, making it challenging to meet attractive price points for food industry producers.

Funding & Investment

The regions face diverse funding challenges, including limited capital availability, complexities in funding mechanisms, reluctance from investors due to industry-specific hurdles, and the need for innovative financing models. Addressing these

challenges requires targeted support, streamlined funding mechanisms, and increased awareness of available financial resources. Long-term investments and innovative investor profiles are needed to embrace the challenges presented in this summary. Estonia and Lithuania face limited capital resources, and in Portugal and France, attracting investment is difficult. Investing in digital technologies is a trend, and in Belgium, a digital platform is needed to foster oyster farming perception. Supportive finance instruments for innovative and circular businesses are needed in Norway and Sweden.

Belgium:

- An onsite information portal on oyster farming for tourists would require investment in technology and educational content to enhance tourists' understanding of oyster farming.
- Land-based aquaculture is considered a high risk with a slow return on investment, which makes it difficult to get funding (investors) or bank loans, and insurance is costly for offshore activities.

Estonia:

- Estonia has a limited amount of capital for blue bioeconomy initiatives.

France:

- Onshore processors in France find it difficult to organise and are reluctant to invest in additional capacity for processing discharges into the sea (viscera, by-catch, etc.).

Lithuania:

- Limited financial resources, non-competitive salaries, complicated and insufficient funding possibilities, and domination of traditional pond aquaculture with better investment conditions.

Norway:

- Limited access to capital for new circular value chains hampers growth.
- Challenges in finding suitable support schemes for policy instruments and an incentive structure not promoting circular products contribute to the struggle.

Portugal:

- Portugal faces complex funding mechanisms, expensive access to the ocean, and reduced cost-efficiency for discovering natural marine products and bioactives.
- Difficulty in attracting reliable funding and inability to match desired price tags per unit.
- Need for assistance in attracting and securing funding, lacking knowledge of available funding mechanisms and facing difficulties accessing public grants and private investment. The absence of dedicated or suitable crowdfunding platforms adds to the challenge.

Sweden:

- Innovation financing is needed to find uses for side streams from macroalgae processing. Land-based aquaculture requires capital, but few investors in Sweden have experience in aquaculture and are hesitant due to the industry's complicated permit processes.
-

Cost of Operations & Infrastructures

The challenges across regions include energy costs, political interest, infrastructure limitations, high operational costs, and the need for better processing technologies. Addressing these challenges requires a holistic approach, increased awareness, streamlined regulations, and innovation and infrastructure development support. Like Lithuania, Belgium faces high installation and operational costs with low-profit margins, and in Portugal, access to the ocean is difficult and costly. In general, infrastructure costs are high and challenging in all regions, but different challenges were observed in the regions due to their peculiar characteristics.

Belgium:

- High installation and operational costs with low-profit margins (land-based as offshore).
- Reduction in fishing fleet: the fishing fleet has shrunk by 50% in the last 20 years, impacting the industry.

Estonia:

- Difficulties with moderate political interest in transitioning to green energy due to capital-intensive nature and challenges in obtaining permits.
- Low power line transmission capacity for reliable large-scale electricity supply.
- Port infrastructure meeting blue economy needs.
- Political resistance to granting more powers to local authorities.
- High operating costs and lack of winter storage capabilities.
- Absence of holistic approach to infrastructure: lack of awareness and knowledge among citizens and politicians.
- Despite well-functioning infrastructure, there is a need for increased awareness and knowledge, streamlined regulatory processes, and support for the capital-intensive sector.

Iceland:

- Limited and challenging cultivation of bivalves in ocean space.
- Infrastructure and expertise limitations in this field hinder growth.

Lithuania:

- High installation, energy and operational costs coupled with low profitability of products and limited growth potential in the sea aquaculture sector.
- The fishing fleet is old and inefficient, impacting overall productivity.

Portugal:

- Logistics are too complex or heavy.
- Access to the ocean is difficult or expensive.

Sweden:

- Inefficiency in processing technology and energy. High costs associated with processing due to the need for better technology and energy-efficient drying methods.
- Companies face difficulties scaling operations due to manual and heavy harvest techniques and high equipment costs.
- Side streams in production processes are treated as waste, incurring additional costs due to lack of utilisation.

Skills & Labour

The activities performed by human labour need adequate skills; however, skills in marine sciences and an educational framework that could match these needs are lacking in the regions. Estonia, Lithuania, and Portugal are the main regions facing low attractive labour conditions and a lack of employees able to work in the field. Challenges can be grouped in terms of workforce and training, economic and education policy, and marine education.

Belgium:

- Challenges in finding skilled labour for aquaculture (missing formation, not well paid).

Estonia:

- Challenges in finding skilled labour in rural areas.
- Lack of satisfactory working conditions, safety procedures, and training possibilities.
- Salaries are not competitive.
- Need for regional education policy development.
- Lack of research and education infrastructure.
- Lack of systematic maritime primary education.
- Challenges in establishing maritime education curricula at various levels.

Lithuania:

- Lack of competent employees and professionals capable of attracting funding.
- Slow growth in scale and low intention to work in rural areas.
- Salaries are not competitive.
- Staff is old and not changing.

Portugal:

- Difficulty in hiring specialised human resources and lack of innovation departments/staff.

- Unawareness of scientific techniques or specialised services that could be helpful, lack of necessary skills or specialised training, lack of knowledge on how to innovate, unawareness of international or regional regulation issues.
- Difficulty in accessing training and education tailored to individual needs.

Environmental

Environmental challenges are mainly related to the impact of industries on the ecosystem, as mentioned by Estonia, Sweden, Scotland, and Belgium regarding water quality. Additionally, the impact of emissions and energy consumption was highlighted in the Estonian region. In general, environmental considerations are taken into account only by a part of the stakeholders, not the entire ecosystem. The absence of support for policies and economic alignment to promote more sustainable and circular activities is also being felt.

Belgium:

- Difficulties in seaweed farming integration due to water quality.
- Environmental disasters have high financial risk in case of storms or diseases.

Estonia:

- Water quality issues affecting fish farming.
- Companies have a high environmental impact due to the lack of emission quotas.
- Mismatch between traditional aquaculture objectives and current environmental policies.
- Challenges in linking natural reserve creation for carbon and nutrient sequestration potential.
- Focus on enhancing access to ecosystem services.
- Non-establishment of a Baltic Sea Centre for the Blue Economy.

Lithuania:

- Environmental impact in pond aquaculture.

Scotland:

- Lack of a vision for blue bioeconomy with social, economic, and environmental factors.
- Concerns about sea water rearing and sea lice, with emphasis on environmental aspects such as water quality.

Detailed information on BBC regions within these categories is presented in Annex I.

Discussion of the results

Given the above, it can be stated that regulation frameworks are aligned with a traditional linear economic model, not fitting some barriers and impacting other identified barriers such as (1) externalities, i.e., costs that a company imposes on other

actors, which are not internalised due to the absence of regulations or financial incentives from the authorities, (2) regulations or other policies that prevent investments because they are cost-driving or create increased risk, (3) untapped economies of scale, (4) economic risk due to thin markets, supplier or buyer market power (e.g. monopoly), specific investments with little to no alternative uses, and (5) need for technological innovations that require significant and risky investments.

The absence of a comprehensive regulatory framework and supportive policies poses a significant obstacle. This includes streamlining permitting processes, establishing clear guidelines for sustainable resource utilisation and creating a more responsive system. Additionally, depending on the biomass and how it is produced inland or offshore, production faces different hurdles in terms of cost of production and infrastructure. Unequal treatment across sectors, a lack of policy framework for sea-based activities and limited governmental support for small and medium-sized enterprises contribute to regulatory challenges. Moreover, slow and complex licensing processes and production limits through quotas hinder the effective management of coastal seas. Regulations related to marine spatial planning, environmental impact assessments, licensing, and permits must be comprehensive, transparent, and adaptive to ensure sustainable development. Complicated and fragmented legal and regulatory frameworks requiring multiple authorities' approvals and long and costly application processes for blue bio-based companies wanting to start their enterprise or expand are major challenges hindering industry growth. Establishing an enabling regulatory framework that supports the development of the blue bioeconomy is essential. Overall, the lack of a clear, holistic view coordinating blue economy activities combined with inadequate investment measures further complicates the regulatory landscape.

Abreast with regulation, limited funding and economic resources contribute to difficulties in achieving economies of scale, as more favourable regulatory frameworks are needed to provide financial incentives for investments in blue bioeconomy ventures. Accessing sufficient capital for investment in research and development, infrastructure, and technology can be challenging. Securing long-term funding is vital to support the growth and sustainability of blue bio-based companies. Investments in infrastructure and process technology are needed to increase efficiency and reduce sustainability impacts in all areas of biomass production, harvest, and processing (manual harvest methods, diesel boats, high energy use). However, securing capital and investment for new and innovative ventures is challenging, as these are seen as high risk. Government economic support is limited, and private investment is unfamiliar with investing in this industry sector.

Another impactful challenge is the limited access to pre-existing infrastructures such as labs, ports, maritime offshore platforms, and land and sea connections, which requires increased collaboration between academia, industry, and government bodies to foster knowledge exchange and technology transfer. Thus, cooperation and collaboration were mentioned as crucial to establishing strategic partnerships and collaborations with neighbouring countries, international stakeholders, and market intermediaries to enhance market access and promote value chain integration. Establishing appropriate infrastructure for processing and adding value may face limitations, given the seasonality and unpredictability inherent to production. Developing the blue bioeconomy requires the necessary infrastructure for efficient and sustainable production, processing, and transportation. Cooperation actions often

focus on improving networking and communication among parties, which facilitates access to pilot and upscale. However, cooperation activities must go beyond this to promote specific research, development and innovation across the value chains.

Improving cooperation among numerous stakeholders, including authorities, is vital to face low market maturity and awareness for blue bio-based products. Challenges lie in communication and marketing aspects due to the lack of social recognition of the advantages of blue bio-based products. Developing and diversifying markets for blue bio-based products can be a challenge. Legal and regulatory actions associated with improved product market access rules are important to step in value chains. Generating sufficient demand, creating consumer awareness, and effectively marketing these products require targeted strategies and stakeholder collaboration. Measures to improve the market situation for secondary raw materials must be improved. Promotion of material recovery or reusing of coproducts is necessary because a communication challenge is based on consumers lacking reliable and relevant information. Another challenge is that consumers are exposed to commercial practices that are deceptive and confusing and weaken their motivation to buy sustainable products (ex: greenwashing). Challenges are also linked to the regulatory field in enforcing existing consumer protection rules in this area. Current regulations largely require a concrete assessment on a case-by-case basis of what information consumers can expect. Lack of standards and guidelines for food producers and consumers are limiting the market demand. Common guidelines are needed to create trust among food producers and meet potential consumer questions.

Technical and scientific challenges in the blue biosector encompass the development of solutions throughout the value chain, hindered by a scarcity of necessary investment measures. For example, the utilisation of all fish raw materials faces obstacles upstream due to a lack of information on collecting fish skins and uncertainty about what to do with leftover bones and heads from primary processing. Valorising products and improving methods across value chains are crucial for preserving coastal bioresources for future generations and developing sustainable technologies. Enhancing infrastructure and technology to achieve efficient and sustainable harvesting, processing, and utilisation of marine resources is crucial.

At the same time, capacity building represents a challenge for blue bio companies. Some barriers include a lack of bioeconomy teaching modules, difficulties finding skilled labour, and unsatisfactory rural working conditions. Safety procedures, training possibilities, and competitive salaries are also lacking and encountered obstacles related to regional education policy, and infrastructure. Establishing a proficient workforce through educational and training initiatives to bolster the expansion and sustainability of the blue bioeconomy sector is crucial. Challenges in this regard include a scarcity of capable individuals adept at securing funding, an ageing and static staff, a shortage of skilled employees, and a diminished interest in working within rural areas.

Additionally, environmental challenges are now being mentioned due to the high impact of blue bio subsectors and their activities. There's a mismatch between traditional linear blue bioeconomy models and environmental policy objectives. In general, economic activity development faces cross-sectorial environmental considerations, and the lack of public programmes and fiscal capacity for testing new circular solutions is insufficient. Additionally, nature reserve creation should align with the carbon and nutrient sequestration potential, and broader marine education

curricula are hindered by intensity and resource constraints. Lack of knowledge about the effects of climate change on aquaculture, such as increasing water temperature, ocean acidification, and extreme weather events, are also relevant factors. More science and research are needed to better understand the factors that can impact the health and growth of aquaculture and farmed species that are critical for industry growth.

Conclusion

The blue bioeconomy is a significant pathway for sustainable development, yet it encounters various environmental, socio-economic, technical, and management obstacles that hinder advancements in multiple subsectors. The main challenges include the need to overcome obstacles related to market access, national and international regulations, funding and trade barriers to boost the export of blue bioproducts. These challenges cannot be tackled independently since they have effects on each other and are related. Therefore, a holistic view of the different challenges is key to understanding each region as a whole. Hurdles in one category can impact others.

The conducted summary of challenges in blue bio subsectors of BBC regions intends to be a supportive database for the upcoming activities under WP5 and throughout the entire BBC project. A significant range of challenges were mapped per region considering the relevant subsectors. Generally, it was possible to classify the challenges into groups which allows for a closer look at the categories of analysis, as well as support and define more focused and targeted matchmaking strategies to promote the economic growth of blue bioeconomy. In addition, this analysis allowed us to see how these categories are related and their impacts across different subsectors.

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Annex I

Country	Sector	Value Chain (biomass)	Challenges	Description of specific challenge
Belgium	Wild cultivation and harvesting	bivalves	Legal & Regulatory	Regulations regarding sanitary zones: high cost for sampling "shellfish area" is passed to the producer.
Belgium	Wild cultivation and harvesting	bivalves	Science	Difficult to find valorisation for oyster shells waste.
Belgium	Wild cultivation and harvesting	bivalves	Environmental	Integration of seaweed farming is difficult because of water quality.
Belgium	Wild cultivation and harvesting	bivalves	Communication & Marketing	Onsite information portal on oyster farming for tourists.
Belgium	Wild cultivation and harvesting	bivalves	Legal & Regulatory	Complex and costly permitting procedure (incl. SEA).
Belgium	Wild cultivation and harvesting	bivalves	Cooperation & Partnership	Opposition from fishermen, sailors, harbour, and municipality (incl. juridical procedures).
Belgium	Wild cultivation and harvesting	bivalves	Legal & Regulatory	Safety breaches of aquafarm by sailors/fishermen.
Belgium	Wild cultivation and harvesting	bivalves	Cost of Operations & Infraestructures	High installation and operational costs, low profit of product.

Belgium	Wild cultivation and harvesting	bivalves	Environmental	High financial risk in case of storms or diseases.
Belgium	Wild cultivation and harvesting	bivalves	Legal & Regulatory	Administrative complexity as responsibilities are dispersed among regional and federal agencies.
Belgium	Wild cultivation and harvesting	fish	Market & Consumer Demand	Small, diverse composition of producers; small production (little country with high density population), high level of knowledge.
Belgium	Wild cultivation and harvesting	fish	Legal & Regulatory	High level of knowledge (pioneers in ofshore extractive aquaculture), small coastline, small offshore area and a lot of other activities in the offshore.
Belgium	Wild cultivation and harvesting	fish	Cost of Operations & Infraestructures	Small fishing fleet, reduced in 50% in last 20 years.
Belgium	Wild cultivation and harvesting	oyster	Funding & Investment	Onsite information portal on oyster farming for tourists requires investment in technology and educational content to enhance tourists' understanding of oyster farming
Estonia	Across sectors	fish	Communication & Marketing	Increasing the popularity of fish dishes.
Estonia	Wild cultivation and harvesting	fish	Skills & Labour	Coastal fisheries must survive and thrive. Young people are not coming up, and traditions are being lost. Training for beach fishermen can be done in Hiiumaa, but not in Saaremaa/there is no time to go there/training is free of charge.Fishing permits are valid for a limited period (7 days), but due to weather conditions it is not always possible to go out to sea on certain days. Uncertain where to fish.
Estonia	Aquaculture	fish	Legal & Regulatory	Establishment of a carbon and nutrient quota system for aquaculture. Lack of political interest in Estonia, with managers believing that new economic sectors that restore the natural environment must be able to manage on their own without state support.
Estonia	Aquaculture	fish	Science	There is a need to develop low-atrophic aquaculture solutions along the entire value chain.

Estonia	Processing	fish	Science	ack of information on the collection of fish skins. Do not know what to do with bones, heads and other parts of the fish left over from primary processing. All fish raw materials have value and processed. A fish sector without waste.
Estonia	Research & development	fish	Science	Lack of knowledge for wider use of furcellaran.
Estonia	Aquaculture	fish	Technological needs	Lack or scarcity of appropriate technological solutions. Nature-friendly aquaculture systems need to be developed.
Estonia	Wild cultivation and harvesting	fish	Technological needs	Lack or scarcity of appropriate technological solutions. There is a need to develop nature-friendly fishing gears.
Estonia	Wild cultivation and harvesting	fish	Technological needs	Fish stocks need improvement. No fish, no perch (Perca fluviatilis) in many coastal areas.
Estonia	Wild cultivation and harvesting	fish	Legal & Regulatory	The possibility of coastal fishing must be preserved for future generations.
Estonia	Industrial (equipment/services suppliers)	fish, algae	Cost of Operations & Infraestructures	Difficulties in switching to green energies. Low transmission capacity of power lines.
Estonia	Industrial (equipment/services suppliers)	fish, algae	Cost of Operations & Infraestructures	Reliable independent large-scale electricity supply.
Estonia	Industrial (equipment/services suppliers)	fish, algae	Cost of Operations & Infraestructures	Port infrastructure meets the needs of the Blue Economy.
Estonia	Wild cultivation and harvesting	fish, algae	Legal & Regulatory	Offshore production would stay in the local community (YIMBY). At the moment, there is practically no political will to give local authorities more powers.

Estonia	Research & development	fish, algae	Legal & Regulatory	University campus that would be managed by all Estonian univeristies.
Estonia	Research & development	fish, algae	Skills & Labour	Salaries are not competitive .Lack of research and education infrastructure, regional education policy needs to be developed.
Estonia	Research & development	fish, algae	Skills & Labour	Lack of research and education infrastructure, regional education policy needs to be developed.
Estonia	Research & development	fish, algae	Skills & Labour	Systematic maritime primary education.
Estonia	Industrial (equipment/services suppliers)	fish, algae	Technological needs	Offshore wind farms. Low transmission capacity of power lines.
Estonia	Aquaculture	fish, algae	Technological needs	Hybrid parks combining different aquaculture farms. Low transmission capacity of power lines.
Estonia	Aquaculture	fish, bivalves	Cooperation & Partnership	Monopoly firms define the general conditions of the business.
Estonia	Aquaculture	fish, bivalves	Cooperation & Partnership	Lack of cooperation between to many stakeholders including authorities.
Estonia	Aquaculture	fish, bivalves	Cost of Operations & Infraestructures	High operating costs and lack of storage capabilities in winter period.
Estonia	Aquaculture	fish, bivalves	Funding & Investment	Limited amount of capital.

Estonia	Aquaculture	fish, bivalves	Legal & Regulatory	Different sectors are not treated equally, no policy framework.
Estonia	Aquaculture	fish, bivalves	Legal & Regulatory	Governmental does not support small and medium sized enterprises: few regulations on the emergence of monopoly firms, restrictive conditions and quotas, over regulating and licensing.
Estonia	Aquaculture	fish, bivalves	Environmental	Water quality is bad and fish farming is impossible. Difficult to minimize nitrogen emissions; developing a harvester tailored for small-sized mussels; economically more sustainable if the mussel farm is handled by a mussel farmer.
Estonia	Aquaculture	fish, bivalves	Environmental	Companies have a high environmental impact, no existing system of emission quotas, entrepreneurs are not motivated to reduce emissions.
Estonia	Aquaculture	fish, bivalves	Environmental	Need to produce optimal amounts all year round to be competitive, there is a mismatch between the objectives of traditional aquaculture and those of current environmental policy.
Estonia	Aquaculture	fish, bivalves	Legal & Regulatory	Lack of systematic veterinary service.
Estonia	Aquaculture	fish, bivalves	Legal & Regulatory	Lack of systematic fish breeding.
Estonia	Aquaculture	fish, bivalves	Skills & Labour	Need for better bioeconomy teaching modules at universities.
Estonia	Aquaculture	fish, bivalves	Skills & Labour	Challenging to find employees in rural areas. Skilled labour, education and training programs are needed.
Estonia	Aquaculture	fish, bivalves	Skills & Labour	Lack of satisfactory working conditions in rural areas.

Estonia	Aquaculture	fish, bivalves	Legal & Regulatory	Lack of safety procedures.
Estonia	Aquaculture	fish, bivalves	Skills & Labour	Lack of training possibilities.
Estonia	Aquaculture	fish, bivalves	Science	Under utilisation of R&D.
Estonia	Processing	macroalgae	Communication & Marketing	Lack of social recognition in rewarding the benefits of macroalgae cultivation.
Estonia	Processing	macroalgae	Cost of Operations & Infraestructures	Difficulties in switching to green energies.
Estonia	Processing	macroalgae	Funding & Investment	Limited amount of capital.
Estonia	Processing	macroalgae	Legal & Regulatory	Quotas set upper limits of production.
Estonia	Processing	macroalgae	Legal & Regulatory	Lack of equality between individuals.
Estonia	Processing	macroalgae	Legal & Regulatory	Overregulation: licencing is too slow and complex.
Estonia	Processing	macroalgae	Skills & Labour	Lack of satisfactory working conditions in rural areas.

Estonia	Processing	macroalgae	Skills & Labour	Lack of safety procedures.
Estonia	Processing	macroalgae	Skills & Labour	Lack of training possibilities.
Estonia	Processing	macroalgae	Environmental	Companies have a high environmental impact, no existing system of emission quotas, entrepreneurs are not motivated to reduce emissions.
Estonia	Processing	macroalgae	Environmental	Water quality is bad and many sea based activities are banned.
Estonia	Processing	macroalgae	Skills & Labour	Need for better bioeconomy teaching modules at universities.
Estonia	Processing	macroalgae	Skills & Labour	Challenging to find employees in rural areas.
Estonia	Processing	macroalgae	Skills & Labour	Salaries are not competitive.
Estonia	Processing	macroalgae	Legal & Regulatory	Economic problems in times of crisis.
Estonia	Processing	macroalgae	Science	Difficulties to valorize products.
Estonia	Processing	macroalgae	Science	Difficulties to valorize products.

Estonia	Processing	macroalgae	Technological needs	There is a need for the development of sustainable technologies that allow the use of seaweed piled on the beach for fertiliser production.
Estonia	Processing	macroalgae	Technological needs	Underdeveloped IT solutions in rural areas.
Estonia	Across sectors	not specified	Cooperation & Partnership	There is a need to address forestry, agriculture and the blue economy as an integrated concept, lack of political interest in setting up such an integrated approach, limited expertise in assessing cross-sectoral impacts.
Estonia	Across sectors	not specified	Cooperation & Partnership	There should be many blue economy companies.
Estonia	Industrial (equipment/services suppliers)	not specified	Cost of Operations & Infraestructures	Infrastructure: Well-functioning infrastructure (harbours, internet, electricity); keep as much of the wind energy value chain as possible in Estonia; wind farms supporting marine life (artificial reefs on sand bottoms).
Estonia	Wild cultivation and harvesting	not specified	Legal & Regulatory	Coastal seas must be managed by local authorities. There is practically no political will to give local authorities more powers.
Estonia	Across sectors	not specified	Legal & Regulatory	Currently, there is no clear holistic view on the coordination of blue economy activities. The environmental impact assessment process must be faster.
Estonia	Across sectors	not specified	Legal & Regulatory	Given the rapid pace of scientific and technological development and the complexity of the natural environment, there is a need for (online) decision support tools to help guide the various blue economy initiatives.
Estonia	Across sectors	not specified	Funding & Investment	The development of economic activities must be based first on environmental considerations, as the state of the natural environment determines future economic potential. In Estonia, there are very few public programmes that, through targeted investments, support the development of maritime solutions in a way that balances environmental interests. Solutions often remain at laboratory and/or small-scale pilot level, and companies do not have the fiscal capacity to test these solutions in a real economic environment.
Estonia	Wild cultivation and harvesting	not specified	Science	The creation of nature reserves must be based on the carbon and nutrient sequestration potential of habitats. Carrying out relevant research and linking the results to environmental objectives.

Estonia	Across sectors	not specified	Skills & Labour	Developing broader curricula for hands-on maritime education in schools. Curricula too intensive, no time to study alternative subjects. Schools do not have the resources to use chartered buses to travel further afield. This is expensive for parents.
Estonia	Research & development	not specified	Skills & Labour	A broad-based (from biology to technology) maritime education curriculum for Saaremaa.
Estonia	Wild cultivation and harvesting	not specified	Skills & Labour	Skipper training in Saaremaa.
Estonia	Across sectors	not specified	Skills & Labour	Opening of a maritime class at the Saaremaa State Gymnasium.
Estonia	Research & development	not specified	Science	Creation of a blue bio-economy centre of excellence in Saaremaa
Estonia	Wild cultivation and harvesting	not specified	Environmental	The sea should be clean and rich in species (blue-green algae, paraffin and other contaminants).
Estonia	Across sectors	not specified	Cooperation & Partnership	Establishment of a Baltic Sea Centre for the Blue Economy.
Estonia	Across sectors	not specified	Communication & Marketing	Tourism: developing tourism, extending the season, better marketing of local produce, higher incomes for locals - higher added value of products and services.
Estonia	Across sectors	not specified	Environmental	Significantly reduce nutrient flows from agriculture to the marine environment, allowing for improved development of different uses of the sea (tourism, aquaculture, etc.). The implementation of existing measures is too ineffective. The environmental constraints on land and sea are different with the terrestrial sector having a significant advantage over maritime economic initiatives.
Estonia	Wild cultivation and harvesting	macroalgae	Market & Consumer Demand	Lack of social recognition in rewarding the environmental and health benefits of macroalgae cultivation.

France	Wild cultivation and harvesting	bivalves	Technological needs	Shellfish residues is difficult to mobilize as these products are sold "whole".
France	Wild cultivation and harvesting	fish	Science	Some of the viscera are thrown back into the sea because their commercial value is too low and they are highly perishable and highly perishable.
France	Wild cultivation and harvesting	fish	Legal & Regulatory	By-catch: undersized fish, for species under quota or minimum catch size.
France	Wild cultivation and harvesting	fish	Funding & Investment	Onshore processors are finding it difficult to get organized, and are reluctant to invest in the immediate future in additional capacity to process discharges into the sea (viscera, by-catch, etc.).
France	Wild cultivation and harvesting	fish	Legal & Regulatory	Reorganizing the industry, fully integrating the valorization of co-products, and improving cross-functional coordination.
France	Wild cultivation and harvesting	fish	Science	Ensuring the integration of innovation.
France	Wild cultivation and harvesting	fish	Legal & Regulatory	Strong sanitary and regulatory constraints, particularly with regard to co-products and "waste".
France	Wild cultivation and harvesting	fish	Market & Consumer Demand	International competition on mass value-added (animal feed, pet food).
France	Wild cultivation and harvesting	fish	Market & Consumer Demand	Replacement of materials of piscicultural origin by materials of plant, algae and insect origin (insects proteins, oils, bioactives).
France	Wild cultivation and harvesting	macroalgae	Market & Consumer Demand	Contrary to the dominant situation worldwide, where seaweed farming accounts for 93% of total algae production, this activity is very limited in France.

France	Wild cultivation and harvesting	macroalgae	Legal & Regulatory	International competition from Asia (food and chemicals) American and Western (chemicals/cosmetics).
France	Wild cultivation and harvesting	macroalgae	Legal & Regulatory	Cumbersome regulations, particularly concerning administrative authorization procedures.
France	Wild cultivation and harvesting	macroalgae	Science	The confidentiality of intellectual property, which locks some solutions.
France	Wild cultivation and harvesting	macroalgae	Technological needs	Loss of competitiveness for French companies: insufficient level of qualification in emerging technologies and insufficient transfer to industry.
France	Blue biotechnology	not specified	Funding & Investment	Low equity, no sales for smes or startups.
France	Blue biotechnology	not specified	Cooperation & Partnership	Lack of both vertical and horizontal integration.
France	Blue biotechnology	not specified	Cooperation & Partnership	Horizontal integration between all players in the "chain" (research, innovation/transfer, industry, consumers).
France	Research & development	not specified	Legal & Regulatory	Problems of coordination and cooperation exist both between the national level and the regions, and between the regions themselves: governance difficulties, tangled systems. These are mainly due to the context of inter-regional competition; insofar as certain regional policies aim to attract companies likely to change location.
Iceland	Wild cultivation and harvesting	macroalgae	Legal & Regulatory	There is currently no legal framework in Iceland for the cultivation of seaweed in the EEZ- there are pilot projects and there is wild harvesting as well as R&D work occuring for carbon capture seaweed cultivation but without the legal framework, the innovation and industry is being held back.
Iceland	Wild cultivation and harvesting	bivalves	Cost of Operations & Infraestructures	Very limited and challenging cultivation of bivalves in ocean space and there is some small scale landbased cultivation of Abalone which is doign well, but the scale, infastrcuture and expertise for this field is still a limiting factor in Iceland. The health of the wild population of Scallops too has kept this fishery small in recent years.

Iceland	Processing	fish	Communication & Marketing	This is particularly for the pelagic fisheries as the whitefish are very advanced, but there are more challenges in the transformation, purification and also marketing of products from these fattier pelagic fish such as Mackrel that have a strong taste and smell profile for the consumer.
Iceland	Wild cultivation and harvesting	fish	Technological needs	Sea cage salmon farming in Iceland faces some challenges related to the escapes of farmed fish into the wild, bad for environment and company image that require improve prevention and management technologies to reduce the risk and impact of such events.
Iceland	Processing	fish	Technological needs	Infastructure limited by scale - for sludge and mortalities from salmon aquaculture - primarilry now hydrolysed and shipped to other countries where infastructure exists for value creation from these side streams, or in the case of sludge - lost to the ocean - there a some pilot projects and a lot of R&D work ongoing for landbased aquaculture sludge treatments for biofuel and fertiliser.
Iceland	Blue biotechnology	crustaceans	Cooperation & Partnership	Supply of raw materials - successful companies in Iceland have developed a whole range of great products from crustcean shells - but now must source shells from overseas as volumes in Iceland fairly small....nearby potential sources currently do not retain or land the shells in many cases.
Iceland	Blue biotechnology	bacteria	Technological needs	The scale of cultivation is currently low, and technology chanllenging for scale up of cultivation, although some of the research very advanced at pilot scale.
Iceland	Blue biotechnology	fish	Market & Consumer Demand	Iceland is a small market and there is often a challenge for companies saling up and developing and international consumer segment.
Lithuania	Wild cultivation and harvesting	fish	Legal & Regulatory	Uneven distribution of quotas.
Lithuania	Wild cultivation and harvesting	fish	Skills & Labour	Lack of competent employees.
Lithuania	Wild cultivation and harvesting	fish	Funding & Investment	Limited financial resources.
Lithuania	Wild cultivation and harvesting	fish	Skills & Labour	Salaries are not competitive.

Lithuania	Aquaculture	fish	Funding & Investment	Limited financial resources.
Lithuania	Aquaculture	fish	Skills & Labour	Lack of competent persons capable of attracting funding.
Lithuania	Aquaculture	fish	Skills & Labour	Lack of competent employees.
Lithuania	Aquaculture	fish	Science	Low applications of innovations.
Lithuania	Aquaculture	fish	Science	Lack of know-how at development stage (innovations).
Lithuania	Aquaculture	fish	Technological needs	Slow growth in scale.
Lithuania	Aquaculture	fish	Funding & Investment	Complicated and insuficient funding possibilities.
Lithuania	Aquaculture	fish	Market & Consumer Demand	Low local market capacity for local aquaculture production.
Lithuania	Aquaculture	fish	Technological needs	Low diversity of cultured species: catfish in RAS (Recirculating Aquaculture System) dominated.
Lithuania	Aquaculture	fish	Cost of Operations & Infraestructures	High installation and operational costs, low profit of product.

Lithuania	Aquaculture	fish	Cost of Operations & Infraestructures	High energy costs.
Lithuania	Aquaculture	fish	Market & Consumer Demand	Lack of social recognition in aquaculture production.
Lithuania	Aquaculture	fish	Skills & Labour	Low intention to work in rural areas.
Lithuania	Aquaculture	fish	Funding & Investment	Domination of traditional pond aquaculture (better conditions for investments).
Lithuania	Aquaculture	fish	Technological needs	Lack/low quality of stocking material (shrimps).
Lithuania	Aquaculture	fish	Science	Micro enterprices dominated in RAS (Recirculating Aquaculture Systems) aquaculture with low development potential.
Lithuania	Aquaculture	fish	Cost of Operations & Infraestructures	Low growth potential in sea aquaculture sector.
Lithuania	Aquaculture	fish	Communication & Marketing	Lack of communication and collaboration with science and other stakeholders, gaps in communication among scientific communities to fostering collaborations.
Lithuania	Aquaculture	fish	Technological needs	Low growth potential in pond aquaculture sector.
Lithuania	Aquaculture	fish	Environmental	Environmental issues for pond aquaculture sector.

Lithuania	Research & development	fish	Science	Low applications of innovations.
Lithuania	Aquaculture	fish	Skills & Labour	Lack of competent employees.
Lithuania	Aquaculture	fish	Skills & Labour	Low intention to work in rural areas.
Lithuania	Aquaculture	fish	Market & Consumer Demand	Low local market capacity for local aquaculture production.
Lithuania	Wild cultivation and harvesting	fish	Technological needs	Low diversity of cultured species: carp in open ponds dominated.
Lithuania	Wild cultivation and harvesting	fish	Science	Seasonality and unpredictability of production.
Lithuania	Wild cultivation and harvesting	fish	Cooperation & Partnership	Changing ecosystems and fish communities.
Lithuania	Wild cultivation and harvesting	fish	Cooperation & Partnership	Lack of communication and collaboration with science and other stakeholders.
Lithuania	Wild cultivation and harvesting	fish	Market & Consumer Demand	Low local market capacity for local fisheries production: Lithuanian fisheries production is mostly sold outside the country.
Lithuania	Wild cultivation and harvesting	fish	Cost of Operations & Infraestructures	Fishing fleet is old and inefficient.

Lithuania	Wild cultivation and harvesting	fish	Skills & Labour	Staff is old and not changing.
Lithuania	Wild cultivation and harvesting	fish	Science	Unsatisfactory stock status.
Lithuania	Wild cultivation and harvesting	fish	Legal & Regulatory	Fishery restrictions.
Lithuania	Wild cultivation and harvesting	fish	Legal & Regulatory	Complicated management system: marine fishery – Ministry of Agriculture, inland fishery – Ministry of Environment.
Lithuania	Wild cultivation and harvesting	fish	Legal & Regulatory	Lithuanian pelagic catches mostly landed in other Baltic Sea ports.
Lithuania	Aquaculture	bivalves	Cost of Operations & Infraestructures	Infraestructures.
Lithuania	Aquaculture	bivalves	Funding & Investment	Invest in more and larger demonstration farms at these strategically selected sites.
Lithuania	Aquaculture	bivalves	Market & Consumer Demand	Develop the mussel market within the feed industry.
Lithuania	Wild cultivation and harvesting	macroalgae	Legal & Regulatory	Collaborate with EU novel food regulation authorities to remove from EU novel food list of species consumed in the Baltic.
Lithuania	Wild cultivation and harvesting	macroalgae	Cost of Operations & Infraestructures	Infraestructures and marine space.

Lithuania	Wild cultivation and harvesting	macroalgae	Funding & Investment	
Lithuania	Wild cultivation and harvesting	macroalgae	Science	
Lithuania	Blue biotechnology	not specified	Cost of Operations & Infraestructures	Shortage and cost increase for many raw materials.
Lithuania	Blue biotechnology	not specified	Market & Consumer Demand	Pathways and market applications at an early stage.
Lithuania	Blue biotechnology	not specified	Cost of Operations & Infraestructures	Transnational access to pilot-scale facilities.
Lithuania	Blue biotechnology	not specified	Skills & Labour	Blue biotechnology study programmes are very rare.
Lithuania	Wild cultivation and harvesting	macroalgae	Funding & Investment	
Lithuania	Wild cultivation and harvesting	macroalgae	Science	
Lithuania	Across sectors	not specified	Funding & Investment	
Lithuania	Across sectors	not specified	Market & Consumer Demand	Public awareness.

Norway	Across sectors	not defined	Communication & Marketing	Secondary raw materials management - consumers often lack reliable and relevant information about the environmental properties of the product in the purchasing situation; greenwashing. Lack of documentation of residual raw materials creates challenges with traceability, approvals and trust in the market for circular products.
Norway	Across sectors	not defined	Legal & Regulatory	Consumer protection rules and regulations are aligned with a traditional linear economic model: externalities, i.e. costs that a company imposes on other actors, which are not internalized due to the absence of regulations or financial incentives from the authorities; regulations or other policies that prevent investments because they are cost-driving or create increased risk; access to capital for new circular value chains limits growth. New forms of production find it challenging to find suitable support schemes for this existing policy instruments.
Norway	Processing	fish	Technological needs	Fish's stomach contents can destroy the facility machinery. Missing competence for other utilization. Need for technological innovations that require significant and risky investments.
Norway	Processing	fish	Market & Consumer Demand	Not enough demand (only local oil and flour mill), not enough area, small volumes, not profitable, more stable and larger supply is necessary if utilization is to be established. Untapped economies of scale. New forms of production do not find their place in the existing regulatory framework, and it needs to be easier to make adjustments.
Norway	Across sectors	not defined	Funding & Investment	Access to capital for new circular value chains limits growth. New forms of production find it challenging to find suitable support schemes for this existing policy instruments. The incentive structure does not promote circular products and forms of production.
Portugal	Wild cultivation and harvesting	fish, algae	Science	Missing capacity to replicate bioresources in laboratory, difficulty in accessing water test facilities, harvesting and sampling approaches are not adequate to biodiscovery.
Portugal	Research & development	fish, algae	Skills & Labour	Difficulty in hiring specialised human resources and lack of innovation department / staff.
Portugal	Research & development	fish, algae	Science	Difficulty with separation and purification downstream protocols, in determining specific mode of action, difficulty in discovering novel marine natural products and bioactives, with safety and efficacy testing protocols and timeframes, in innovating on screening technologies and platforms, in determining correct formulation for future desired / predicted route of administration.
Portugal	Research & development	fish, algae	Technological needs	Difficulty in getting sustainable and reproducible batch supply (adequate culture / harvest, adequate manufacturing technologies, adequate volumes yield).
Portugal	Across sectors	fish, algae	Cooperation & Partnership	Difficulty in penetrating existing value chains, need to create new value chains.

Portugal	Across sectors	fish, algae	Cost of Operations & Infraestructures	Logistics too complex or heavy.
Portugal	Across sectors	fish, algae	Science	Lack of knowledge on the predicted / desired route of administration / type of formulation for final application.
Portugal	Research & development	fish, algae	Science	Difficulty in accessing laboratory spaces and water test spaces.
Portugal	Wild cultivation and harvesting	fish, algae	Science	Unawareness of scientific techniques or specialised services.
Portugal	Wild cultivation and harvesting	fish, algae	Legal & Regulatory	Access to bioresources/ biobanks is complicated or not clear.
Portugal	Wild cultivation and harvesting	fish, algae	Technological needs	Difficulty in accessing robotics, ROVs and drones, as well as sensors materials and expertise.
Portugal	Research & development	fish, algae	Skills & Labour	Unawareness of scientific techniques or specialised services that could be helpful, lack of necessary skills or specialised training, lack of knowledge on how to innovate, unwareness of international or regional regulation issues.
Portugal	Research & development	fish, algae	Technological needs	Difficulty in accessing facilities for prototyping and pilot scale units, in accessing local laboratory facilities for product development and prototyping.
Portugal	Research & development	fish, algae	Cooperation & Partnership	Difficulty in finding national and international cooperation partners.
Portugal	Industrial (equipment/services suppliers)	fish, algae	Technological needs	Difficulty in accessing manufacturing facilities.

Portugal	Across sectors	fish, algae	Skills & Labour	Difficulty in accessing training and education tailored to individual needs.
Portugal	Across sectors	fish, algae	Legal & Regulatory	Inappropriate political focus or strategy and difficulty in accessing specialised legal, contractual services.
Portugal	Across sectors	fish, algae	Cooperation & Partnership	Difficulty in finding national cooperation partners, lack of international business development support, lack of national business and acocunting services development support, difficulty in finding international cooperation partners, Difficulty in accessing incubation/office services and spaces.
Portugal	Wild cultivation and harvesting	fish, algae	Communication & Marketing	Difficulty in reaching out to clients, difficulty in communicating the added value of product to clients, lacking marketing tools and development capacity, need for new packaging.
Portugal	Wild cultivation and harvesting	fish, algae	Communication & Marketing	Difficulty to find the right events to showcase products and find new clients.
Portugal	Wild cultivation and harvesting	fish, algae	Market & Consumer Demand	There is no market demand for innovative added-value products and do not know what to focus on or what the market needs.
Portugal	Research & development	fish, algae	Market & Consumer Demand	Difficulty in determining real market need, need to build consumer awareness, lack of knowledge on how to develop a business plan, consumer/market demands are not aligned with the limitations in production methods, competition (similar products).
Portugal	Wild cultivation and harvesting	fish, algae	Market & Consumer Demand	Need help in defining and developing a business model.
Portugal	Wild cultivation and harvesting	fish, algae	Funding & Investment	Complex mechanisms to receive funding.
Portugal	Wild cultivation and harvesting	fish, algae	Cost of Operations & Infraestructures	Reduced cost-efficiency of discovering novel marine natural products and bioactives.

Portugal	Wild cultivation and harvesting	fish + algae	Cost of Operations & Infraestructures	Access to ocean is difficult or expensive.
Portugal	Wild cultivation and harvesting	fish, algae	Funding & Investment	Difficulty in attracting reliable funding.
Portugal	Wild cultivation and harvesting	fish, algae	Funding & Investment	Can not match desired price tag/ unit.
Portugal	Wild cultivation and harvesting	fish, algae	Funding & Investment	Need help in attracting or securing funding, lack of knowledge of available funding mechanisms, difficulty in accessing public grants and private investement, lack of dedicated or suitable crowdfunding platforms.
Portugal	Wild cultivation and harvesting	fish, algae	Legal & Regulatory	Complex licensing and regulation.
Portugal	Wild cultivation and harvesting	fish, algae	Legal & Regulatory	Complex licensing and regulation and find several Legal/IP constraints to innovate and develop new products.
Portugal	Research & development	fish, algae	Legal & Regulatory	Intellectual property issues, difficulty in understanding or in complying with heavy regulatory requirements and complex design of certification schemes.
Portugal	Across sectors	fish, algae	Legal & Regulatory	Difficulty in dealing with IP issues, complex international or regional regulatory issues.
Portugal	Across sectors	fish, algae	Funding & Investment	Lack of financial sector’s knowledge on the Blue Bioeconomy aspects.
Scotland	Blue biotechnology	not specified	Cooperation & Partnership	Scotland's vision for Blue Bioeconomy with 3 elements: Social, Economic and Environment.

Scotland	Wild cultivation and harvesting	fish	Science	Sea water rearing and sea lice.
Scotland	Wild cultivation and harvesting	fish	Environmental	Environmental - water quality.
Sweden	Wild cultivation and harvesting	european oysters - edulis	Legal & Regulatory	Oyster industry is limited. Wild oysters (Ostrea edulis) are only species allowed to be harvested commercially but their growth is negatively impacted by invasive species which are not allowed to be harvested commercially (and therefore continues to dominate).
Sweden	Wild cultivation and harvesting	european oysters - edulis	Legal & Regulatory	Oyster spat that is ready for export to EU cannot be sold as testing program for bomeia doesn't exist. There is more demand for Ostrea edulis outside of Sweden in France. Oyster farmers in France need good supply of spat and there is a market for spat in EU, but the company will not reach that market without the testing. Lost market opportunity. There are very heavy and long-term processes to build a testing program. This will take too long and the company will lose their market.
Sweden	Wild cultivation and harvesting	european oysters - edulis	Market & Consumer Demand	Low demand due to public perception of oysters as a "luxury" food and consumer preferences. Consumer awareness of the local native species is low and therefore many oysters consumed are imported.
Sweden	Wild cultivation and harvesting	european oysters - edulis	Legal & Regulatory	Selling/exporting spat to other EU countries is hindered due to lack of testing resources available by authorities for parasitic diseases like Bonamiosis. A testing protocol exists, but the authorities do not have resources in place to do the proper testing necessary for export in a relevant timeframe.
Sweden	Wild cultivation and harvesting	european oysters - edulis	Legal & Regulatory	Permitting process, complicated with several authorities needing to be contacted (separately) and long time for approval. Authorities are not coordinated in the permit process.
Sweden	Processing	blue mussels - mytilus edulis	Science	Industry would like to grow but have challenges with "waste" side-streams , 30-40% of the harvest is sorted out as not sellable to end consumer, but it cannot be disposed of in nature (illegal in Sweden), - there are valuable proteins and other properties in the side streams to explore valorization but no procress available for side-stream processing, need for technology to extract valueable products.
Sweden	Wild cultivation and harvesting	blue mussels - mytilus edulis	Science	Minimize waste (crushed shells) in harvest methods, increase harvest volumes reduce shell crush - need for improved mussel harvest methods to reduce crushing.
Sweden	Wild cultivation and harvesting	blue mussels - mytilus edulis	Legal & Regulatory	permitting process, several authorities you need to apply to (seperately) and long time for approval authorities are not coordinated in the permit process.

Sweden	Wild cultivation and harvesting	blue mussels - mytilus edulis	Science	Calcium deposits from "spiral worms" make the shells unattractive to consumers, increases waste streams, research on methods of reducing this "fouling" of mussel shells, or side-stream valorization methods to use the extra calcium.
Sweden	Wild cultivation and harvesting	blue mussels - mytilus edulis	Science	Testing and monitoring of algae blooms - better system needed - today it takes too much time and is done by hand/boat - could be automated. Understanding algae blooms is important for optimal placement of growings sites to avoid toxins.
Sweden	Wild cultivation and harvesting	blue mussels - mytilus edulis	Science	Invasive species (sea squirts) attach to the ropes, outcompete mussels and reduce the volumes in cultivation. Methods to reduce the amount of sea squirts growing on ropes - or to harvest and sell sea squirts as a secondary revenue stream.
Sweden	Processing	blue Mussels - mytilus edulis	Cost of Operations & Infraestructures	Processing equipment, results in a lot of crushed shells. Process machines to reduce the amount of crushed shells. Costs associated with processing are expensive.
Sweden	Wild cultivation and harvesting	blue mussels - mytilus edulis	Science	Research regarding the impacts of changing marine biological processes related to ex. climate change are needed. These are potential threats to successful cultivation.
Sweden	Processing	blue mussels - mytilus edulis	Science	Mussel filaments - contribute to the problem of crushed shells in processing as they are difficult to remove in seperation. Need for research and process technology - a process to "loosen" the filment material.
Sweden	Processing	blue mussels - mytilus edulis	Market & Consumer Demand	Packaging materials (plastic nets) for sale to end cosumer pose a challenge for food markets/stores, leaking and smelly. Test various consumer packaging to increase attractiveness and ease of use.
Sweden	Wild cultivation and harvesting	macroalgae, sugar kelp	Cooperation & Partnership	Finding the right partners to get macroalgae products to the market is a challenge.
Sweden	Wild cultivation and harvesting	macroalgae, sugar kelp	Market & Consumer Demand	Consumer knowledge about macroalgae as a blue food is low, there is limited knowledge how to for example prepare and eat the product (fresh, dry, fermented).
Sweden	Wild cultivation and harvesting	macroalgae, sugar kelp	Communication & Marketing	There is a need for more collaboration among producers in communication and information dissemination to consumers, limit the levels of misinformation to consumers that could potentially affect the market uptake.

Sweden	Processing	macroalgae, sugar kelp	Legal & Regulatory	Iodine and cadmium content, there are unclear consumer guidelines from food authorities what are the allowed values and how to communicate to consumers responsibly. The authorities need to develop relevant food safety guidelines together with industry and support industry in providing correct consumer information (Sweden Livsmedelsverket). Also, more information to consumers about the health aspects of macroalgae are needed together with nutritional guidelines for consumers.
Sweden	Processing	macroalgae, sugar kelp	Communication & Marketing	Iodine and cadmium content, there are unclear consumer guidelines from food authorities what are the allowed values and how to communicate to consumers responsibly. The authorities need to develop relevant food safety guidelines together with industry and support industry in providing correct consumer information (Sweden Livsmedelsverket). Also, more information to consumers about the health aspects of macroalgae are needed together with nutritional guidelines for consumers.
Sweden	Wild cultivation and harvesting	macroalgae, sugar kelp	Market & Consumer Demand	There are not enough growers and manual cultivation/harvest methods which hinder production at scale to create the suitable volumes for macroalgae to meet the price point be attractive to food industry producers. Food production companies want cheap ingredients, need to produce large volumes to reduce cost.
Sweden	Processing	macroalgae, sugar kelp	Cost of Operations & Infraestructures	Industry needs better processing technology, more energy efficient drying, but also machinery for cutting, preparing and packaging. There are high unit production costs with current methods.
Sweden	Wild cultivation and harvesting	macroalgae, sugar kelp	Cost of Operations & Infraestructures	Companies are challenged to scale their operations, harvest techniques are manual and heavy, limiting the volumes able to be harvested and the costs for equipment are high and currently the market is not mature enough to make a return on the investment.
Sweden	Processing	macroalgae, sugar kelp	Cost of Operations & Infraestructures	Side streams are created in production processes on land but there are no uses for the side-streams yet so they are dealt with as waste, which is a cost.
Sweden	Wild cultivation and harvesting	macroalgae, sugar kelp	Legal & Regulatory	Site selection and permit processing are long and expensive processes, hinder for new macroalgae farmers. Need for streamlined processes, larger areas for permits where several farmers can cultivate for longer periods of time as well.
Sweden	Processing	acroalgae, sugar kelp	Funding & Investment	Innovation financing is needed to help find uses for the side-streams from macroalage processing.
Sweden	Processing	Sea squirts	Science	Challenges lie in the scale up of production and finding the right type of process design to make use of the raw material to 100 percent as they do today and make sure no side streams go to spill.
Sweden	Wild cultivation and harvesting	sea squirts	Legal & Regulatory	Permitting processes are long, several different authorities are involved and the coordination of these is limited.

Sweden	Wild cultivation and harvesting	offshore wind / aquaculture	Legal & Regulatory	The regulatory framework and the co-existance model needs to be developed/determined for the actors involved. The development of offshore wind parks on the west of Sweden are presenting the possibility of co-existance with aquaculture cultivation. Primarily macroalgae. There are many actors interested in the offshore wind space but there are conflicts in interest between various groups where the co-existance model is not complete. Tthere is potential for opening up for cultivation at offshore wind sites, but the practicalities are not clear as of yet. There are obstacles in terms of actual models for this cultivation practices, the investment, the access, the insurance, the ownership models etc. If it does not prove to be viable then it wil not happen.
Sweden	Wild cultivation and harvesting	crustaceans	Legal & Regulatory	Site selection and permits for land-based RAS (Recirculating Aquaculture Systems) cultivation are long and costly.
Sweden	Aquaculture	crustaceans	Funding & Investment	Land-based aquaculture requires capital, there are few investors with experience in aquaculture in Sweden, many of whom are uncertain about the industry. They are also less inclined to invest because of the complicated permit processes.