Deliverable 3.1

Potential of the blue bioeconomy including lessons learnt from European initiatives, data collection strategies and recommendations for monitoring ecosystem services

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Abstract	This report presents a comprehensive analysis of socio-economic barriers in the blue bioeconomy value chains, aiming to identify opportunities and promote socially and environmentally responsible behaviour. The present version was updated after receiving feedback from project evaluators.
Keywords	Blue bioeconomy, value chains, indicators, ecosystem services

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Acronyms

BBC	BlueBioClusters
BGS	Blue Growth Strategy
CFP	Common Fisheries Policy
CSR	Corporate Social Responsibility
EMODnet	European Marine Observation and Data Network
ESFRI	The European Strategy Forum on Research Infrastructures
EU	European Union
FAO	Food and Agricultural Organisation
IMP	The Integrated Maritime Policy
IMTA	Integrated Multi-Trophic Aquaculture
MAES	Mapping and Assessment of Ecosystems and their Services
MSFD	Marine Strategy Framework Directive
NGO	Non-Governmental Organisation
RAS	Recirculating Aquaculture Systems
SCBE	Sustainable Criteria for the Blue Economy
SBE	Sustainable Blue Economy
SDG	Sustainable Development Goal
SME	Small and medium-sized enterprises
UN	United Nations
UNCLOS	United Nations Convention on the Law of the Sea
VAB	Value added benefit

Executive Summary

This report examines the socio-economic barriers and enablers within blue bioeconomy value chains, focusing on fisheries, algae, and mussel farming. It highlights key enabling factors—such as regulatory measures, corporate responsibility initiatives, and education—that support the transition to socially and environmentally responsible practices. Using global and EU frameworks, including the Marine Strategy Framework Directive (MSFD), European Green Deal, and UN Sustainable Development Goals (SDGs), the report develops criteria and indicators to measure these value chains' environmental, economic, and social impacts.

The *Sustainability Compass* methodology is introduced as a pilot framework for assessing ecosystem services, offering a holistic approach to understanding challenges and identifying actionable strategies for sustainable development. By integrating participatory processes, stakeholder input, and existing European observation networks like EMODnet and Copernicus, this pilot provides a foundation for improved data collection and analysis. However, the framework requires further development and additional data to ensure its scalability and effectiveness in addressing sector-specific challenges.

The findings offer valuable insights for policymakers, industry stakeholders, and researchers. They provide a starting point for fostering collaboration, improving monitoring strategies, and supporting evidence-based decision-making to drive the sustainable growth of the blue bioeconomy.

1. Socio-Economic Barriers and Enablers in Blue Bioeconomy Value Chains

The blue bioeconomy sector focuses on harvesting and sustainably utilising renewable aquatic resources, such as fish, seaweed, sponges, jellyfish, and microorganisms, to create a diverse range of products and services. As the eighth-largest global producer of fishery and aquaculture products, the European Union (EU) plays a critical role in the sector, accounting for 2% of global production (European Commission, 2024). The EU's internal market is the world's second-largest for trade and third-largest for fishery and aquaculture product consumption (EUMOFA, 2023).

Rising global demand for marine resources makes a resilient blue bioeconomy vital for balancing environmental sustainability and economic growth, driving innovation, employment, and responsible resource management (Herath & Sanjeewa, 2024). In recent years, Europe's fisheries and aquaculture industries have faced a series of significant challenges. The COVID-19 pandemic disrupted global supply chains, while Russia's war in Ukraine exacerbated economic instability, resulting in increasing energy and production costs that have contributed to inflationary pressures (European Commission, 2023). These crises highlight the need for resilience and adaptability in the blue bioeconomy for sustainable growth.

This chapter examines the socio-economic barriers and potentials within blue bioeconomy value chains, focusing on fisheries, algae farming, and mussel farming. Using a combination of desktop research and systematically collected data from multiple European countries provided by BBC project partners (*see Annex I for a detailed overview*), the analysis identifies insights for industry and public sector stakeholders. Stakeholder workshops, such as the 2023 Blue Bioeconomy events on Saaremaa Island (Estonia), offered a platform for dialogue and data collection. In addition, strategic documents, including the Belgian Strategic Plan for Aquaculture and Portugal's Blue Bioeconomy Roadmap, provided regional perspectives to enrich the analysis.

Fisheries

Fisheries production in Europe ranks third globally, with species like herring, Alaska pollock, cod, blue whiting, and mackerel accounting for over half of the region's output (EUMOFA, 2023). Inflation significantly impacted the fisheries and aquaculture sector, driving household spending on fish products up by 11%, yet at-home consumption fell by 17% in major EU countries. While export values grew by 19%, a 5% volume decline contributed to a worsening trade deficit, which rose by €4.73 billion in 2022 (EUMOFA, 2023).

Small-scale fisheries, comprising 80% of the EU fleet (around 85,000 vessels) and employing over 40% of fishers, face challenges such as achieving fair prices and adding value to their catches. Despite the superior quality of small-scale fishery products, they struggle to compete in markets dominated by imports, large-scale

operations, aquaculture, and illegal fishing (Pascual-Fernández et al., 2019). Strategies like certification schemes, direct selling, and alternative food networks can enhance market differentiation and improve livelihoods (Pascual-Fernández et al., 2019).

Regulatory factors both support and hinder the industry. While science-based management fosters sustainability, outdated laws and restrictive quotas challenge planning. European Parliaments study (2023) finds that fuel use efficiency and greenhouse gas emissions need to be integrated as an explicit goal of fisheries management and monitored based on robust data collection. The sector's high dependence on fossil fuels makes it vulnerable to price fluctuations and societal decarbonisation demands, highlighting the need for innovation in fleet renewal and alternative energy use (Saviolidis et al., 2020).

Resource factors reveal potential in innovations aimed at fleet renewal, carbon footprint reduction, value-added processing, and byproduct utilisation. However, investment costs, uncertain returns, and technology gaps, especially in alternative fuels, pose barriers to sustainability (Saviolidis et al., 2020).

Rising consumer demand for sustainable and traceable fish products is shaping market factors. Certification schemes like the Marine Stewardship Council (MSC) are critical for market access, but their high costs and inconsistent reputational benefits pose challenges. Additionally, some companies express concerns about the influence of retailers and environmental NGOs, which can affect public perception and market stability (Saviolidis et al., 2020).

Small-scale fishers face significant hurdles in securing livelihoods, including difficulties in achieving fair prices and adding value to their catches. Although their products often boast superior quality and freshness, these advantages do not always translate into higher prices or increased demand. Local catches frequently struggle to compete in markets dominated by imports, large-scale operations, aquaculture, and even illegal fishing (Pascual-Fernández et al., 2019).

Research on marketing strategies for promoting small-scale fisheries products remains limited. However, Pascual-Fernández et al. (2019) highlight several value-adding strategies, such as certification of origin schemes, eco-labels, direct selling, alternative food networks, and collective labels. These approaches aim to enhance product differentiation, improve market access, and support the livelihoods of small-scale fishers. Product valorisation is critical for profitability, with opportunities for innovations in fishmeal, fish oil, and even fish skin utilisation. Public awareness, education, and training are vital in strengthening the sector’s contribution to local economies and the EU bioeconomy. A notable example is the 100% Fish project, initiated by the Iceland Ocean Cluster, which encourages the seafood industry to maximise the utilisation of each fish caught. This initiative fosters value creation by promoting waste reduction, supporting new business ventures, and creating job opportunities (Iceland Ocean Cluster, 2024).

Figure 1. 100% Fish project from Iceland (Iceland Ocean Cluster, 2024).

Climate change is a growing concern, impacting stock distributions and fishing infrastructure resilience. Industry adaptability, fisher-led conservation, and knowledge-sharing support adaptation. However, specialisation, workforce shortages, and limited access to training inhibit effective adaptation, underscoring the need for multi-level planning and stakeholder collaboration (Maltby et al., 2023).

Algae

Algae are diverse photosynthetic organisms, ranging from microscopic species to large macroalgae like kelp, which can grow over 30 meters. In Europe, macroalgae production relies primarily on harvesting wild stocks, with 68% of companies using manual collection and 76% operating sea-based aquaculture installations. Microalgae production is dominated by photobioreactors, used by over two-thirds of companies, followed by ponds (19%) and fermenters (10%) (Kuech et al., 2023).

The algae industry offers significant opportunities to tackle societal challenges, contributing to carbon neutrality, sustainable food systems, and a circular bioeconomy

(Araújo et al., 2021). Macroalgae cultivation can support coastal economies, improve carbon sequestration, and meet rising demand for sustainable products. Integrated Multi-Trophic Aquaculture (IMTA) systems further enhance sustainability by boosting biomass processing efficiency. However, the sector faces hurdles such as limited offshore cultivation, mismatches between high-demand species and production, high costs, and market gaps (Kuech et al., 2023).

Microalgae hold promise due to their adaptability in controlled systems, producing high-value products for food, feed, cosmetics, and biofuels. They provide essential nutrients with low environmental impact but are limited by high costs, technological constraints, and contamination risks. Scaling production remains challenging, requiring advancements in cultivation technology and cost reductions (Kuech et al., 2023).

The algae sector aligns with EU Green Deal and Blue Bioeconomy goals, offering alternatives to wild-caught fish, reducing eutrophication, and supporting climate targets. Nonetheless, fragmented governance, regulatory inconsistencies, and low production levels hinder its growth. Investments in infrastructure, cultivation technology, and streamlined policies are critical, alongside raising consumer awareness and addressing knowledge gaps about environmental impacts and market dynamics (European Commission, 2022; Araújo et al., 2021; Greene et al., 2022)

Poor coastal water quality and lengthy environmental assessments also delay algal farming development. Social recognition of algal farming's benefits—such as economic opportunities and improved water quality—is low, compounded by socio-economic challenges like transitioning to green energy, low wages, and inadequate IT infrastructure in rural areas. Expanding cultivation into low-salinity regions like the Baltic Sea and using beach-cast algae for fertilisers can create additional value streams (Kuech et al., 2023).

Research on consumer attitudes toward seaweed remains limited, often focusing on specific countries or case studies (van den Burg et al., 2018). Despite this, the popularity and consumption of seaweed are growing, particularly in coastal regions where familiarity with seaweed is higher (CBI, 2022).

Govaerts and Olsen (2023) investigated consumer attitudes toward seaweed-based food products in Norway, revealing that positive attitudes strongly influence consumption, with perceived behavioural control reinforcing this relationship. Key drivers of acceptance included the perceived naturalness and uniqueness of seaweed, suggesting that these attributes are critical for market growth. Similarly, Jönsson et al. (2024) conducted a tasting experiment in Sweden using bread and spread products incorporating four types of European seaweed. Consumers generally appreciated these products, with taste, flavour, and texture emerging as the most influential factors for acceptability. These findings highlight the importance of sensory attributes in shaping consumer preferences.

Seaweed-based products are increasingly present in retail markets, with the food industry leveraging seaweed as a unique flavour and versatile ingredient. However, for many European consumers, seaweed remains a niche product. Its novelty often necessitates repeated exposure and experience to overcome hesitations and integrate them into diets (CBI, 2022).

Consumer acceptability for low-trophic aquaculture (LTA) products, including seaweed and mussels, has also been studied. Tunca et al. (2024) used an extended Theory of Planned Behaviour to explore factors influencing consumer intentions in Denmark, the United Kingdom, and France. The study found subjective norms to be the strongest predictors of purchase intentions, followed by attitudes, food neophobia, subjective knowledge, and health consciousness. Food neophobia negatively influenced intentions, highlighting the need for targeted efforts to address consumer hesitations toward unfamiliar foods.

The FAO (2022) emphasised the importance of social acceptability for sustainable aquaculture in the Mediterranean and Black Sea regions. Their guidelines recommend stakeholder engagement, transparency, and community involvement in aquaculture initiatives to balance socio-economic benefits like job creation and food security with environmental stewardship. Adaptive management practices, including regular assessments and adjustments based on social and environmental impacts, are vital for fostering public trust and acceptance. These measures ensure that sustainable aquaculture products like seaweed and mussels align with community needs and ecological priorities, driving broader consumer acceptance.

The European Commission (2022) issued a communication titled *"Towards a Strong and Sustainable EU Algae Sector,"* outlining key action areas to advance the algae industry. These include enhancing governance frameworks and legislation, fostering a more favourable business environment, bridging knowledge, data, technology, and innovation gaps, and increasing social awareness and acceptance of algae and algae-based products.

Economic and social measures, such as financial support for small enterprises, improving working conditions, and avoiding monopolistic practices, are necessary for balanced sector growth. Governance reforms, including simplifying licensing, improving transparency, and introducing carbon and nutrient quotas, can further support expansion. Technological innovations like renewable energy solutions and decision-support tools will be necessary for sustainability and productivity.

Figure 2. Red alga (Furcellaria lumbricalis) collected from the coast of Saaremaa at Vetik production rooms in Estonia (photo: Liisi Lees)

Mussels

While global mussel aquaculture has grown, the EU mussel industry has experienced a steady decline, with production falling from over 600,000 tonnes in the late 1990s to approximately 431,000 tonnes in 2022 (Riecken, 2024). This decline contrasts with rising output in species like salmon and seabass and has contributed to stagnation in the EU aquaculture sector. Despite mussels accounting for over a third of the EU's aquaculture output, reduced production has increased reliance on imports, primarily from Chile, resulting in significant economic losses (Avdelas et al., 2021).

The EU mussel industry employs various cultivation techniques, each with distinct challenges. Off-bottom culture, the most efficient method, faces competition for marine space as longline and raft farming requires extensive surface areas. On-bottom culture is hampered by predator threats and spat shortages. Additionally, the sector's fragmentation, dominated by small-scale producers, limits bargaining power, driving down ex-farm prices and reducing profitability (Avdelas et al., 2021).

Governance issues further hinder growth. Complex regulatory and permitting processes vary across Member States, creating barriers to expansion. Initiatives to integrate mussel producers into cooperatives and producer organisations aim to improve vertical integration, streamline operations, and enhance market access through certifications like Protected Designation of Origin (PDO) (Avdelas et al., 2021)

Environmental challenges, such as poor coastal water quality, invasive species, harmful algal blooms, and climate extremes, exacerbate difficulties, reducing production and increasing costs. However, mussels provide ecological benefits as filter feeders, improving water quality and sequestering carbon, aligning with EU sustainability goals and offering a low-cost, high-protein food source (Avdelas et al., 2021).

A comprehensive strategy is essential to revitalise the sector. While the CFP and Commission Strategic Guidelines offer a framework for sustainable development, further targeted measures are needed. National shellfish strategies could leverage tools like GIS for marine spatial planning, certifications, blockchain for digital traceability, and emergency funds for environmental disruptions. These steps would enhance consumer trust, sector stability, and alignment with the EU Green Deal and Farm to Fork Strategy (Avdelas et al., 2021).

Innovation is key to the sector's future. Advances in mussel grading, processing, and renewable energy adoption can improve efficiency and resilience. Balancing land- and sea-based activities through nutrient emission regulations and streamlining permitting for industrial facilities is crucial. Developing specialised shellfish handling equipment in regions like the Baltic Sea (especially for low salinity areas) and introducing environmentally friendly packaging can further support growth. Collaboration between industry and government, alongside investments in research and sustainable practices, will enable the EU mussel industry to support coastal communities, foster resilience, and contribute to the blue bioeconomy (Riecken, 2024).

Conclusion

To conclude, the European blue bioeconomy, encompassing fisheries, algae, and mussel value chains, holds significant potential to address societal, environmental, and economic challenges. However, the sector faces interlinked barriers across environmental, economic, social, and governance domains that impede its growth and sustainability. Declining water quality, rising production costs, market limitations, and regulatory complexities pose significant obstacles to expansion. Social barriers, such as inadequate working conditions, workforce shortages, and limited bioeconomy-specific education, further complicate recruitment and retention efforts, particularly in rural areas. Governance challenges, including fragmented regulatory processes and inconsistent permitting, discourage innovation and SME participation.

Addressing these challenges requires a holistic, multifaceted approach. Key strategies include investing in product valorisation to enhance profitability, adopting advanced technologies to improve efficiency and sustainability, and fostering regulatory coherence to streamline operations. Integrating aquaculture with other sectors, such as agriculture and forestry, and promoting sustainable business practices are essential for creating circular, resilient value chains. Stakeholder collaboration is critical to ensure knowledge sharing and alignment between industry, research, policy, and communities.

High-priority investment in research and development will be crucial in unlocking the sector's potential. Innovation in areas such as carbon-efficient aquaculture systems, digital traceability, and environmentally friendly practices will drive progress. Through enhanced governance, stakeholder engagement, and sustainable practices, Europe can revitalise its blue bioeconomy, supporting coastal communities and aligning with its Green Deal objectives and global sustainability commitments.

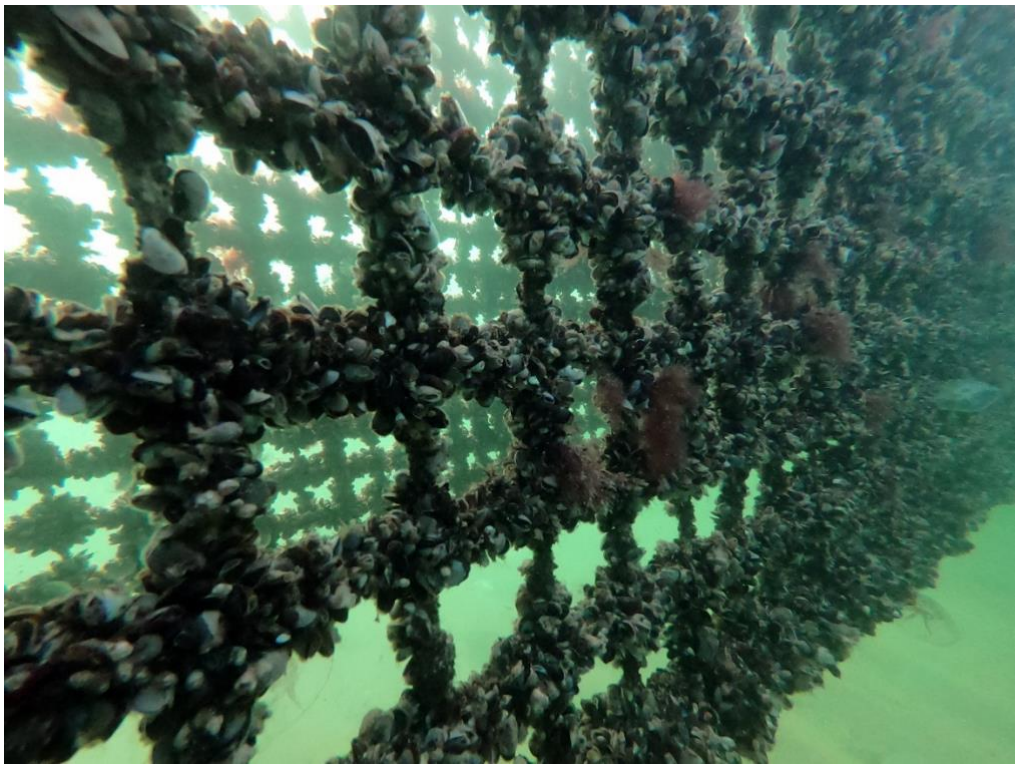

Figure 3. Mussel farming in Estonia (photo: Jonne Kotta).

1.1. Enabling Factors for a Transition to Responsible Behaviour

Transitioning to a socially and environmentally responsible blue bioeconomy requires integrating key enabling factors across education, legislation, financial mechanisms, collaboration, corporate responsibility, certifications, and technology. These factors collectively promote sustainable practices, foster innovation, and encourage stakeholder accountability.

Education and Awareness

Education and awareness are foundational to promoting responsible practices within the blue bioeconomy. Targeted educational efforts inform policymakers, industry stakeholders, and the public about sustainable practices, empowering them to make informed decisions. By highlighting the environmental and social consequences of unsustainable activities, education fosters a culture of sustainability, encouraging proactive participation and responsible decision-making across sectors.

Communities of Practice (CoPs) are increasingly valued for fostering broad stakeholder engagement. These informal, collaborative groups bring together individuals who share common interests but approach them from diverse perspectives. CoPs facilitate the exchange of knowledge, mutual learning, and the development of a shared vision regarding specific processes or common assets. In the BBC project, we have successfully utilised CoPs within project regions to enhance awareness and engagement around the blue bioeconomy. Learn more from BlueBioClusters. (2024). D6.1 Lessons learnt from Blue Bio Communities of Practices.

Figure 4. Engaging in a dynamic Community of Practice event held in Estonia; participants gather to explore strategies and foster discussions on effectively raising awareness about the transformative potential of the blue bioeconomy (photo: Merli Rätsep)

Legislative Support

Legislative frameworks play an important role in enabling the transition to sustainable business models. Policies incentivising responsible behaviour, such as funding support and risk reduction for innovative practices, drive industry adoption of sustainable approaches (de Mattos & de Albuquerque, 2018). Legislative measures also promote transparency, accountability, and alignment with environmental objectives, creating a regulatory environment conducive to long-term sustainability. During the BBC project, the concept of the Ecosystem Approach Wheel was further developed in WP3. The EA wheel could help in the transition as policies could use it

to incentivise and reward companies for adopting nature-inclusive practices, aligning economic growth with environmental stewardship.

Access to Funding and Financial Incentives

Sustainable practices often require significant financial investment, making access to funding a key enabler. Governments, international organisations, and private investors can support innovation through grants, subsidies, and programmes targeting environmentally responsible practices. Financial mechanisms reduce entry barriers for SMEs and startups, fostering wider adoption of sustainable models. Accessible funding ensures the scalability of solutions that address environmental and social challenges within the sector.

Collaborative Networks and Partnerships

Building collaborative networks across diverse stakeholders is essential for driving responsible behaviour. Inclusive partnerships between academia, industry, NGOs, and local communities enable knowledge exchange, capacity building, and co-development of innovative solutions (Berkowitz, 2020). These networks enhance synergies, resilience, and holistic decision-making, ensuring that multiple perspectives contribute to sustainable practices and long-term sectoral success.

The BlueBioClusters' Searchable Interactive Open-Source Portal, known as **BlueBioMatch – The Blue Bioeconomy Hub**, is an outstanding example of enhancing access to funding and fostering collaborative networks while sharing technology and innovation. This cutting-edge platform serves as a dynamic hub for diverse stakeholders, including startups, small and medium-sized enterprises (SMEs), researchers, policymakers, and funding organisations. BlueBioMatch is designed to streamline the exchange of essential information, technologies, and opportunities while actively encouraging collaborative initiatives. By facilitating knowledge sharing and forming strategic partnerships, the platform is critical in driving the sustainable development of blue bioresources within the blue bioeconomy sector. Learn more from BlueBioClusters. (2024). *D 4.2 Searchable Interactive Open-Source Portal*.

Corporate Social Responsibility (CSR)

CSR plays a key role in embedding sustainability into business operations. Companies engaging in CSR initiatives are more likely to adopt innovative, sustainable practices that align with environmental and social objectives (de Mattos & de Albuquerque, 2018). This commitment not only drives internal operational changes but also enhances brand reputation, builds consumer trust, and attracts responsible investors, reinforcing the market's shift toward sustainability.

Sustainability Labels and Certifications

Sustainability labels and certifications are vital tools for promoting responsible behaviour in the blue bioeconomy. They provide measurable criteria for public procurement, enabling sustainable sourcing.

By empowering consumers to make environmentally conscious purchasing decisions, these certifications increase demand for responsible products and services, further driving industry-wide adoption of sustainable practices.

The blue MSC label is a globally recognised symbol that signifies seafood sourced from sustainable and well-managed fisheries. It is applied exclusively to wild fish or seafood that meet the requirements of the MSC Fisheries Standard, ensuring practices that protect marine ecosystems and maintain fish populations for the future. This certification reflects a commitment to responsible fishing, including minimising environmental impacts and supporting the livelihoods of those dependent on healthy oceans. Choosing products with the blue MSC label helps consumers make environmentally conscious decisions while supporting the preservation of marine biodiversity. See more: msc.org.

Figure 5. Blue MSC label (source: Wikipedia).

Technology and Innovation

Technological advancements are transformative in enabling sustainable blue bioeconomy practices. Innovations such as selective harvesting methods, efficient resource utilisation technologies, and advanced waste management solutions significantly reduce environmental impacts. Investments in research and development, coupled with technology transfer initiatives, are essential for ensuring the accessibility and scalability of these solutions. Technology supports the sector's sustainable growth by improving resource efficiency and ecosystem health.

Consumers care about transparency. Consumer behaviour has changed drastically in the blue bioeconomy in the past few years. One important reason for this change is that consumers are becoming more aware that modern supply chains are increasing in complexity. Raw materials are being sourced from across the globe, often through multiple middlemen. Modern consumers understand that fraud is happening and that paper documents can and are being tampered with. They are worried they are not getting the products they think they are paying for. Technology that offers origin verification is now available. ORIVO AS, a Norwegian company offering its services globally, has developed verification programs designed to rebuild consumer trust through evidence-based transparency. Transparency in the value chain has become a key factor in achieving increased sales and improved profit margins. Growth in this business area will support a more sustainable and trustable blue bioeconomy.

2. Frameworks for Assessing Impact in the Blue Bioeconomy

The blue bioeconomy generates protein, raw materials, valuable chemicals, biomass, and significant job opportunities. Its growth can occur gradually or experience exponential expansion, contributing to coastal communities' prosperity and employment enhancement. By embracing innovative technologies, the blue bioeconomy aims to attract young talent, securing a promising future for the sector. Ensuring sustainability and preserving the quality of marine resources is vital for the industry's success. Numerous instances have highlighted the negative impact of economic activities on the marine environment, leading to the implementation of environmental laws that often restrict business development reliant on marine resources.

Simultaneously, maritime spatial planning is expected to address various challenges through an ecosystem-based approach to partitioning marine space. Consequently, the licensing process and criteria for granting permits for activities in the sea have become a focal point of attention.

This chapter explores the initiatives undertaken at both the global and European Union (EU) levels to establish a comprehensive assessment framework in the blue bioeconomy. These initiatives are the foundation for developing criteria and specific indicators to measure the social, economic, and environmental impacts of various blue bioeconomy value chains and feed into the Sustainability Compass (*Chapter 3*).

2.1. Global Frameworks

The United Nations Sustainable Development Goals (SDGs) serve as a globally recognised framework for sustainable development, including their relevance to the blue bioeconomy (United Nations, 2024). They offer a comprehensive set of targets and indicators that guide the assessment and monitoring of social, economic, and environmental impacts within the blue bioeconomy. SDG 14, "Life Below Water," is particularly significant for oceans and seas, aiming to conserve and sustainably use marine resources. In support of SDG 14, the United Nations has established the UN Decade of Ocean Science for Sustainable Development (Ocean Decade) from 2021 to 2030, recognising the vital role of science-informed policies and promoting inclusive approaches to scientific research for a sustainable Blue Economy.

It is important to note that international law holds authority over both EU and national law. The United Nations Convention on the Law of the Sea (UNCLOS), established in 1982, provides a comprehensive framework for governing the world's oceans and seas. UNCLOS sets out principles and rules for the sustainable use of marine resources and governs various aspects of ocean activities. Additionally, global and regional agreements under UNCLOS aim to protect and develop regional seas, with national authorities taking primary responsibility for marine governance.

The United Nations Food and Agricultural Organisation's (FAO) Code of Conduct for Responsible Fisheries incorporates environmental principles for aquaculture development (FAO,1995). While there are currently no binding international agreements specific to aquaculture, voluntary instruments have been established within the framework of the Code to assist fishers, industry, and governments in implementing responsible practices. The FAO's technical guidelines on aquaculture certification provide guidance for the development of credible certification schemes promoting orderly and sustainable growth in the sector (FAO, 2011).

Although international frameworks do not focus exclusively on blue bioeconomy value chains, they address the social, economic, and ecological impacts of ocean-based activities, indirectly encompassing aspects of the blue bioeconomy. These frameworks emphasise the importance of sustainable marine use and provide guiding principles for responsible practices.

2.2. EU Frameworks

The EU recognises the need for sustainable growth in the blue economy to align with the European Green Deal (EGD). To achieve this, the EU has developed a report titled "Sustainability Criteria for the Blue Economy" (European Commission, 2021), aiming to create a Blue Economy Sustainable Framework. This framework will utilise sustainability criteria and indicators to assess blue economy activities, encompassing environmental, social, economic, and governance dimensions of sustainability. The goal is to provide public and private investors with a tool to select sustainable blue economy projects. To develop the "Sustainability Criteria for the Blue Economy" (SCBE), a study analysed and compared 30 existing sustainability frameworks related to blue economy sectors and activities. However, most of these frameworks did not meet the requirements of the SCBE. These requirements include incorporating the four dimensions of sustainability, adopting a cross-sectoral approach, and allowing flexibility for application across different scales, levels, and geographic areas (European Commission, 2019).

The Sustainable Blue Economy (SBE) approach, an updated version of the Blue Growth Strategy (BGS) from 2012, is the leading strategy for the blue bioeconomy. The SBE is a long-term strategy that supports sustainable growth in the marine and maritime sectors, recognising the role of oceans and seas as drivers for the European economy. It promotes innovation, growth, and coherence across sectors while minimising environmental damage, aligning with the European Green Deal and the Recovery Plan for Europe.

The EU Blue Economy Observatory (European Commission, 2024a) serves as a comprehensive platform for monitoring and analysing the state and development of the blue economy sectors in the European Union. It collects data, conducts research, and provides valuable insights to support evidence-based decision-making and promote sustainable growth in the blue economy.

BlueInvest (European Commission, 2024b) is an EU initiative that fosters sustainable and innovative technologies and solutions within the blue economy sector. It offers support for investment and market readiness to small and medium-sized enterprises (SMEs) and start-ups, connecting them with potential investors and facilitating their access to funding opportunities. Through these efforts, BlueInvest aims to accelerate the growth of promising blue economy ventures and contribute to their success in raising finance.

The European Green Deal (European Commission, 2024c), introduced in 2020, is a cross-sectoral policy that aims to make the EU economy sustainable by transforming climate and environmental challenges into opportunities. At its core is the Farm to Fork Strategy (European Commission, 2020), which seeks to make food systems fair, healthy, and environmentally friendly.

The Integrated Maritime Policy (IMP) and Common Fisheries Policy (CFP) are EU policy frameworks that intersect with the blue bioeconomy, focusing on goals related to Blue Growth and sustainability. The CFP (European Union, 2013) sets rules for sustainable fishing, conservation of fish stocks, and aquaculture policy. The Strategic Guidelines for the Sustainable Development of EU Aquaculture provide tools within the CFP, simplifying administrative procedures, enhancing coordination, and promoting longer-term licensing with monitoring and enforcement mechanisms.

Regarding binding EU legislation, the blue bioeconomy is primarily governed by environmental directives. Aquaculture, as a significant sector within the marine blue bioeconomy, is regulated by various directives, including the European Water Framework Directive, the Marine Strategy Framework Directive, the Directive on the conservation of natural habitats and wild fauna and flora, the Directive on the conservation of wild birds, the Industrial Emissions Directive, and others. These directives obligate national authorities to implement measures to achieve good ecological status and water quality standards.

The Marine Strategy Framework Directive (MSFD, 2008) is an EU policy instrument that aims to achieve and maintain good environmental status in European marine waters. It provides a framework for assessing the impact of activities within the blue bioeconomy on the marine environment, setting specific indicators and criteria for monitoring and evaluating environmental impacts. The MSFD contributes to the sustainable use and conservation of marine resources.

The Marine Spatial Planning Directive is an EU policy instrument that aims to promote the sustainable use of marine resources and space. It provides a framework for coordinating various activities in the marine environment to ensure their compatibility and minimise conflicts, fostering a balanced and ecosystem-based approach to marine spatial planning.

The Mapping and Assessment of Ecosystems and their Services (MAES) report, initiated by the EU, focuses on mapping and assessing ecosystems and their services to support decision-making processes. MAES provides a comprehensive

understanding of ecosystems' value and benefits within the blue bioeconomy, guiding informed decision-making and sustainable management practices. It helps identify opportunities for promoting the sustainable utilisation and conservation of natural resources within the blue bioeconomy sector.

The EU's strategic approaches, policies, and directives address the social, economic, and ecological aspects of the blue bioeconomy but mostly do not focus directly on the needs of blue bioeconomy, especially on regenerative ocean farming.

3. Social, Economic, and Environmental Impacts of the Blue Bioeconomy: Developing Impact Indicators and Methodologies for Ecosystem Service Assessment

The blue bioeconomy has significant social, economic, and environmental impacts. Traditional methods for assessing the impacts of the blue bioeconomy often face challenges due to excessive specialisation and limited integration between science, policy, and society, creating significant barriers to achieving sustainable human development. While specialisation has contributed to a deepening of knowledge within specific disciplines, understanding complex interactions between systems is often neglected. Particularly in sustainable development, the divergence between economics and the natural sciences is pronounced, and the interface that informs decision-making remains weak. These barriers often downplay uncertainty and leave room for entrenched political positions, potentially undermining evidence-based decision-making and the pursuit of the SDGs set out in the 2030 Agenda.

To overcome this challenge, we adopted the Sustainability Compass framework, which promotes the interconnectedness of science through transdisciplinary social learning and the meta-evaluation of scientific knowledge in the pursuit of the SDGs (Sajeva et al., 2020, 2020a, 2022, 2024). The Sustainability Compass uses a multidimensional indicator system rooted in sustainability goals, integrating social, economic, and environmental dimensions to comprehensively assess ecosystem services in the blue bioeconomy (Figure 6 and 7; Tables 1 and 2). It outlines sustainability through relevant themes and metrics generated and refined through a participatory learning process. This inclusive process allows all stakeholders - be they business owners, environmental managers, or other interested parties - to contribute actively. This methodology aimed to translate overarching sustainability principles into actionable insights, fostering alignment with human well-being and ecological balance. By integrating various stakeholders through participatory frameworks, the approach emphasised clarity in distinguishing ultimate sustainability goals from the methods used to achieve them, thereby avoiding misaligned priorities. Moreover, by promoting systematic, participatory, and continuous societal learning about sustainability, the Sustainability Compass facilitates the exchange and comparison of multiple dimensions of sustainability between different actors. This, in turn,

strengthens their knowledge and understanding of sustainability as a comprehensive concept that goes beyond simply meeting environmental requirements.

The primary aim of this framework is to provide a practical, efficient methodology for identifying concrete methods, initiatives and solutions that can be used to achieve clearly defined sustainability goals. These actions are then linked to specific indicators, with targets explicitly linked to human well-being and our ecosystems' continued functioning and balance. Building on this foundation, the methodology included a bottom-up approach emphasising evidence-based societal learning. Workshops, targeted interviews and collaborative platforms enabled stakeholders to identify critical cause-and-effect relationships between operations and sustainability goals. For instance, stakeholders used the "Means & Goals" (Figure 6) framework to map out necessary actions and assess their feasibility, barriers, and impacts on sustainability indicators. To ensure a holistic perspective, these actions were systematically categorised across natural, human, social, economic, and physical dimensions. Specific methodologies included back-casting scenarios, triangulation of results, and detailed mapping of indicators through tools like the BlueBioSites geoportal (https://gis.sea.ee/bluebiosites/) and portals like EMODnet (https://emodnet.ec.europa.eu/geoviewer/) and Copernicus (https://marine.copernicus.eu/). During the assessment, the identified concrete actions were aligned with established EU and global frameworks, including the Marine Strategy Framework Directive (MSFD), the Mapping and Assessment of Ecosystems and their Services (MAES), the Green Deal, and the UN Sustainable Development Goals (SDGs) (*see Chapter 2*). This alignment facilitated the development of connections to ecosystem services and the monitoring of associated impacts. Overall, the Sustainability Compass facilitates a shared understanding of sustainability among different actors. It helps formulate a shared vision for achieving sustainability and provides a means to measure the level of sustainability, for example, in national or regional plans.

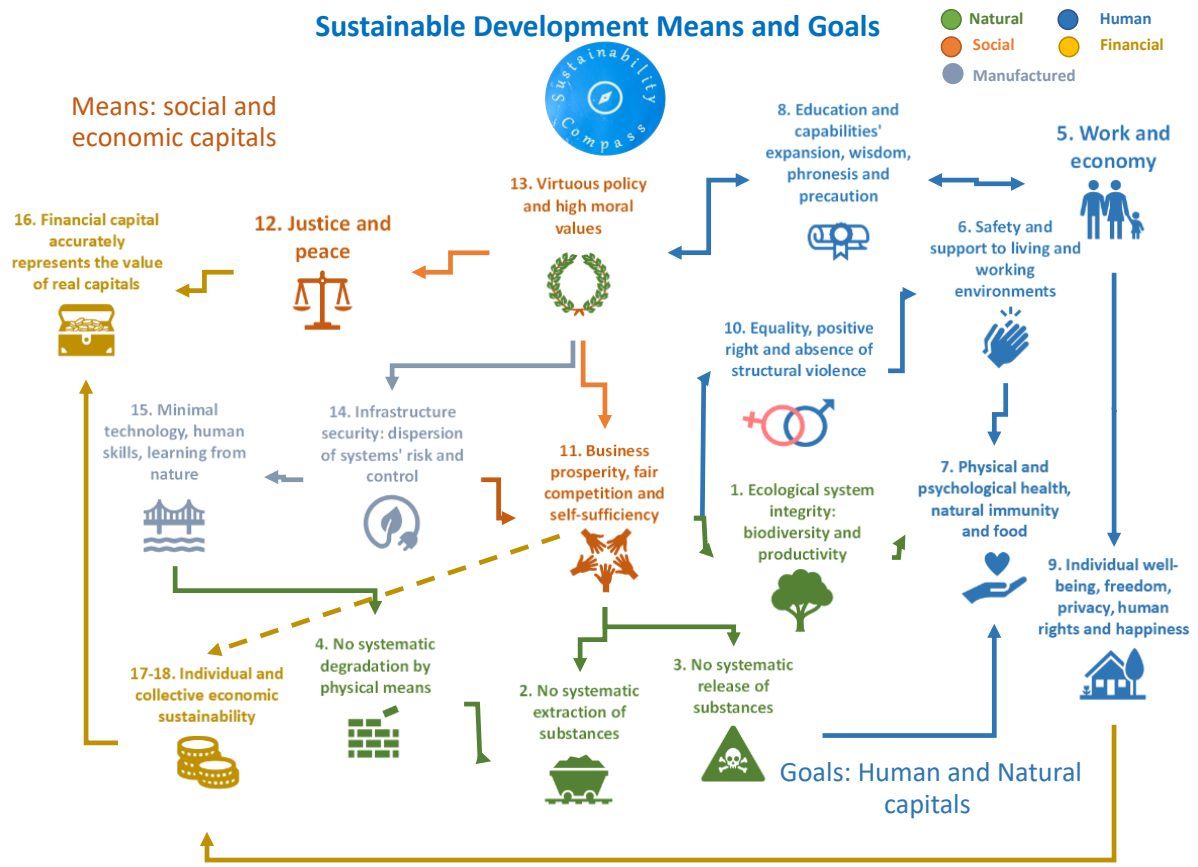

Figure 6. A systemic, integrated representation of the Sustainability Compass means and goals (Sajeva et al., 2022).

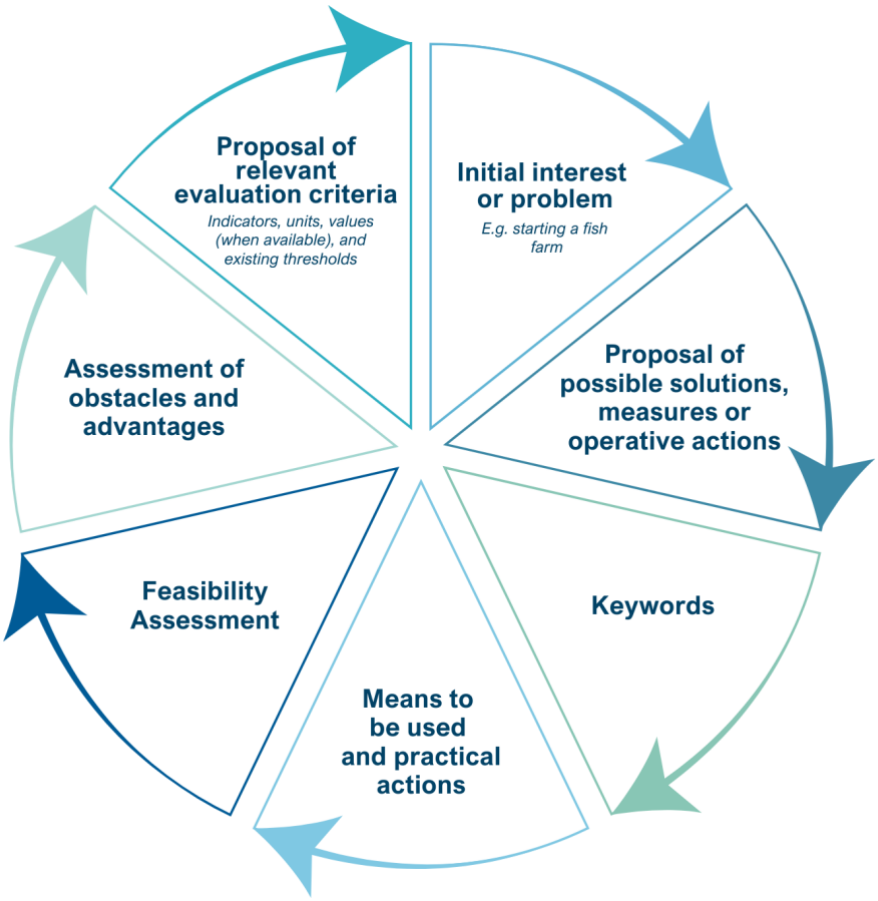

Figure 7. The process of working with the Sustainability Compass (after Sajeva et al., 2024).

Table 1. The Sustainability Compass goals and criteria are classified according to the five capitals model of sustainability (Sajeva et al., 2022).

Natural systems
1. Ecological system integrity: maintaining biological diversity and productivity
2. No systematic extraction of substances, exceeding the capacity of the environment to neutralise their harmful effects
3. No systematic release of substances, exceeding the capacity of the environment to neutralise their harmful effects
4. **No systematic degradation by physical means**, exceeding the capacity of the environment to neutralise their harmful effects
Human well-being
5. Work and economy: access to varied and satisfying opportunities for work and business, especially rural depressed areas
6. Safety and support to living and working environments
7. Human health: high standard of physical and psychological health through precautionary principle, to avoid to systematically increase concentrations of substances in human body, e.g. good quality of water and of GMO free and organic food
8. Education and capabilities' expansion: Independent and free education, open scientific debate, wisdom, phronesis and precaution
9. Human well-being, freedom, privacy, individual human rights, peace, justice and happiness
10. Equality between individuals and organisations, based on race, gender, age, health state or wealth, positive freedom and absence of structural violence and dominant position for assuring equal opportunities of development

GOALS

Table 2. The Sustainability Compass means, or intermediate goals, classified according to the five capitals model of sustainability (Sajeva et al., 2022).

Social: collective institutions, regulations and social infrastructures and services
11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions
12. Justice: assurance of trusted, effective fair, accessible and just institutional, legal and judicial services and protection of the citizens, peace, democracy and plurality, public participation and bottom-up approaches. Assurance of basic human rights of physical and psychological integrity.
13. Virtuous policy and high moral values social structures and institutions support human rights and development and to the environmental sustainability, absence of corruption, transparency, accountability, ethics, wisdom and phronesis
Physical infrastructure
14. Security of critical infrastructure: avoiding systems' risk concentration, and of relying on a unique infrastructure or organisation or losing control from users. Non-adoption of innovation when usefulness or absence of harm for individuals is not proven. Efficient, secure an less invasive infrastructure systems and technology, learning from nature. Assurance of individual freedom and privacy.
15. Minimal infrastructure, technologies and processes at support of human well-being minimum use of natural resources and manufactured capital and maximum use of human work and skills (help to humans)
Economy
16. Financial capital accurately represents the value of natural, human, social and manufactured capital
17. Economic sustainability for individuals **18. Economic sustainability for public/private organisations**

MEANS

The BBC project applied the Sustainability Compass methodology to analyse value chains within the blue bioeconomy, focusing on fisheries, algae, and mussel farming across various European countries. Detailed case information and corresponding value chains are provided in Annex I. Data gathered through workshops, interviews, and document analysis were synthesised into a comprehensive database encompassing environmental, economic, and social impacts, challenges, potential solutions, and target goals, each supported by measurable impact indicators. These indicators span thematic areas such as ecology, human well-being, and various forms of capital (social, physical, economic) while aligning with the Sustainability Compass

goals. Each entry is linked to ecosystem services, disservices, and their respective indicators.

Each database entry addresses a specific environmental, social, or economic challenge, accompanied by identified barriers, potential solutions, and indicators reflecting status and progress toward goals. The database is designed with flexibility, enabling data categorisation by activities, topics, and targets, facilitating the updating of existing entries and the incorporation of new insights.

The Sustainability Compass employs a participatory process involving entrepreneurs, environmental managers, researchers, and stakeholders. This approach fosters a shared understanding of sustainability, promotes collaborative goal setting, and evaluates sustainability levels within national or regional frameworks. Users initiate the process by identifying challenges, assigning keywords, and proposing actions. These actions are linked to specific means or objectives from predefined tables (Tables 1 and 2), which are interchangeable depending on the context.

The workflow includes feasibility ratings (low, medium, high) assigned via drop-down menus, identification of barriers and benefits for achieving objectives, and definition of qualitative indicators. Users provide units of measurement, thresholds, and values for ecosystem services. Targets, including interim milestones, are described in terms of achievement status and their relationship to natural, human, social, physical infrastructure, or economic capital. In cases where only means or milestones are mentioned without achieving targets, the progress may still be valuable but does not necessarily indicate success. Each entry is supplemented with references for further details. This structured methodology offers a dynamic tool for evaluating sustainability in blue bioeconomy value chains, ensuring adaptability, inclusivity, and precision in addressing challenges and fostering progress.

The following subsections summarise the impacts, challenges, and potential solutions identified in the blue bioeconomy, along with their associated indicators, mapped across various value chains. The complete dataset, including all details, is available in Annex I.

During the mapping process, each blue bioeconomy action was linked to one or more ecosystem services (cultural, provisioning, regulating). Where information was available, stakeholders contributed relevant indicators to assess the flow of these services. However, the study's broad geographical scope and limitations in available knowledge, data, and time made it impractical to quantify or assign a valuation to these flows. Consequently, we present only the number of ecosystem services identified for each value chain and theme. Detailed qualitative descriptions of these ecosystem services are provided in the subsequent subsections (Figure 8 and 9).

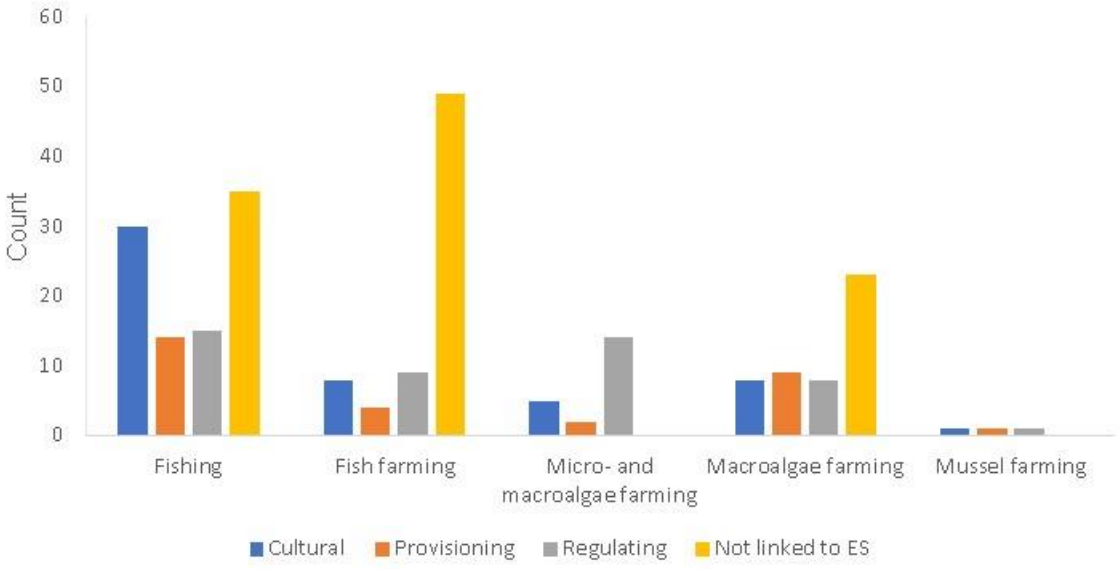

Figure 8. The number of broad groups of ecosystem services identified for each indicator of the studied value chains. Some indicators are also applied to multiple value chains (e.g., microalgae and macroalgae).

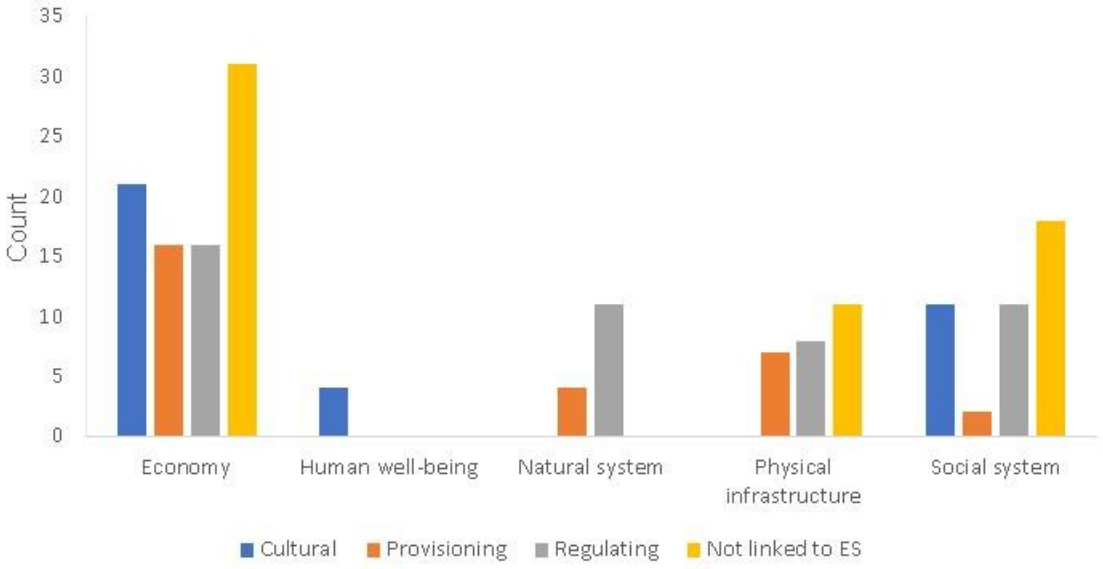

Figure 9. The number of broad groups of ecosystem services identified for each of the studied value chains (see Figure 6).

There is ongoing work to harmonise LCA approaches for low trophic aquaculture practices (e.g., seaweed and mussel farming; AlgaeProBanos provides some other similar projects). Once this work is completed, the value chains related to low trophic aquaculture will be able to provide more specific indicators of emissions and other factors. The Sustainable Compass and Ecosystem Wheel (WP3 of BBC project) are primarily self-evaluation tools for companies. These assessments should be complemented with detailed LCAs, which can also address social aspects of the value chain through a so-called social LCA. In this process, companies must evaluate a critical set of harmonised indicators to enable comparison across different actors within the sector.

3.1. Fisheries and Fish Farming

Fish aquaculture and fisheries are important components of the blue bioeconomy, focusing on balancing food production with ecological sustainability. A significant challenge in this value chain is managing overfishing and nutrient emissions, particularly nitrogen and phosphorus, which can disrupt aquatic ecosystems if not effectively controlled. Economic pressures and technical limitations in nutrient management further complicate adopting sustainable practices.

A key solution lies in developing sustainable fishmeal alternatives, such as insect-based feeds, algal biomass, or single-cell proteins from microbial fermentation. These innovations reduce dependency on traditional fishmeal, which contributes to overfishing while optimising feed efficiency to lower nutrient emissions. Other approaches include integrating biofilters or constructed wetlands within aquaculture systems to capture excess nutrients.

The amount of greenhouse gases emitted provided information on the sector's environmental footprint. At the same time, the proportion of environmentally friendly fishing gear used indicated the industry's commitment to reducing negative ecological impacts. The proportion of fish biomass utilised or valorised provided a measure of resource efficiency. Indicators such as the "amount of nutrients emitted by fish farming" (e.g., kilograms of biologically available nitrogen per tonne of feed) provide a measurable benchmark for evaluating the sustainability of fish farming practices. Ecosystem service indicators such as water quality improvements and nutrient cycling provide additional insight into environmental benefits.

Social and economic resilience was examined through several indicators. The presence of a fair quota system and systematic fish farming regulations reflected governance mechanisms and operational strategies within the sector. The number of blue economy enterprises also provided a measure of the economic vitality of the sector. As discussed in Chapter 2, frameworks such as the Marine Strategy Framework Directive (MSFD) and the EU Common Fisheries Policy (CFP) provide regulatory tools to promote sustainable fishing practices, address overfishing, and ensure good environmental status in marine waters. Regulatory aspects, such as the time taken to process documents and obtain licences, were key indicators of administrative efficiency and support for the sector. Equity was assessed by the level of justice and economic equality, with safety captured by the number of accidents.

The sector's primary obstacles include the high costs of advanced technologies, limited access to accurate data, and a lack of standardised metrics for assessing ecosystem service impacts. Addressing these requires investments in research, data-sharing platforms, and harmonised guidelines for sustainability practices across regions.

3.2. Algae Farming

Algae farming plays a vital role in the blue bioeconomy, supporting nutrient mitigation, carbon sequestration, water quality improvement, and climate regulation. Large-scale

farming of species such as kelp and red algae can enhance ecosystem resilience, particularly in eutrophic regions.

Challenges include the technological limitations of scaling up operations and the economic feasibility of sustainable farming practices. Solutions involve developing integrated multi-trophic aquaculture (IMTA) systems, which combine seaweed cultivation with fish and shellfish farming. This approach uses nutrient outputs from aquaculture as inputs for seaweed growth, improving resource efficiency. Advances in selective breeding and offshore farming technologies also offer potential for expansion.

Indicators like "amount of carbon sequestered by seaweed farming" and "amount of nutrients removed per hectare" assess environmental contributions. Ecosystem service indicators linked to water purification and biodiversity further highlight its ecological value. The amount of fertiliser and agricultural growth substrate produced from marine algae provided additional insight into the sector's role in resource recycling and promoting a circular economy.

Economic vitality was examined through indicators such as the share of green energy used, which indicates sustainable practices, and profit per tonne of raw material, which reflects economic efficiency. The number of innovations implemented represented the sector's commitment to progress and improvement. Social indicators included the availability of sector specialists, particularly in rural areas, signifying the accessibility of expertise. The Happy Employee Index served as a measure of employee satisfaction and well-being. The provision of internet speed measured infrastructure support in rural areas. As noted in Chapter 2, the European Commission’s Algae Strategy (2022) and the EU Green Deal emphasise the importance of creating supportive governance frameworks, streamlining licensing procedures, and fostering innovation to advance the algae sector's role in achieving climate neutrality and promoting a circular bioeconomy. In terms of governance and regulation, the time taken to obtain licences, the level of government investment in businesses and the equal treatment of land- and sea-based initiatives were considered critical indicators.

Barriers to adoption include limited market demand, regulatory challenges, and insufficient public awareness. Creating supportive policies, raising awareness of seaweed’s benefits, and developing markets for seaweed-based products are essential steps toward growth.

3.3. Mussel Farming

Mussel farming provides both a sustainable protein source and ecological benefits through biofiltration. Mussels remove nitrogen, phosphorus, and suspended particles from water, making them valuable for nutrient mitigation in eutrophic areas.

The main challenges in mussel farming are achieving economic viability and adapting to environmental changes such as warming waters and ocean acidification. Proposed solutions include improving farming technologies, such as automated harvesting systems, and integrating mussel farming into IMTA systems to utilise nutrients from

nearby aquaculture activities. Utilising mussel by-products, such as shells, for construction materials can also enhance profitability.

Indicators like "amount of nutrients sequestered by mussel farming" (e.g., kilograms of nitrogen or phosphorus removed per tonne of mussels produced) track ecological contributions. Additional indicators, such as water clarity improvements, demonstrate the broader environmental benefits of mussel farming. The sector's impact on waste reduction was reflected in the decreasing amount of by-product waste and the increasing use of by-products in new applications.

Economic indicators included the relationship between production yield and costs, which indicates economic efficiency, the availability of systematic financial support for small businesses and disadvantaged areas, and the diversity of aquaculture products on the market. From a social perspective, the Happiness Index, the number of courses attended, and salary growth were important indicators. As highlighted in Chapter 2, the EU Strategic Guidelines for Sustainable Aquaculture and the Common Fisheries Policy (CFP) emphasise the need for simplified licensing procedures, targeted financial support, and harmonised governance to promote sustainability and competitiveness in the aquaculture sector. Regulatory indicators included the time taken to process documents and the proportion of nature-friendly aquaculture solutions, indicating the sector's commitment to sustainable practices.

Subsidies for ecosystem service delivery, market development, and investment in research to address climate resilience can mitigate economic challenges. Collaboration among policymakers, industries, and researchers will support the long-term sustainability of mussel farming.

3.4. Cross-Cutting Issues

All the value chains shared common considerations, including infrastructure, sectoral value added (VAB), investment in innovative research and development, and the availability of specialised academic programmes. Key cross-sectoral indicators included the annual number of related events, the emergence of start-ups and new companies, and the time required to secure operational licenses.

Conclusion

This report analyses the socio-economic barriers and potentials within specific blue bioeconomy value chains (fisheries, algae, and mussel farming). The findings identify key enabling factors—such as regulatory measures, corporate responsibility initiatives, education, and innovation—essential for facilitating a transition toward socially and environmentally responsible behaviour. By mapping these barriers and potentials, the analysis highlights pathways for industry and public authorities to address sustainability challenges while fostering economic and ecological resilience.

This report presents a structured methodology for assessing ecosystem services within blue bioeconomy value chains developed through the application of the Sustainability Compass. The Sustainability Compass emerged as a response to the need for a holistic, multi-dimensional approach to understanding the environmental, economic, and social challenges faced by fisheries, algae, and mussel farming sectors. By integrating participatory frameworks, global and EU standards, and indicators, this methodology offers a foundational tool to identify barriers, evaluate impacts, and guide stakeholders toward sustainable solutions.

However, it is important to note that the current framework represents a pilot effort—a starting point for creating a global understanding of the challenges and opportunities within the blue bioeconomy. While it offers a systematic way to link sustainability goals with actionable strategies, further development is required. More comprehensive and high-quality data and expanded input from stakeholders will be necessary to refine the methodology, validate the indicators, and ensure its applicability across diverse geographic and sectoral contexts.

Moving forward, the Sustainability Compass provides a solid foundation for fostering dialogue, knowledge exchange, and evidence-based decision-making. By building on this pilot initiative, future iterations can enhance the assessment of ecosystem services, support robust data collection strategies, and contribute to the creation of tailored solutions that address the needs of both local and global end-users. This iterative process will be key to achieving a sustainable and thriving blue bioeconomy.

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ANNEX 1 – Partner Input on Blue Bioeconomy Sectors

Country	Information source	Activities performed	Value chain name	Part of the value chain	Spatial location where activities are carried out	Specific topic/interest/problem	Keyword	Solution/Action to be done	Feasibility	Obstacles for achievement	Indicator	Indicator unit	Is it an indicator of ecosystem service?	Broad ecosystem service type	Narrow ecosystem service type	Status	Goal beyond the specific topic	Theme	Reference
Name of country	e.g. Interviews with expert/producers/ producer organisation/governmental agency/etc or questionnaire or literature review	Main activity related to interview/questionnaire/review	Value chain name (e.g. mussel value chain)	Which part of the value chain the activity relates to (e.g. mussel farming, mussel valorization,	Name of location if relevant/available, alternatively just region name can be inserted	e.g. Water quality is bad and fish farming is impossible	e.g. Water quality	Mussel farming to compensate adverse effects of fish farming	Evaluation of the feasibility of an	Identified internal (e.g., intrinsic limitations faced by company to put in practice the indicated solution, such as the lack of technical solution or the	Amount of nutrients removed by mussel farming	kg nitrogen, kg phosphorus	Yes/No	Provisioning/regulating/cultural	e.g. Recreation and tourism; biofiltration; nutrient cycling	Objective achieved/not achieved	Long term goal; here the classification can be changed to better fit goals of the project	Natural system; Human well-being; Social system; Physical infrastructure; Economy	Source for information; does not apply if the information was collected during the interview, unless the
Estonia	interview with producer (100% of the sector covered)	fish farming; mussel farming	fish and mussel value chain	fish and mussel aquaculture	Tagalaht	Water quality is bad and fish farming is impossible	Water quality	Developing sustainable fish meal	high	difficult to minimize nitrogen emissions	Amount of nutrients emitted by fish farming	kg biologically available nitrogen per	Yes	Regulating		Achieved	1. Ecological system integrity: maintain	Natural system	
Estonia	interview with producer (100% of the sector covered)	fish farming; mussel farming	fish and mussel value chain	fish and mussel aquaculture	Tagalaht	Water quality is bad and fish farming is impossible	Water quality	Developing sustainable fish meal	high	difficult to minimize nitrogen emissions	Amount of nutrients emitted by fish farming	kg biologically available nitrogen per	Yes	Regulating		Achieved	3. No systematic release of substances, e	Natural system	
Estonia	interview with producer (100% of the sector covered)	fish farming; mussel farming	fish and mussel value chain	fish and mussel aquaculture	Tagalaht	Water quality is bad and fish farming is impossible	Water quality	Developing sustainable fish meal that al	high	difficult to minimize nitrogen emissions	Amount of nutrients emitted by fish farming	kg biologically available nitrogen per	Yes	Regulating		Achieved	18. Economic sustainability for public/p	Economy	
Estonia	interview with producer (100% of the sector covered)	fish farming; mussel farming	fish and mussel value chain	fish and mussel aquaculture	Tagalaht	Water quality is bad and fish farming is impossible	Water quality	Developing mussel farming technologie	high	economically more sustainable if the mussel	Amount of nutrients sequestred by mussel farm	kg nitrogen sequestred per tonne mus	Yes	Regulating		Achieved	1. Ecological system integrity: maintain	Natural system	
Estonia	interview with producer (100% of the sector covered)	fish farming; mussel farming	fish and mussel value chain	fish and mussel aquaculture	Tagalaht	Water quality is bad and fish farming is impossible	Water quality	Developing mussel farming technologie	high	economically more sustainable if the mussel	Amount of nutrients sequestred by mussel farm	kg nitrogen sequestred per tonne mus	Yes	Regulating		Achieved	3. No systematic release of substances, e	Natural system	
Estonia	interview with producer (100% of the sector covered)	fish farming; mussel farming	fish and mussel value chain	fish and mussel aquaculture	Tagalaht	Water quality is bad and fish farming is impossible	Water quality	Developing mussel farming technologie	high	economically more sustainable if the mussel	Amount of nutrients sequestred by mussel farm	kg nitrogen sequestred per tonne mus	Yes	Regulating		Achieved	18. Economic sustainability for public/p	Economy	
Estonia	interview with producer (100% of the sector covered)	fish farming; mussel farming	fish and mussel value chain	fish and mussel aquaculture	Tagalaht	Water quality is bad and fish farming is impossible	Water quality	Developing mussel farming technologie	high	developing a harvester tailored for small-sca	Mussel yield per one cultivation cycle	tonne wet weight of mussels	Yes	Provisioning		Not achieved	18. Economic sustainability for public/p	Economy	
Estonia	interview with producer (100% of the sector covered)	fish farming; mussel farming	fish and mussel value chain	fish and mussel aquaculture	Tagalaht	Water quality is bad and fish farming is impossible	Water quality	Developing mussel farming technologie	high	developing a harvester tailored for small-sca	Mussel yield per one cultivation cycle	tonne wet weight of mussels	Yes	Provisioning		Not achieved	18. Economic sustainability for public/p	Physical infrastructure	
Estonia	interview with producer (100% of the sector covered)	fish farming; mussel farming	fish and mussel value chain	fish and mussel aquaculture	Tagalaht	Companies have a high environmental impact	Greenhouse gas emission	Achieve zero net GHG emission through high		no existing system of emission quotas, entre	Amount of GHG emitted	tonne CO2 equivalent per year				Achieved	3. No systematic release of substances, e	Natural system	
Estonia	interview with producer (100% of the sector covered)	fish farming; mussel farming	fish and mussel value chain	fish and mussel aquaculture	Tagalaht	Different sectors are not treated equally	Lack of justice	Land and sea based activities should be	low	sea based aquaculture activities are banned	Level of justice	unitless				Not achieved	12. Justice: assurance of trusted, effectiv	Social system	
Estonia	interview with producer (100% of the sector covered)	fish farming; mussel farming	fish and mussel value chain	fish and mussel aquaculture	Tagalaht	Different sectors are not treated equally	Lack of justice	Land and sea based activities should be	low	sea based aquaculture activities are banned	Level of justice	unitless				Not achieved	11. Business prosperity, competitiveness	Economy	
Estonia	interview with producer (100% of the sector covered)	fish farming; mussel farming	fish and mussel value chain	fish and mussel aquaculture	Tagalaht	Different sectors are not treated equally	Lack of justice	Land and sea based activities should be	low	sea based aquaculture activities are banned	Level of justice	unitless				Not achieved	18. Economic sustainability for public/p	Economy	
Estonia	interview with producer (100% of the sector covered)	fish farming; mussel farming	fish and mussel value chain	fish and mussel aquaculture	Tagalaht	Monopoly firms define the general conditions of the business	Lack of equality of econom	Avoidance of monopoly or dominant pc	medium	few regulations on the emergence of monop	Level of equality of economic conditions	unitless				Not achieved	11. Business prosperity, competitiveness	Economy	
Estonia	interview with producer (100% of the sector covered)	fish farming; mussel farming	fish and mussel value chain	fish and mussel aquaculture	Tagalaht	Need to produce optimal amounts all year round to be competitive	Scaling-up potential	Optimal scaling-up strategies	medium	there is a mismatch between the objectives	Ratio of production yield and costs	tonne per euros	Yes	Provisioning		Not achieved	18. Economic sustainability for public/p	Economy	
Estonia	interview with producer (100% of the sector covered)	fish farming; mussel farming	fish and mussel value chain	fish and mussel aquaculture	Tagalaht	Governmental does not support small and medium sized enterpri	Governmental support	Support competitiveness and well-sufficie	medium	few regulations on the emergence of monop	Level of equality of economic conditions	unitless				Not achieved	11. Business prosperity, competitiveness	Economy	
Estonia	interview with producer (100% of the sector covered)	fish farming; mussel farming	fish and mussel value chain	fish and mussel aquaculture	Tagalaht	Lack of storage capabilities in winter period	Storage capabilities	Governmental support for the security o	medium	none	Storage capabilities sufficient	unitless				Not achieved	14. Security of critical infrastructure: av	Economy	
Estonia	interview with producer (100% of the sector covered)	fish farming; mussel farming	fish and mussel value chain	fish and mussel aquaculture	Tagalaht	Lack of systematic veterinary service	Veterinary service	Governmental support for the security o	low	moderate political interest	Systematic veterinary service available	unitless				Not achieved	14. Security of critical infrastructure: av	Economy	
Estonia	interview with producer (100% of the sector covered)	fish farming; mussel farming	fish and mussel value chain	fish and mussel aquaculture	Tagalaht	Lack of systematic fish breeding	Fish breeding	Governmental support for fish breeding	low	moderate political interest	Systematic fish breeding available	unitless				Not achieved	14. Security of critical infrastructure: av	Economy	
Estonia	interview with producer (100% of the sector covered)	fish farming; mussel farming	fish and mussel value chain	fish and mussel aquaculture	Tagalaht	Limited amount of capital	Capital	Governmental financial support for sma	medium	none	Systematic financial support for small scale bu	unitless				Not achieved	18. Economic sustainability for public/p	Economy	
Estonia	interview with producer (100% of the sector covered)	fish farming; mussel farming	fish and mussel value chain	fish and mussel aquaculture	Tagalaht	Need for better bioeconomy teaching modules at universities	Education	Governmental support for tailored educ	low	poor university funding for adding curricula	Availability of sector specialists	unitless				Not achieved	8. Education and capabilities' expansion	Human well-being	
Estonia	interview with producer (100% of the sector covered)	fish farming; mussel farming	fish and mussel value chain	fish and mussel aquaculture	Tagalaht	Challenging to find employees in rural areas	Employees	Governmental support for rural develop	medium	none	Availability of sector specialists in rural areas	unitless				Not achieved	8. Education and capabilities' expansion	Human well-being	
Estonia	interview with producer (100% of the sector covered)	fish farming; mussel farming	fish and mussel value chain	fish and mussel aquaculture	Tagalaht	Challenging to find employees in rural areas	Employees	Governmental support for rural develop	medium	none	Availability of sector specialists in rural areas	unitless				Not achieved	5. Work and economy: access to varied a	Human well-being	
Estonia	interview with producer (100% of the sector covered)	fish farming; mussel farming	fish and mussel value chain	fish and mussel aquaculture	Tagalaht	Lack of satisfactory working conditions in rural areas	Working conditions	Providing satisfactory working conditio	high	none	Index of happiness	unitless				Achieved	5. Work and economy: access to varied a	Human well-being	
Estonia	interview with producer (100% of the sector covered)	fish farming; mussel farming	fish and mussel value chain	fish and mussel aquaculture	Tagalaht	Lack of safety procedures	Safety at work	Securing safety procedures	high	none	Number of accidents	unitless				Achieved	6. Safety and support to living and worki	Human well-being	
Estonia	interview with producer (100% of the sector covered)	fish farming; mussel farming	fish and mussel value chain	fish and mussel aquaculture	Tagalaht	Lack of training possibilities	Working conditions	Providing satisfactory training courses	high	none	Number of courses participated	unitless				Achieved	8. Education and capabilities' expansion	Human well-being	
Estonia	interview with producer (100% of the sector covered)	algae valorization; algal cultivation	macroalgae value chain	macroalgae processing	Saaremaa Island	Lack of satisfactory working conditions in rural areas	Working conditions	Providing satisfactory working conditio	high	none	Happy employee index	unitless				Achieved	5. Work and economy: access to varied a	Human well-being	
Estonia	interview with producer (100% of the sector covered)	algae valorization; algal cultivation	macroalgae value chain	macroalgae processing	Saaremaa Island	Lack of safety procedures	Safety at work	Securing safety procedures	high	none	Number of accidents	unitless				Achieved	6. Safety and support to living and worki	Human well-being	
Estonia	interview with producer (100% of the sector covered)	algae valorization; algal cultivation	macroalgae value chain	macroalgae processing	Saaremaa Island	Lack of training possibilities	Working conditions	Providing satisfactory training courses	high	none	Number of courses participated	unitless				Achieved	8. Education and capabilities' expansion	Human well-being	
Estonia	interview with producer (100% of the sector covered)	algae valorization; algal cultivation	macroalgae value chain	macroalgae processing	Saaremaa Island	Companies have a high environmental impact	Greenhouse gas emission	Achieve zero net GHG emission through high		no existing system of emission quotas, entre	Amount of GHG emitted	tonne CO2 equivalent per year				Almost achieved	3. No systematic release of substances, e	Natural system	
Estonia	interview with producer (100% of the sector covered)	algae valorization; algal cultivation	macroalgae value chain	macroalgae processing	Saaremaa Island	Water quality is bad and many sea based activities are banned	Water quality	Sustainable harvesting of macroalgae re	high	none	Amount of nutrients sequestred by algal harves	kg nitrogen sequestred per tonne mac	Yes	Regulating		Achieved	3. No systematic release of substances, e	Natural system	
Estonia	interview with producer (100% of the sector covered)	algae valorization; algal cultivation	macroalgae value chain	macroalgae processing	Saaremaa Island	Water quality is bad and many sea based activities are banned	Water quality	Sustainable harvesting of macroalgae re	high	none	Amount of nutrients sequestred by algal harves	kg nitrogen sequestred per tonne mac	Yes	Regulating		Achieved	1. Ecological system integrity: maintain	Natural system	
Estonia	interview with producer (100% of the sector covered)	algae valorization; algal cultivation	macroalgae value chain	macroalgae processing	Saaremaa Island	Quotas set upper limits of production	Quotas	Need to develop feasible macroalgal cul	medium	lack of an existing analogue in algae cultivat	Macroalgal yield per one cultivation cycle	tonne wet weight of macroalgae	Yes	Provisioning		Not achieved	1. Ecological system integrity: maintain	Natural system	
Estonia	interview with producer (100% of the sector covered)	algae valorization; algal cultivation	macroalgae value chain	macroalgae processing	Saaremaa Island	Quotas set upper limits of production	Quotas	Need to develop feasible macroalgal cul	medium	lack of an existing analogue in algae cultivat	Macroalgal yield per one cultivation cycle	tonne wet weight of macroalgae	Yes	Provisioning		Not achieved	11. Business prosperity, competitiveness	Economy	
Estonia	interview with producer (100% of the sector covered)	algae valorization; algal cultivation	macroalgae value chain	macroalgae processing	Saaremaa Island	Quotas set upper limits of production	Quotas	Need to develop feasible macroalgal cul	medium	lack of an existing analogue in algae cultivat	Macroalgal yield per one cultivation cycle	tonne wet weight of macroalgae	Yes	Provisioning		Not achieved	18. Economic sustainability for public/p	Economy	
Estonia	interview with producer (100% of the sector covered)	algae valorization; algal cultivation	macroalgae value chain	macroalgae processing	Saaremaa Island	Lack of social recognition in rewarding the benefits of macroalgae	Unpaid ecosystem services	Development of quotas to pay for ecosy	low	moderate political interest	Amount of nutrients sequestred by macroalgal	kg nitrogen sequestred per tonne mac	Yes	Regulating		Not achieved	18. Economic sustainability for public/p	Economy	
Estonia	interview with producer (100% of the sector covered)	algae valorization; algal cultivation	macroalgae value chain	macroalgae processing	Saaremaa Island	Lack of social recognition in rewarding the benefits of macroalgae	Unpaid ecosystem services	Development of quotas to pay for ecosy	low	moderate political interest	Amount of nutrients sequestred by macroalgal	kg nitrogen sequestred per tonne mac	Yes	Regulating		Not achieved	1. Ecological system integrity: maintain	Natural system	
Estonia	interview with producer (100% of the sector covered)	algae valorization; algal cultivation	macroalgae value chain	macroalgae processing	Saaremaa Island	Lack of social recognition in rewarding the benefits of macroalgae	Unpaid ecosystem services	Development of quotas to pay for ecosy	low	moderate political interest	Amount of nutrients sequestred by macroalgal	kg nitrogen sequestred per tonne mac	Yes	Regulating		Not achieved	3. No systematic release of substances, e	Natural system	
Estonia	interview with producer (100% of the sector covered)	algae valorization; algal cultivation	macroalgae value chain	macroalgae processing	Saaremaa Island	Lack of social recognition in rewarding the benefits of macroalgae	Unpaid ecosystem services	Development of quotas to pay for ecosy	low	moderate political interest	Amount of nutrients sequestred by macroalgal	kg nitrogen sequestred per tonne mac	Yes	Regulating		Not achieved	11. Business prosperity, competitiveness	Economy	
Estonia	interview with producer (100% of the sector covered)	algae valorization; algal cultivation	macroalgae value chain	macroalgae processing	Saaremaa Island	Lack of social recognition in rewarding the benefits of macroalgae	Unpaid ecosystem services	Development of quotas to pay for ecosy	low	moderate political interest	Amount of nutrients sequestred by macroalgal	kg nitrogen sequestred per tonne mac	Yes	Regulating		Not achieved	13. Virtuous policy and high moral value	Social system	
Estonia	interview with producer (100% of the sector covered)	algae valorization; algal cultivation	macroalgae value chain	macroalgae processing	Saaremaa Island	Lack of social recognition in rewarding the benefits of macroalgae	Unpaid ecosystem services	Development of quotas to pay for ecosy	low	moderate political interest	Amount of nutrients sequestred by macroalgal	kg nitrogen sequestred per tonne mac	Yes	Regulating		Not achieved	12. Justice: assurance of trusted, effectiv	Social system	
Estonia	interview with producer (100% of the sector covered)	algae valorization; algal cultivation	macroalgae value chain	macroalgae processing	Saaremaa Island	Difficulties in switching to green energies	Green energies	Governmental support for transition to	medium	moderate political interest	Share of green energy used	percentage				Not achieved	18. Economic sustainability for public/p	Economy	
Estonia	interview with producer (100% of the sector covered)	algae valorization; algal cultivation	macroalgae value chain	macroalgae processing	Saaremaa Island	Difficulties in switching to green energies	Green energies	Governmental support for transition to	medium	moderate political interest	Share of green energy used	percentage				Not achieved	1. Ecological system integrity: maintain	Natural system	
Estonia	interview with producer (100% of the sector covered)	algae valorization; algal cultivation	macroalgae value chain	macroalgae processing	Saaremaa Island	Need for better bioeconomy teaching modules at universities	Education	Governmental support for tailored educ	low	poor university funding for adding curricula	Availability of sector specialists	unitless				Not achieved	8. Education and capabilities' expansion	Human well-being	
Estonia	interview with producer (100% of the sector covered)	algae valorization; algal cultivation	macroalgae value chain	macroalgae processing	Saaremaa Island	Challenging to find employees in rural areas	Employees	Governmental support for rural develop	medium	none	Availability of sector specialists in rural areas	unitless				Not achieved	8. Education and capabilities' expansion	Human well-being	
Estonia	interview with producer (100% of the sector covered)	algae valorization; algal cultivation	macroalgae value chain	macroalgae processing	Saaremaa Island	Challenging to find employees in rural areas	Employees	Governmental support for rural develop	medium	none	Availability of sector specialists in rural areas	unitless				Achieved	5. Work and economy: access to varied a	Human well-being	
Estonia	interview with producer (100% of the sector covered)	algae valorization; algal cultivation	macroalgae value chain	macroalgae processing	Saaremaa Island	Limited amount of capital	Capital	Governmental financial support for sma	high	none	Systematic financial support for small scale bu	unitless				Achieved	18. Economic sustainability for public/p	Economy	
Estonia	interview with producer (100% of the sector covered)	algae valorization; algal cultivation	macroalgae value chain	macroalgae processing	Saaremaa Island	Lack of equality between individuals	Equality	Assure equal treatment among individu	high	none	Level of equality	unitless				Achieved	10. Equality between individuals and ory	Human well-being	
Estonia	interview with producer (100% of the sector covered)	algae valorization; algal cultivation	macroalgae value chain	macroalgae processing	Saaremaa Island	Salaries are not competitive	Salaries	Introduce competitive salaries	high	none	Happy employee index	unitless				Achieved	17. Economic sustainability for individu	Economy	
Estonia	interview with producer (100% of the sector covered)	algae valorization; algal cultivation	macroalgae value chain	macroalgae processing	Saaremaa Island	Underdeveloped IT solutions in rural areas	IT	Develop modern IT solutions in rural ar	medium	moderate political interest	Internet speed	megabits per second				Not achieved	15. Minimal infrastructure, technologie	Physical infrastructure	
Estonia	interview with producer (100% of the sector covered)	algae valorization; algal cultivation	macroalgae value chain	macroalgae processing	Saaremaa Island	Underdeveloped IT solutions in rural areas	IT	Develop modern IT solutions in rural ar	medium	moderate political interest	Internet speed	megabits per second				Not achieved	11. Business prosperity, competitiveness	Social system	
Estonia	interview with producer (100% of the sector covered)	algae valorization; algal cultivation	macroalgae value chain	macroalgae processing	Saaremaa Island	Underdeveloped IT solutions in rural areas	IT	Develop modern IT solutions in rural ar	medium	moderate political interest	Internet speed	megabits per second				Not achieved	18. Economic sustainability for public/p	Economy	
Estonia	interview with producer (100% of the sector covered)	algae valorization; algal cultivation	macroalgae value chain	macroalgae processing	Saaremaa Island	Difficulties to valorize products	Valorization	Governmental support for product valo	high	none	Profit per tonne of raw material	euros	Yes	Provisioning		Almost achieved	18. Economic sustainability for public/p	Economy	
Estonia	interview with producer (100% of the sector covered)	algae valorization; algal cultivation	macroalgae value chain	macroalgae processing	Saaremaa Island	Difficulties to valorize products	Valorization	Governmental support for product valo	high	none	Profit per tonne of raw material	euros	Yes	Provisioning		Almost achieved	11. Business prosperity, competitiveness	Social system	
Estonia	interview with producer (100% of the sector covered)	algae valorization; algal cultivation	macroalgae value chain	macroalgae processing	Saaremaa Island	Economic problems in times of crisis	Crisis	Government support for businesses in t	medium	none	Government investment in businesses	euros				Not achieved	18. Economic sustainability for public/p	Economy	
Estonia	interview with producer (100% of the sector covered)	algae valorization; algal cultivation	macroalgae value chain	macroalgae processing	Saaremaa Island	Overregulation: licencing is too slow and complex	Overregulation	Develop simple, fast and transparent lic	medium	none	Time to obtain a licence	years				Not achieved	13. Virtuous policy and high moral value	Social system	
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	not relevant	not relevant	Saaremaa Island	Enhance access to ecosystem services through the development of the Blue Economy	Restoring ecosystem services	Support the development of the blue economy in its broadest sense.	medium							Not achieved	1. Ecological system integrity: maintaining biological diversity and productivity	Natural system	
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	not relevant	not relevant	Saaremaa Island	Enhance access to ecosystem services through the development of the Blue Economy	Restoring ecosystem services	Support the development of the blue economy in its broadest sense.	medium							Not achieved	5. Work and economy: access to varied and satisfying opportunities for work and business, especially rural depressed areas	Economy	
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	not relevant	not relevant	Saaremaa Island	Enhance access to ecosystem services through the development of the Blue Economy	Restoring ecosystem services	Support the development of the blue economy in its broadest sense.	medium							Not achieved	9. Human well-being, freedom, privacy, individual human rights, peace, justice and happiness	Human well/being	
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	not relevant	not relevant	Saaremaa Island	Coastal seas must be managed by local authorities	Change governance	Change legislation to give more powers to local authorities.	low	At the moment, there is practically no political will to give local authorities more powers.	Amount of rights granted to local authorities to manage marine space (by area and/or by theme).	%		No	Not relevant	Not relevant	Not achieved	12. Justice: assurance of trusted, effective fair, accessible and just institutional, legal and judicial services and protection of the citizens, peace, democracy and plurality, public participation and bottom-up approaches. Assurance of basic human rights of physical and psychological integrity.	Social system	
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	not relevant	not relevant	Saaremaa Island	The environmental impact assessment process must be faster.	Governance efficiency	The rules governing the procedure for new blue bioeconomy initiatives need to be better spelled out and based on the principle of consistency, to allow for faster processing of documents. At present, officials are often not in a position to take decisions because no precedent has been set.	medium	Currently, there is no clear holistic view on the coordination of blue economy activities.	Time taken to process documents.	years		No	Not relevant	Not relevant	Not achieved	13. Virtuous policy and high moral values social structures and institutions support human rights and development and to the environmental sustainability, absence of corruption, transparency, accountability, ethics, wisdom and phronesis	Social system	
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	fishing value chain	fishing	Saaremaa Island	There is a need to develop nature-friendly fishing gears.	Technology solutions	The introduction of nature-friendly fishing gears (e.g. hemp and similar) that do not release micro-plastics into the environment and do not have significant by-catches.	medium	Lack or scarcity of appropriate technological solutions.	Share of nature-friendly fishing gear.	%		No	Not relevant	Not relevant	Not achieved	15. Minimal infrastructure, technologies and processes at support of human well-being	Physical infrastructure	
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain	aquaculture solutions	Saaremaa Island	Nature-friendly aquaculture systems need to be developed.	Technology solutions	The introduction of eco-friendly aquaculture solutions (e.g. hemp ropes, sheep's wool-filters) that do not release micro-plastics and other substances harmful to the environment.	medium	Lack or scarcity of appropriate technological solutions.	Share of nature-friendly aquaculture solutions.	%		No	Not relevant	Not relevant	Not achieved	15. Minimal infrastructure, technologies and processes at support of human well-being	Physical infrastructure	
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	not relevant	not relevant	Saaremaa Island	The development of economic activities must be based first on environmental considerations, as the state of the natural environment determines future economic potential.	Restore and/or maintain good environmental status	Marine management must strike a balance between the natural environment and economic objectives, make use of the best available knowledge and technological solutions, and avoid economic solutions that completely lack an environmental dimension.	medium	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.	Share of nature-friendly marine economy initiatives.	%		No	Not relevant	Not relevant	Not achieved	15. Minimal infrastructure, technologies and processes at support of human well-being	Physical infrastructure	
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	not relevant	not relevant	Saaremaa Island	The development of economic activities must be based first on environmental considerations, as the state of the natural environment determines future economic potential.	Restore and/or maintain good environmental status	Marine management must strike a balance between the natural environment and economic objectives, make use of the best available knowledge and technological solutions, and avoid economic solutions that completely lack an environmental dimension.	medium	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.	Share of nature-friendly marine economy initiatives.	%		No	Not relevant	Not relevant	Not achieved	13. Virtuous policy and high moral values social structures and institutions support human rights and development and to the environmental sustainability, absence of corruption, transparency, accountability, ethics, wisdom and phronesis	Social system	
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain	aquaculture solutions	Saaremaa Island	Establishment of a carbon and nutrient quota system for aquaculture.	Carbon and nutrient quotas	Setting up a system of carbon and nutrient quotas for aquaculture to support aquaculture solutions that improve the natural environment.	low	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.	Availability of a quota system.	unitless	Yes	Regulating	carbon and nutrient sequestration	Not achieved	1. Ecological system integrity: maintaining biological diversity and productivity	Natural system	

Estonia	2023.02.03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain	aquaculture solutions	Saaremaa Island	Establishment of a carbon and nutrient quota system for aquaculture.	Carbon and nutrient quotas	Setting up a system of carbon and nutrient quotas for aquaculture to support aquaculture solutions that improve the natural environment.	low	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.	Availability of a quota system.	unitless	Yes	Regulating	carbon and nutrient sequestration	Not achieved	13. Virtuous policy and high moral values social structures and institutions support human rights and development and to the environmental sustainability, absence of corruption, transparency, accountability, ethics, wisdom and phronesis	Social system
Estonia	2023.02.03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	not relevant	not relevant	Saaremaa Island	The creation of nature reserves must be based on the carbon and nutrient sequestration potential of habitats.	Climate mitigation, habitat restoration	There is a need to realistically map the carbon and nutrient sequestration potential of different habitats through experimental measurements and then use this knowledge to develop a network of protected areas.	high	Carrying out relevant research and linking the results to environmental objectives.	Calculations of the carbon and nutrient sequestration potential of protected areas.	unitless	Yes	Regulating	carbon and nutrient sequestration	Not achieved	1. Ecological system integrity: maintaining biological diversity and productivity	Natural system
Estonia	2023.02.03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain	entire value chain	Saaremaa Island	There is a need to develop low-trophic aquaculture solutions along the entire value chain.	Technology solutions	In the shellfish farming solution, more emphasis needs to be put on the development of harvesters that can also handle the smaller Baltic Sea shellfish, as well as the creation of industrial facilities for shellfish processing (protein, other valuable components). In addition, shellfish harvesting solutions should be developed that can be placed deeper in the water column (e.g. 3-4 m depth) to allow better co-use of different human activities (e.g. leasure boating). In the case of seaweed, there is a need to create algae farming solutions for the Estonian coastal areas and to develop industrial facilities for the refining of algae raw materials (alginates, pigments, etc.). In addition, there is a need to invest in educating the local population so that they would like to participate in such initiatives.	high	Scarcity of necessary investment measures	Investment in innovative research and development projects	euros	No	Not relevant	Not relevant	Not achieved	15. Minimal infrastructure, technologies and processes at support of human well-being	Physical infrastructure
Estonia	2023.02.03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain	entire value chain	Saaremaa Island	There is a need to develop low-atrophic aquaculture solutions along the entire value chain.	Technology solutions	In the shellfish farming solution, more emphasis needs to be put on the development of harvesters that can also handle the smaller Baltic Sea shellfish, as well as the creation of industrial facilities for shellfish processing (protein, other valuable components). In addition, shellfish harvesting solutions should be developed that can be placed deeper in the water column (e.g. 3-4 m depth) to allow better co-use of different human activities (e.g. leasure boating). In the case of seaweed, there is a need to create algae farming solutions for the Estonian coastal areas and to develop industrial facilities for the refining of algae raw materials (alginates, pigments, etc.). In addition, there is a need to invest in educating the local population so that they would like to participate in such initiatives.	high	Scarcity of necessary investment measures	Investment in innovative research and development projects	euros	No	Not relevant	Not relevant	Not achieved	13. Virtuous policy and high moral values social structures and institutions support human rights and development and to the environmental sustainability, absence of corruption, transparency, accountability, ethics, wisdom and phronesis	Social system
Estonia	2023.02.03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	not relevant	not relevant	Saaremaa Island	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.	Technology solutions	Creation of web-based decision support tools linking existing environmental datasets, scientific expertise and technological potential in such a way as to guide various blue economy initiatives.	high	Scarcity of necessary investment measures	Share of scientific and knowledge-based decision-making.	%	No	Not relevant	Not relevant	Not achieved	8. Education and capabilities' expansion: Independent and free education, open scientific debate, wisdom, phronesis and precaution	Social system
Estonia	2023.02.03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	not relevant	not relevant	Saaremaa Island	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.	Technology solutions	Creation of web-based decision support tools linking existing environmental datasets, scientific expertise and technological potential in such a way as to guide various blue economy initiatives.	high	Scarcity of necessary investment measures	Share of scientific and knowledge-based decision-making.	%	No	Not relevant	Not relevant	Not achieved	1. Ecological system integrity: maintaining biological diversity and productivity	Natural system
Estonia	2023.02.03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	macroalgae value chain	macroalgae harvesting and processing	Saaremaa Island	There is a need for the development of sustainable technologies that allow the use of seaweed piled on the beach for fertiliser production.	Technology solutions	Creating sustainable technologies that allow the use of seaweed piled on the beach for fertiliser production.	high	Scarcity of necessary investment measures	Amount of fertiliser produced from marine algae.	tonnes	Yes	Provisioning	Amount of marine algae harvested; amount of fertilizers produced	Not achieved	1. Ecological system integrity: maintaining biological diversity and productivity	Natural system
Estonia	2023.02.03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	macroalgae value chain	macroalgae harvesting and processing	Saaremaa Island	There is a need for the development of sustainable technologies that allow the use of seaweed piled on the beach for fertiliser production.	Technology solutions	Creating sustainable technologies that allow the use of seaweed piled on the beach for fertiliser production.	high	Scarcity of necessary investment measures	Amount of fertiliser produced from marine algae.	tonnes	Yes	Provisioning	Amount of marine algae harvested; amount of fertilizers produced	Not achieved	15. Minimal infrastructure, technologies and processes at support of human well-being	Physical infrastructure
Estonia	2023.02.03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	macroalgae value chain	macroalgae harvesting and processing	Saaremaa Island	There is a need for the development of sustainable technologies that allow the use of seaweed piled on the beach for agriculture growth substrate production.	Technology solutions	Creating sustainable technologies that allow the use of seaweed piled on the beach for agriculture growth substrate production.	high	Scarcity of necessary investment measures	Amount of agriculture growth substrate produced from marine algae.	tonnes	Yes	Provisioning	Amount of marine algae harvested; amount of agriculture growth substrate produced	Not achieved	1. Ecological system integrity: maintaining biological diversity and productivity	Natural system
Estonia	2023.02.03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	macroalgae value chain	macroalgae harvesting and processing	Saaremaa Island	There is a need for the development of sustainable technologies that allow the use of seaweed piled on the beach for agriculture growth substrate production.	Technology solutions	Creating sustainable technologies that allow the use of seaweed piled on the beach for agriculture growth substrate production.	high	Scarcity of necessary investment measures	Amount of agriculture growth substrate produced from marine algae.	tonnes	Yes	Provisioning	Amount of marine algae harvested; amount of agriculture growth substrate produced	Not achieved	15. Minimal infrastructure, technologies and processes at support of human well-being	Physical infrastructure
Estonia	2023.02.03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	not relevant	not relevant	Saaremaa Island	Significantly reduce nutrient flows from agriculture to the marine environment, allowing for improved development of different uses of the sea (tourism, aquaculture, etc.).	Technology solutions; improved policies	Implementing significantly more effective measures to limit diffuse pollution from agriculture to the marine environment.	low	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.	Equal treatment of land and sea-based initiatives.	unitless	No	Not relevant	Not relevant	Not achieved	13. Virtuous policy and high moral values social structures and institutions support human rights and development and to the environmental sustainability, absence of corruption, transparency, accountability, ethics, wisdom and phronesis	Social system
Estonia	2023.02.03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	not relevant	not relevant	Saaremaa Island	There is a need to address forestry, agriculture and the blue economy as an integrated concept.	Change governance; improved policies	Establish a joint development plan for forestry, agriculture and the blue economy.	medium	Lack of political interest in setting up such an integrated approach, limited expertise in assessing cross-sectoral impacts.	Equal treatment of land and sea-based initiatives.	unitless	No	Not relevant	Not relevant	Not achieved	13. Virtuous policy and high moral values social structures and institutions support human rights and development and to the environmental sustainability, absence of corruption, transparency, accountability, ethics, wisdom and phronesis	Social system
Estonia	2023.02.03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	not relevant	not relevant	Saaremaa Island	There should be many blue economy companies	Blue economy companies				Number of blue economy companies	count	No	Not relevant	Not relevant		11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions	Economy
Estonia	2023.02.03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	tourism	infrastructure supporting tourism	Saaremaa Island	Development of the Estonian islands and archipelago for cruises and other forms of tourism	Tourism	It is possible to rent a bike, a car or a bicycle to get around the island from any port in Saaremaa.		Why is he coming to my coast? Fishing tourism requires tourists to have their own boat to go out to sea. There are no restaurants in the harbour.			Yes	Cultural	Recreation and tourism		15. Minimal infrastructure, technologies and processes at support of human well-being	Economy
Estonia	2023.02.03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	tourism	infrastructure supporting tourism	Saaremaa Island	Development of very active marine tourism (bird watching, wildlife watching and observation).	Tourism	Development of smart harbours, reservations can be made at sea. One booking system for the whole Baltic Sea. Boat bottom cleaning in harbours. Shipwreck visits.		Weather conditions are unpredictable.			Yes	Cultural	Recreation and tourism		15. Minimal infrastructure, technologies and processes at support of human well-being	Economy
Estonia	2023.02.03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	fishing value chain	fishing	Saaremaa Island	Coastal fisheries must survive and thrive.	Coastal fisheries	Training and information available.		Young people are not coming up, and traditions are being lost.			Yes	Cultural	Education and training		8. Education and capabilities' expansion: Independent and free education, open scientific debate, wisdom, phronesis and precaution	Social system
Estonia	2023.02.03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	fishing value chain	fishing	Saaremaa Island	Coastal fisheries must survive and thrive	Coastal fisheries	Training centre in Saaremaa/subsidies for youth trainings		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			Yes	Cultural	Education and training		8. Education and capabilities' expansion: Independent and free education, open scientific debate, wisdom, phronesis and precaution	Social system
Estonia	2023.02.03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	fishing value chain	fishing	Saaremaa Island	Coastal fisheries must survive and thrive	Coastal fisheries	Sale of 1-day special fishing permits		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.			Yes	Cultural			13. Virtuous policy and high moral values social structures and institutions support human rights and development and to the environmental sustainability, absence of corruption, transparency, accountability, ethics, wisdom and phronesis	Social system
Estonia	2023.02.03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	fishing value chain	fishing	Saaremaa Island	The possibility of coastal fishing must be preserved for future generations	Coastal fisheries	Inherited fishing permits could be shared between several children.		Inheritable fishing permits that can only be passed on to one child at a time.			Yes	Cultural			13. Virtuous policy and high moral values social structures and institutions support human rights and development and to the environmental sustainability, absence of corruption, transparency, accountability, ethics, wisdom and phronesis	Social system

Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	fishing value chain	fishing	Saaremaa Island	Coastal fisheries must survive and thrive	Coastal fisheries	Information easily available	Uncertain where to fish			No	Not relevant	Education and training	8. Education and capabilities' expansion: Independent and free education, open scientific debate, wisdom, phronesis and precaution	Social system
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	fishing value chain	fish processing	Saaremaa Island	All fish raw materials have value and processed. A fish sector without waste.	Fish processing	Fish skins fully valorised.	Lack of information on the collection of fish skins.	Percentage of fish biomass used/valorised	%	yes	Provisioning		11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	fishing value chain	fish processing	Saaremaa Island	All fish raw materials have value and processed. A fish sector without waste.	Fish processing	Fish skins fully valorised.	Do not know what to do with bones, heads and other parts of the fish left over from primary processing.	Percentage of fish biomass used/valorised	%	yes	Provisioning		11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	fishing value chain	fish processing	Saaremaa Island	All fish raw materials have value and processed. A fish sector without waste.	Fish processing	Fish skin product design development		Percentage of fish biomass used/valorised	%	yes	Cultural		11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	fishing value chain	fish processing	Saaremaa Island	All fish raw materials have value and processed. A fish sector without waste.	Fish processing	Finding a wider use for fish meal.		Percentage of fish biomass used/valorised	%	yes	Provisioning		11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	fishing value chain	fish processing	Saaremaa Island	All fish raw materials have value and processed. A fish sector without waste.	Fish processing	Use of fish oil in medicine, pharmaceutical industry.		Percentage of fish biomass used/valorised	%	yes	Provisioning		11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	fishing value chain	fish marketing	Saaremaa Island	Increasing the popularity of fish dishes.	Fish consumption	Fish crisps also for human consumption. Processing of fish skin for human consumption.				yes	Provisioning		11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	fishing value chain	fish marketing	Saaremaa Island	Increasing the popularity of fish dishes.	Fish consumption	Share information that fish from the Baltic Sea is mostly non-toxic and safe.				yes	Cultural		11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	fishing value chain	fish marketing	Saaremaa Island	Increasing the popularity of fish dishes.	Fish consumption	Communicating scientific information to citizens and consumers.				yes	Cultural		11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	fishing value chain	fish marketing	Saaremaa Island	Increasing the popularity of fish dishes.	Fish consumption	Free seafood promotions (buy x amount and get 1 free seafood product).				yes	Provisioning		11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	fishing value chain	fish marketing	Saaremaa Island	Increasing the popularity of fish dishes.	Fish consumption	Create a fish festival in Saaremaa. In this festival fish products for eating and other fish products (oil, skin) are presented.				yes	Cultural		11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	fishing value chain	seaweed marketing	Saaremaa Island	Wider use of furcellaran.	Seaweed consumption		Lack of knowledge			yes	Provisioning		11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	fishing value chain	fish marketing	Saaremaa Island	Increasing the popularity of fish dishes.	Fish consumption	Familiarisation of children with fish dishes from kindergarten onwards.				yes	Cultural		11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	fishing value chain	fish marketing	Saaremaa Island	Increasing the popularity of fish dishes.	Fish consumption	Involving children in cooking at kindergarten level through the establishment of cooking classes and children's circles.				yes	Cultural		11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	fishing value chain	fish marketing	Saaremaa Island	Increasing the popularity of fish dishes.	Fish consumption	Special days for fish and seafood dishes.				yes	Cultural		11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	fishing value chain	fish marketing	Saaremaa Island	Increasing the popularity of fish dishes.	Fish consumption	Very good availability of cleaned fish in shops.				yes	Not relevant		11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	fishing value chain	fish marketing	Saaremaa Island	Increasing the popularity of fish dishes.	Fish consumption	Create visually and spatially appealing and innovative fishmongery/fish shops with aquariums.				yes	Cultural		11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	fishing value chain	fish marketing	Saaremaa Island	Increasing the popularity of fish dishes.	Fish consumption	Adult fish cooking workshops.				yes	Cultural		11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	fishing value chain	fish marketing	Saaremaa Island	All fish raw materials have value and processed. A fish sector without waste.		Fish workshops for adults (skinning, boning).				yes	Cultural		11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	fishing value chain	fish marketing	Saaremaa Island	Increasing the popularity of fish dishes.		National information campaigns on why fish is good for you and why you need fish.				yes	Cultural		11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	fishing value chain	fish marketing	Saaremaa Island	Increasing the popularity of fish dishes.		In Saaremaa Spa and other recreational facilities, fish dishes are on the menu. Since the stomach is empty anyway, fish dishes can be popularised by offering, for example, a free cocktail, drink or cake.				yes	Cultural		11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	fishing value chain	fish marketing	Saaremaa Island	Increasing the popularity of fish dishes.		Delivering a message: fish is a superfood.				yes	Cultural		11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	not relevant	not relevant	Saaremaa Island	Developing broader curricula for hands-on maritime education in schools.	Maritime education		Curricula too intensive, no time to study alternative subjects.			yes	Cultural		8. Education and capabilities' expansion: Independent and free education, open scientific debate, wisdom, phronesis and precaution	Social system

Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	not relevant	not relevant	Saaremaa Island	Developing broader curricula for hands-on maritime education in schools.	Maritime education	Involvement of practitioners in school classes and visits to interesting maritime sites.		Schools do not have the resources to use chartered buses to travel further afield. This is expensive for parents.			yes	Cultural			8. Education and capabilities' expansion: Independent and free education, open scientific debate, wisdom, phronesis and precaution	Social system
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	not relevant	not relevant	Saaremaa Island	Improving the training of tourism operators	Maritime education			Educational programmes on seafaring, the blue economy, for tourism operators.			yes	Cultural			8. Education and capabilities' expansion: Independent and free education, open scientific debate, wisdom, phronesis and precaution	Social system
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	not relevant	not relevant	Saaremaa Island	A broad-based (from biology to technology) maritime education curriculum for Saaremaa.	Maritime education						yes	Cultural			8. Education and capabilities' expansion: Independent and free education, open scientific debate, wisdom, phronesis and precaution	Social system
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	not relevant	not relevant	Saaremaa Island	Developing broader curricula for hands-on maritime education in schools.	Maritime education	Better community engagement.					yes	Cultural			8. Education and capabilities' expansion: Independent and free education, open scientific debate, wisdom, phronesis and precaution	Social system
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	not relevant	not relevant	Saaremaa Island	Skipper training in Saaremaa	Maritime education						yes	Cultural			8. Education and capabilities' expansion: Independent and free education, open scientific debate, wisdom, phronesis and precaution	Social system
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	not relevant	not relevant	Saaremaa Island	Opening of a maritime class at the Saaremaa State Gymnasium.	Maritime education						yes	Cultural			8. Education and capabilities' expansion: Independent and free education, open scientific debate, wisdom, phronesis and precaution	Social system
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	not relevant	not relevant	Saaremaa Island	Creation of a blue bio-economy centre of excellence in Saaremaa	Maritime education						yes	Cultural			8. Education and capabilities' expansion: Independent and free education, open scientific debate, wisdom, phronesis and precaution	Social system
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	energy value chain	wind energy production	Saaremaa Island	Construction and maintenance of wind turbines on the island of Saaremaa and surrounding sea areas	Wind energy production	Wind turbine maintenance in Saaremaa. Related training at Saaremaa Vocational School.		The vocational school is not in a position to deal with specific issues.			yes	Cultural			8. Education and capabilities' expansion: Independent and free education, open scientific debate, wisdom, phronesis and precaution	Social system
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	not relevant	not relevant	Saaremaa Island	Training for skippers with special skills	Maritime education						yes	Cultural			8. Education and capabilities' expansion: Independent and free education, open scientific debate, wisdom, phronesis and precaution	Social system
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	not relevant	not relevant	Saaremaa Island	The sea should be clean and rich in species.	Ecological system integrity			Blue-green algae, paraffin and other contaminants.			yes	Regulating			1. Ecological system integrity: maintaining biological diversity and productivity	Natural system
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	fishing value chain	fishing	Saaremaa Island	Fish stocks need improvement	Fish stock integrity	We should start with the valorisation of fish that have been of low value but for which stocks are higher, e.g. Carassius carassius		No fish, no perch (Perca fluviatilis) in many coastal areas.			yes	Provisioning			15. Minimal infrastructure, technologies and processes at support of human well-being	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	energy value chain	wind energy production	Saaremaa Island	Developing offshore wind farms to meet energy needs	Wind energy production			The opposition at the local level			yes	Provisioning			11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	energy value chain	wind energy production	Saaremaa Island	Developing offshore wind farms to meet energy needs	Wind energy production	Scientific research is needed to manage all these risks.		Local communities believe that fish and birds will disappear if wind farms are built in the sea.			yes	Regulating			11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	energy value chain	wind energy production	Saaremaa Island	Developing offshore wind farms to meet energy needs	Wind energy production			Locals do not like the deteriorating sea view			yes	Cultural			11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	energy value chain	wind energy production	Saaremaa Island	Developing offshore wind farms to meet energy needs	Wind energy production			Noise and vibration increase after wind turbine installation			yes	Cultural			11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	energy value chain	wind energy production	Saaremaa Island	Developing offshore wind farms to meet energy needs	Wind energy production	Wind turbine maintenance in Saaremaa. Related training at Saaremaa Vocational School.		Weak energy expertise			yes	Cultural			11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	energy value chain	wind energy production	Saaremaa Island	Developing offshore wind farms to meet energy needs	Wind energy production	Wind turbine maintenance in Saaremaa. Related training at Saaremaa Vocational School.		No engineers available			yes	Cultural			11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	energy value chain	wind energy production	Saaremaa Island	There is a need for the development of an energy-independent Saaremaa.	Energy security			We are not sure that our basic needs will be met.			yes	Provisioning			15. Minimal infrastructure, technologies and processes at support of human well-being	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	energy value chain	wind energy production	Saaremaa Island	Developing offshore wind farms to meet energy needs	Wind energy production	Free electricity on the Sõrve peninsula		What is the direct benefit to the people of Saaremaa? Current solutions do not demonstrate that the local community benefits.			yes	Provisioning			11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	energy value chain	wind energy production	Saaremaa Island	Development of solar power plants for energy needs	Wind energy production	Neighbours get free electricity		What is the direct benefit to the people of Saaremaa? Current solutions do not demonstrate that the local community benefits.			yes	Provisioning			11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	energy value chain	wind energy production	Saaremaa Island	Developing offshore wind farms to meet energy needs	Wind energy production			Saaremaa island gets waste, environmental degradation, negative environmental impact			yes	Regulating			11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	energy value chain	solar energy production	Saaremaa Island	Developing offshore wind farms to meet energy needs	Solar energy production	Solar panels for an alternative way of producing green energy. Batteries for energy storage		No wind			yes	Provisioning			11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	energy value chain	wind energy production	Saaremaa Island	Developing offshore wind farms to meet energy needs	Wind energy production	It is important to communicate wind measurement information objectively, as offshore areas tend to have strong winds.		No wind			yes	Provisioning			11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	not relevant	not relevant	Saaremaa Island	Establishment of a Baltic Sea Centre for the Blue Economy	Blue economy centre	Exhibitions, conferences, information for locals and tourists					yes	Cultural			8. Education and capabilities' expansion: Independent and free education, open scientific debate, wisdom, phronesis and precaution	Social system
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	energy value chain	wind energy production	Saaremaa Island	Developing offshore wind farms to meet energy needs	Wind energy production	Mapping of the seabed, impact studies		Potentially hazardous to the environment			yes	Cultural			8. Education and capabilities' expansion: Independent and free education, open scientific debate, wisdom, phronesis and precaution	Social system
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain; fishing value chain; macroalgae value chain	entire value chain	Saaremaa Island	Offshore wind farms	Technology solutions; gree	Governmental financial support for technology improvement and rural development	medium	Increasing the transmission capacity of power lines	Share of green energy used	%	yes		Not relevant	Not achieved	18. Economic sustainability for public/private organisations	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain; fishing value chain; macroalgae value chain	entire value chain	Saaremaa Island	Offshore wind farms	Technology solutions; gree	Governmental financial support for technology improvement and rural development	medium	Increasing the transmission capacity of power lines	Share of green energy used	%			Not relevant	Not achieved	5. Work and economy: access to varied and satisfying opportunities for work and business, especially rural depressed areas	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain; fishing value chain; macroalgae value chain	entire value chain	Saaremaa Island	Difficulties in switching to green energies	Technology solutions; gree	Governmental financial support for technology improvement and rural development	medium	Increasing the transmission capacity of power lines	Share of green energy used	%			Not relevant	Not achieved	18. Economic sustainability for public/private organisations	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain; fishing value chain; macroalgae value chain	entire value chain	Saaremaa Island	Difficulties in switching to green energies	Technology solutions; gree	Governmental financial support for technology improvement and rural development	medium	Increasing the transmission capacity of power lines	Share of green energy used	%			Not relevant	Not achieved	5. Work and economy: access to varied and satisfying opportunities for work and business, especially rural depressed areas	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain; fishing value chain; macroalgae value chain	entire value chain	Saaremaa Island	Reliable independent large-scale electricity supply	Technology solutions; gree	Governmental financial support for technology improvement and rural development	medium	Increasing the transmission capacity of power lines	Share of green energy used	%			Not relevant	Not achieved	18. Economic sustainability for public/private organisations	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain; fishing value chain; macroalgae value chain	entire value chain	Saaremaa Island	Reliable independent large-scale electricity supply	Technology solutions; gree	Governmental financial support for technology improvement and rural development	medium	Increasing the transmission capacity of power lines	Share of green energy used	%			Not relevant	Not achieved	5. Work and economy: access to varied and satisfying opportunities for work and business, especially rural depressed areas	Economy

Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain; fishing value chain; macroalgae value chain	entire value chain	Saaremaa Island	Blue Economy would be 25% from the GDP in Saaremaa	Technology solutions; gree	Governmental financial support for technology improvement and rural development	low	Increasing the transmission capacity of power lines	Share of nature-friendly marine economy initiatives.	%	No	Not relevant	Not relevant	Not achieved	15. Minimal infrastructure, technologies and processes at support of human well-being	Physical infrastructure
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain; fishing value chain; macroalgae value chain	entire value chain	Saaremaa Island	Blue Economy would be 25% from the GDP in Saaremaa	Technology solutions; gree	Governmental financial support for technology improvement and rural development	low	Increasing the transmission capacity of power lines	Share of nature-friendly marine economy initiatives.	%	No	Not relevant	Not relevant	Not achieved	5. Work and economy: access to varied and satisfying opportunities for work and business, especially rural depressed areas	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain; fishing value chain; macroalgae value chain	entire value chain	Saaremaa Island	Blue Bioeconomy would be at least 10% from the GDP in Estonia	Technology solutions; gree	Governmental financial support for technology improvement and rural development	low	Increasing the transmission capacity of power lines	Share of nature-friendly marine economy initiatives.	%	No	Not relevant	Not relevant	Not achieved	15. Minimal infrastructure, technologies and processes at support of human well-being	Physical infrastructure
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain; fishing value chain; macroalgae value chain	entire value chain	Saaremaa Island	Blue Bioeconomy would be at least 10% from the GDP in Estonia	Technology solutions; gree	Governmental financial support for technology improvement and rural development	low	Increasing the transmission capacity of power lines	Share of nature-friendly marine economy initiatives.	%	No	Not relevant	Not relevant	Not achieved	5. Work and economy: access to varied and satisfying opportunities for work and business, especially rural depressed areas	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain; fishing value chain; macroalgae value chain	entire value chain	Saaremaa Island	Hybrid parks combining different aquaculture farms	Technology solutions; gree	Governmental financial support for technology improvement and rural development	low	Increasing the transmission capacity of power lines	Share of nature-friendly aquaculture solutions.	%	No	Not relevant	Not relevant	Not achieved	1. Ecological system integrity: maintaining biological diversity and productivity	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain; fishing value chain; macroalgae value chain	entire value chain	Saaremaa Island	Hybrid parks combining different aquaculture farms	Technology solutions; gree	Governmental financial support for technology improvement and rural development	low	Increasing the transmission capacity of power lines	Share of nature-friendly aquaculture solutions.	%	No	Not relevant	Not relevant	Not achieved	18. Economic sustainability for public/private organisations	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain; fishing value chain; macroalgae value chain	entire value chain	Saaremaa Island	Hybrid parks combining different aquaculture farms	Technology solutions; gree	Governmental financial support for technology improvement and rural development	low	Increasing the transmission capacity of power lines	Share of nature-friendly marine economy initiatives.	%	No	Not relevant	Not relevant	Not achieved	13. Virtuous policy and high moral values social structures and institutions support human rights and development and to the environmental sustainability, absence of corruption, transparency, accountability, ethics, wisdom and phronesis	Social system
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain; fishing value chain; macroalgae value chain	entire value chain	Saaremaa Island	Hybrid parks combining different aquaculture farms	Technology solutions; gree	Governmental financial support for technology improvement and rural development	low	Increasing the transmission capacity of power lines	Share of nature-friendly marine economy initiatives.	%	No	Not relevant	Not relevant	Not achieved	15. Minimal infrastructure, technologies and processes at support of human well-being	Physical infrastructure
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain; fishing value chain; macroalgae value chain	entire value chain	Saaremaa Island	Port infrastructure meets the needs of the Blue Economy	Technology solutions; green energies; change governance	Change legislation to give more powers to local authorities. Establishment of the port that is owned by Saaremaa municipality	low	At the moment, there is practically no political will to give local authorities more powers.	Amount of rights granted to local authorities to manage marine space (by area and/or by theme).	%	No	Not relevant	Not relevant	Not achieved	12. Justice: assurance of trusted, effective fair, accessible and just institutional, legal and judicial services and protection of the citizens, peace, democracy and plurality, public participation and bottom-up approaches. Assurance of basic human rights of physical and psychological integrity.	Social system
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain; fishing value chain; macroalgae value chain	entire value chain	Saaremaa Island	Port infrastructure meets the needs of the Blue Economy	Technology solutions; green energies; change governance	Change legislation to give more powers to local authorities. Establishment of the port that is owned by Saaremaa municipality	low	At the moment, there is practically no political will to give local authorities more powers.	Amount of rights granted to local authorities to manage marine space (by area and/or by theme).	%	No	Not relevant	Not relevant	Not achieved	18. Economic sustainability for public/private organisations	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain; fishing value chain; macroalgae value chain	entire value chain	Saaremaa Island	Port infrastructure meets the needs of the Blue Economy	Technology solutions; green energies; change governance	Change legislation to give more powers to local authorities. Establishment of the port that is owned by Saaremaa municipality	low	At the moment, there is practically no political will to give local authorities more powers.	Amount of rights granted to local authorities to manage marine space (by area and/or by theme).	%	No	Not relevant	Not relevant	Not achieved	5. Work and economy: access to varied and satisfying opportunities for work and business, especially rural depressed areas	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain; fishing value chain; macroalgae value chain	entire value chain	Saaremaa Island	Offshore production would stay in the local community (YIMBY)	Change governence	Change legislation to give more powers to local authorities.	low	At the moment, there is practically no political will to give local authorities more powers.	Amount of rights granted to local authorities to manage marine space (by area and/or by theme).	%	No	Not relevant	Not relevant	Not achieved	18. Economic sustainability for public/private organisations	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain; fishing value chain; macroalgae value chain	entire value chain	Saaremaa Island	Offshore production would stay in the local community (YIMBY)	Change governence	Change legislation to give more powers to local authorities.	low	At the moment, there is practically no political will to give local authorities more powers.	Amount of rights granted to local authorities to manage marine space (by area and/or by theme).	%	No	Not relevant	Not relevant	Not achieved	5. Work and economy: access to varied and satisfying opportunities for work and business, especially rural depressed areas	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain; fishing value chain; macroalgae value chain	entire value chain	Saaremaa Island	Offshore production would stay in the local community (YIMBY)	Change governence	Change legislation to give more powers to local authorities.	low	At the moment, there is practically no political will to give local authorities more powers.	Amount of rights granted to local authorities to manage marine space (by area and/or by theme).	%	No	Not relevant	Not relevant	Not achieved	11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain; fishing value chain; macroalgae value chain	entire value chain	Saaremaa Island	University campus that would be managed by all Estonian univerities	Education	Establishment of the joint university campus for Saaremaa	low	Regional education policy needs to be developed	Availability of sector specialists	unitless	No	Not relevant	Not relevant	Not achieved	8. Education and capabilities' expansion: Independent and free education, open scientific debate, wisdom, phronesis and precaution	Social system
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain; fishing value chain; macroalgae value chain	entire value chain	Saaremaa Island	University campus that would be managed by all Estonian univerities	Education	Establishment of the joint university campus for Saaremaa	low	Lack of research and education infrastructure	Availability of sector specialists	unitless	No	Not relevant	Not relevant	Not achieved	8. Education and capabilities' expansion: Independent and free education, open scientific debate, wisdom, phronesis and precaution	Social system
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain; fishing value chain; macroalgae value chain	entire value chain	Saaremaa Island	University campus that would be managed by all Estonian univerities	Education	Establishment of the joint university campus for Saaremaa	low	Lack of intrest	Availability of sector specialists	unitless	No	Not relevant	Not relevant	Not achieved	8. Education and capabilities' expansion: Independent and free education, open scientific debate, wisdom, phronesis and precaution	Social system
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain; fishing value chain; macroalgae value chain	entire value chain	Saaremaa Island	University campus that would be managed by all Estonian univerities	Education	Establishment of the joint university campus for Saaremaa	low	Economic benefits might be questionable	Availability of sector specialists	unitless	No	Not relevant	Not relevant	Not achieved	8. Education and capabilities' expansion: Independent and free education, open scientific debate, wisdom, phronesis and precaution	Social system
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain; fishing value chain; macroalgae value chain	entire value chain	Saaremaa Island	University campus that would be managed by all Estonian univerities	Education	Establishment of the joint university campus for Saaremaa	low	Reputation of the Baltic Sea is underestimated	Availability of sector specialists	unitless	No	Not relevant	Not relevant	Not achieved	8. Education and capabilities' expansion: Independent and free education, open scientific debate, wisdom, phronesis and precaution	Social system
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain; fishing value chain; macroalgae value chain	entire value chain	Saaremaa Island	Improving the tourism of Blue Bioeconomy	Tourism	Establisment of the discovery center of Blue Bioeconomy	low	Regional education policy needs to be developed	Availability of sector specialists	unitless	No	Cultural	Not relevant	Not achieved	8. Education and capabilities' expansion: Independent and free education, open scientific debate, wisdom, phronesis and precaution	Social system
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain; fishing value chain; macroalgae value chain	entire value chain	Saaremaa Island	Improving the tourism of Blue Bioeconomy	Tourism	Establisment of the discovery center of Blue Bioeconomy	low	Lack of intrest	Availability of sector specialists	unitless	No	Cultural	Not relevant	Not achieved	8. Education and capabilities' expansion: Independent and free education, open scientific debate, wisdom, phronesis and precaution	Social system
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain; fishing value chain; macroalgae value chain	entire value chain	Saaremaa Island	Improving the tourism of Blue Bioeconomy	Tourism	Establisment of the discovery center of Blue Bioeconomy	low	Economic benefits might be questionable	Availability of sector specialists	unitless	No	Cultural	Not relevant	Not achieved	8. Education and capabilities' expansion: Independent and free education, open scientific debate, wisdom, phronesis and precaution	Social system
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain; fishing value chain; macroalgae value chain	entire value chain	Saaremaa Island	Improving the tourism of Blue Bioeconomy	Tourism	Establisment of the discovery center of Blue Bioeconomy	low	Reputation of the Baltic Sea is underestimated	Availability of sector specialists	unitless	No	Cultural	Not relevant	Not achieved	8. Education and capabilities' expansion: Independent and free education, open scientific debate, wisdom, phronesis and precaution	Social system
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain; fishing value chain; macroalgae value chain	entire value chain	Saaremaa Island	Improving the tourism of Blue Bioeconomy	Tourism	Establisment of the discovery center of Blue Bioeconomy	low	Regional education policy needs to be developed	Availability of sector specialists	unitless	No	Cultural	Not relevant	Not achieved	5. Work and economy: access to varied and satisfying opportunities for work and business, especially rural depressed areas	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain; fishing value chain; macroalgae value chain	entire value chain	Saaremaa Island	Improving the tourism of Blue Bioeconomy	Tourism	Establisment of the discovery center of Blue Bioeconomy	low	Lack of intrest	Availability of sector specialists	unitless	No	Cultural	Not relevant	Not achieved	5. Work and economy: access to varied and satisfying opportunities for work and business, especially rural depressed areas	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain; fishing value chain; macroalgae value chain	entire value chain	Saaremaa Island	Improving the tourism of Blue Bioeconomy	Tourism	Establisment of the discovery center of Blue Bioeconomy	low	Economic benefits might be questionable	Availability of sector specialists	unitless	No	Cultural	Not relevant	Not achieved	5. Work and economy: access to varied and satisfying opportunities for work and business, especially rural depressed areas	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain; fishing value chain; macroalgae value chain	entire value chain	Saaremaa Island	Improving the tourism of Blue Bioeconomy	Tourism	Establisment of the discovery center of Blue Bioeconomy	low	Reputation of the Baltic Sea is underestimated	Availability of sector specialists	unitless	No	Cultural	Not relevant	Not achieved	5. Work and economy: access to varied and satisfying opportunities for work and business, especially rural depressed areas	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain; fishing value chain; macroalgae value chain	entire value chain	Saaremaa Island	Salaries are not competitive	Improve salaries	Establishment of the joint university campus for Saaremaa	high	Lack of research and education infrastructure	Happy employee index	unitless				Not achieved	17. Economic sustainability for individuals	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain; fishing value chain; macroalgae value chain	entire value chain	Saaremaa Island	Salaries are not competitive	Improve salaries	Establishment of the discovery center of Blue Bioeconomy	high	Lack of research and education infrastructure	Happy employee index	unitless				Not achieved	17. Economic sustainability for individuals	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain; fishing value chain; macroalgae value chain	entire value chain	Saaremaa Island	Salaries are not competitive	Improve salaries	Establishment of the joint university campus for Saaremaa	high	Regional education policy needs to be developed	Happy employee index	unitless				Not achieved	17. Economic sustainability for individuals	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain; fishing value chain; macroalgae value chain	entire value chain	Saaremaa Island	Salaries are not competitive	Improve salaries	Establishment of the discovery center of Blue Bioeconomy	high	Regional education policy needs to be developed	Happy employee index	unitless				Not achieved	17. Economic sustainability for individuals	Economy
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain; fishing value chain; macroalgae value chain	entire value chain	Saaremaa Island	Systematic maritime primary education	Education	Establishment of the joint university campus for Saaremaa	low	Regional education policy needs to be developed		unitless	No	Not relevant	Not relevant	Not achieved	8. Education and capabilities' expansion: Independent and free education, open scientific debate, wisdom, phronesis and precaution	Social system
Estonia	2023 02 03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain; fishing value chain; macroalgae value chain	entire value chain	Saaremaa Island	Systematic maritime primary education	Education	Establishment of the joint university campus for Saaremaa	low	Lack of research and education infrastructure		unitless	No	Not relevant	Not relevant	Not achieved	8. Education and capabilities' expansion: Independent and free education, open scientific debate, wisdom, phronesis and precaution	Social system

Estonia	2023.02.03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain; fishing value chain; macroalgae value chain	entire value chain	Saaremaa Island	Systematic maritime primary education	Education	Establishment of the joint university campus for Saaremaa	low	Economic benefits might be questionable		unitless	No	Not relevant	Not relevant	Not achieved	8. Education and capabilities' expansion: Independent and free education, open scientific debate, wisdom, phronesis and precaution	Social system
Estonia	2023.02.03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	not relevant	not relevant	Saaremaa Island	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).	Education	Electrical ferries, new solutions; synergies between windparks and ferry transport (passenger and cargo)	low	Awareness of the citizens, politicians; lack of knowledge	Informed public	unitless	no	Not relevant	Not relevant	Not achieved	8. Education and capabilities' expansion: Independent and free education, open scientific debate, wisdom, phronesis and precaution; 5. Work and economy: access to varied and satisfying opportunities for work and business, especially rural depressed areas	Social system
Estonia	2023.02.03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	not relevant	not relevant	Saaremaa Island	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.	Governance efficiency	need for complete solutions	low	fragmentation of responsibilities (at higher level status quo is prefered) - need for a holistic approach	Amount of rights granted to local authorities to manage marine space (by area and/or by theme).	%	no	Not relevant	Not relevant	Not achieved	12. Justice: assurance of trusted, effective fair, accessible and just institutional, legal and judicial services and protection of the citizens, peace, democracy and plurality, public participation and bottom-up approaches. Assurance of basic human rights of physical and psychological integrity; 11. Business prosperity,	Social system
Estonia	2023.02.03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	not relevant	not relevant	Saaremaa Island	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.	Education	bring in experts, know-how, guest lecturers ; cooperation between entrepreneurs and scientists	low	lack of knowledge and competence	Lack/availability of sector specialists	unitless	no	Not relevant	Not relevant	Not achieved	8. Education and capabilities' expansion: Independent and free education, open scientific debate, wisdom, phronesis and precaution; 5. Work and economy: access to varied and satisfying opportunities for work and business, especially rural depressed areas	Social system
Estonia	2023.02.03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	not relevant	not relevant	Saaremaa Island	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.	Governance efficiency	"sea" ministry	low	regulatory hurdles, difficult to build anything on the sea - long expensive complex procedures.	Amount of rights granted to local authorities to manage marine space (by area and/or by theme).	%	no	Not relevant	Not relevant	Not achieved	12. Justice: assurance of trusted, effective fair, accessible and just institutional, legal and judicial services and protection of the citizens, peace, democracy and plurality, public participation and bottom-up approaches. Assurance of basic human rights of physical and psychological integrity; 11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and	Social system
Estonia	2023.02.03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	not relevant	not relevant	Saaremaa Island	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.	Technology solutions; finantial capital	pilots, cooperation between entrepreneurs and scientists	low	difficult to start - capital-intensive sector	new businesses started	nr of businesses	no	Not relevant	Not relevant	Not achieved	5. Work and economy: access to varied and satisfying opportunities for work and business, especially rural depressed areas	Economy
Estonia	2023.02.03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	not relevant	not relevant	Saaremaa Island	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.	Education	raise awareness, teach, open businesses to public (visits)	low	not in my backyard	Lack/availability of sector specialists	unitless	no	Not relevant	Not relevant	Not achieved	8. Education and capabilities' expansion: Independent and free education, open scientific debate, wisdom, phronesis and precaution; 5. Work and economy: access to varied and satisfying opportunities for work and business, especially rural depressed areas	Social system
Estonia	2023.02.03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	not relevant	not relevant	Saaremaa Island	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.	capital	need for complete solutions	medium	loans difficult to access	new businesses started	nr of businesses	no	Not relevant	Not relevant	Not achieved	17. Economic sustainability for individuals, 18. Economic sustainability for public/private organisations	Economy
Estonia	2023.02.03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	not relevant	not relevant	Saaremaa Island	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.	Education	pilots, cooperation between entrepreneurs and scientists, open businesses- raise awareness, less wrong information	low	high risk field- will you get all permits?	Lack/availability of sector specialists	unitless	no	Not relevant	Not relevant	Not achieved	8. Education and capabilities' expansion: Independent and free education, open scientific debate, wisdom, phronesis and precaution; 5. Work and economy: access to varied and satisfying opportunities for work and business, especially rural depressed areas	Social system
Estonia	2023.02.03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	not relevant	not relevant	Saaremaa Island	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.	Governance efficiency	active citizens, citizens get profit from value chains (20%),	low	availability of services, accessibility (how to get more people into rural areas?), good transport connections	share of locals in developments	%	no	Not relevant	Not relevant	Not achieved	17. Economic sustainability for individuals, 8. Education and capabilities' expansion: Independent and free education, open scientific debate, wisdom, phronesis and precaution; 5. Work and economy: access to varied and satisfying opportunities for work and business, especially rural depressed areas	Economy
Estonia	2023.02.03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	not relevant	not relevant	Saaremaa Island	Tourism: developing tourism, extending the season, better marketing of local produce, higher incomes for locals - higher added value of products&services	Tourism, governance	entrepreneurs position themselves (local quality); pilots	low	access and good (direct) transport connections	access to mainland	unitless	no	Not relevant	Not relevant		5. Work and economy: access to varied and satisfying opportunities for work and business, especially rural depressed areas, 17. Economic sustainability for individuals, 18. Economic sustainability for public/private organisations	social system, economy
Estonia	2023.02.03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	not relevant	not relevant	Saaremaa Island	Tourism: developing tourism, extending the season, better marketing of local produce, higher incomes for locals - higher added value of products&services	Tourism	entrpreneurs positions themselves; what kind of tourist is expected- position and targeted marketing	low	on-site local (food/produce) sale, better access	Availability of sector specialists	unitless	No	Cultural	tourism	Not achieved	5. Work and economy: access to varied and satisfying opportunities for work and business, especially rural depressed areas, 17. Economic sustainability for individuals, 18. Economic sustainability for public/private organisations	social system, economy
Estonia	2023.02.03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	not relevant	not relevant	Saaremaa Island	Tourism: developing tourism, extending the season, better marketing of local produce, higher incomes for locals - higher added value of products&services	Tourism	encourage new services (go fishing with a local fisherman)- to diversify their income and offer more tourist activities	low	few specialised services and tour guides e.g. air tourism, hunting tourism, niche tourism	Availability of sector specialists	unitless	No	Cultural	tourism	Not achieved	5. Work and economy: access to varied and satisfying opportunities for work and business, especially rural depressed areas, 17. Economic sustainability for individuals, 18. Economic sustainability for public/private organisations	social system, economy
Estonia	2023.02.03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	not relevant	not relevant	Saaremaa Island	Tourism: developing tourism, extending the season, better marketing of local produce, higher incomes for locals - higher added value of products&services	Tourism	diversify products and services, pilots, learn from other countries	low	seasonality	Availability of sector specialists	unitless	No	Cultural	tourism	Not achieved	5. Work and economy: access to varied and satisfying opportunities for work and business, especially rural depressed areas, 17. Economic sustainability for individuals, 18. Economic sustainability for public/private organisations	social system, economy
Estonia	2023.02.03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	not relevant	not relevant	Saaremaa Island	Tourism: developing tourism, extending the season, better marketing of local produce, higher incomes for locals - higher added value of products&services	Tourism, governance	active citizens, citizens get profit from value chains (20%), encourage businesses at rural areas (offer infrastructure)	low	urbanisation	share of people living at rural areas	%	no	Not relevant	Not relevant	Not achieved	5. Work and economy: access to varied and satisfying opportunities for work and business, especially rural depressed areas	Social system
Estonia	2023.02.03 BlueBioStakeholderWorkshop in Saaremaa Island	diverse background	aquaculture value chain; fishing value chain; macroalgae value chain	entire value chain	Saaremaa Island	Tourism: developing tourism, extending the season, better marketing of local produce, higher incomes for locals - higher added value of products&services	Tourism, technology solutions	Product development competitions, use fish in the whole value chain, hackations (like in Finland)	low	fish- difficulties in creating value chains. What would people want?	nr new value chains	unitless	no	Not relevant	Not relevant	Not achieved	5. Work and economy: access to varied and satisfying opportunities for work and business, especially rural depressed areas, 17. Economic sustainability for individuals, 18. Economic sustainability for public/private organisations	Economy
Belgium	Working group on aquaculture within Blue Cluster; note with policy recommendations to tackle bottlenecks for aquaculture sector	oyster cultivation (100% of sector)	oyster value chain	cultivation; local shop and restaurant	Oesterput (Ostend)	Regulations regarding sanitary zones: high cost for sampling "shellfish area" is passed to the producer	Regulation	Benchmarking study on regulations in other EU countries									13. Virtuous policy and high moral values social structures and institutions support human rights and development and to the environmental sustainability, absence of corruption, transparency, accountability, ethics, wisdom and phronesis	Economy
Belgium	Working group on aquaculture within Blue Cluster; note with policy recommendations to tackle bottlenecks for aquaculture sector	oyster cultivation (100% of sector)	oyster value chain	cultivation; local shop and restaurant	Oesterput (Ostend)	Difficult to find valorisation for oyster shells waste	Waste valorisation	Search for commercial valorisation and processor abroad									15. Minimal infrastructure, technologies and processes at support of human well-being	Economy
Belgium	Working group on aquaculture within Blue Cluster; note with policy recommendations to tackle bottlenecks for aquaculture sector	oyster cultivation (100% of sector)	oyster value chain	cultivation; local shop and restaurant	Oesterput (Ostend)	Integration of seaweed farming is difficult because of water quality	Water quality	Screening of local species for IMTA									1. Ecological system integrity: maintaining biological diversity and productivity	Natural system
Belgium	Working group on aquaculture within Blue Cluster; note with policy recommendations to tackle bottlenecks for aquaculture sector	oyster cultivation (100% of sector)	oyster value chain	cultivation; local shop and restaurant	Oesterput (Ostend)	Onsite information portal on oyster farming for tourists	Tourism	Storytelling on oyster farming					yes	Cultural			8. Education and capabilities' expansion: Independent and free education, open scientific debate, wisdom, phronesis and precaution	Social system
Belgium	Working group on aquaculture within Blue Cluster; note with policy recommendations to tackle bottlenecks for aquaculture sector	mussel cultivation (100% of sector)	mussel value chain	cultivation; retail	Westdiep (offshore near coast of Nieuwpoort)	Complex and costly permitting procedure (incl. SEA)	Permitting	Prepermitted areas for aquaculture eg maripark									13. Virtuous policy and high moral values social structures and institutions support human rights and development and to the environmental sustainability, absence of corruption, transparency, accountability, ethics, wisdom and phronesis	Economy

Belgium	Working group on aquaculture within BlueCluster; note with policy recommendations to tackle bottlenecks for aquaculture sector	mussel cultivation (100% of sector)	mussel value chain	cultivation; retail	Westdiep (offshore near coast of Nieuwpoort)	Opposition from fishermen, sailors, harbour, and municipality (incl. juridical procedures)	Social acceptance	informing stakeholders in early stage											8. Education and capabilities' expansion: Independent and free education, open scientific debate, wisdom, phronesis and precaution	Social system
Belgium	Working group on aquaculture within BlueCluster; note with policy recommendations to tackle bottlenecks for aquaculture sector	mussel cultivation (100% of sector)	mussel value chain	cultivation; retail	Westdiep (offshore near coast of Nieuwpoort)	Safety breaches of aquafarm by sailors/fishermen	Safety	drones to patrouill area											6. Safety and support to living and working environments	Economy
Belgium	Working group on aquaculture within BlueCluster; note with policy recommendations to tackle bottlenecks for aquaculture sector	mussel cultivation (100% of sector)	mussel value chain	cultivation; retail	Westdiep (offshore near coast of Nieuwpoort)	High installation and operational costs, low profit of product	Profitability	economics of scale											18. Economic sustainability for public/private organisations	Economy
Belgium	Working group on aquaculture within BlueCluster; note with policy recommendations to tackle bottlenecks for aquaculture sector	mussel cultivation (100% of sector)	mussel value chain	cultivation; retail	Westdiep (offshore near coast of Nieuwpoort)	High financial risk in case of storms or diseases	Risks	Insurance solutions for aquaculture, collective compensation funds											18. Economic sustainability for public/private organisations	Economy
Belgium	Working group on aquaculture within BlueCluster; note with policy recommendations to tackle bottlenecks for aquaculture sector	mussel cultivation (100% of sector)	mussel value chain	cultivation; retail	Westdiep (offshore near coast of Nieuwpoort)	Administrative complexity as responsibilities are dispersed among regional and federal agencies	Administration	One stop shop for aquaculture entrepreneurs											13. Virtuous policy and high moral values social structures and institutions support human rights and development and to the environmental sustainability, absence of corruption, transparency, accountability, ethics, wisdom and phronesis	Economy
Belgium	Belgian strategic Plan Aquaculture 2021-2030	diverse background	landbased aquaculture (fish,shrimps)	cultivation; retail	Flanders	small, diverse composition of producers; small production (little country with high density population); High level of knowledge	Challenges, threats and weaknesses	1. There is a need for strong networking and communication channels to reach interested producers and investors, as well as specific actions to create an incentive investment framework for the sector (e.g. financial support). 2. Aquaculture (both onshore and offshore) should further pursue integration with other sectors and activities, contributing to the circular system while reducing production costs 3. There should be opportunities to engage in ancillary activities (including tourism, angling, catering, education, etc.) in addition to aquaculture as a main activity, thus ensuring a guaranteed income. Projects based on multiple use are strongly recommended as part of an integrated approach. 6. There is a need for better cooperation among producers, for example through a producer or industry organisation 7. There is a need for additional	1. Negative image towards consumers (especially due to activities in other countries) 2. Unfamiliarity of aquaculture products among consumers, especially freshwater fish which is less well known than marine fish 3. Need for a lot of energy (RAS-systems; temperature) 4. Lack of info and knowledge among potential producers about production, marketing, business management, legislation; 5. Low production quantity which hinders the competitiveness: unattractive for B2B activities; few economies of scale and high cost of production; difficulties in meeting demand an retail sector; lack of visibility of the industry; etc. 6. the aspect of animal welfare can play a limiting role in terms of both production possibilities and market perception (and consequently sales). 7. legal restrictions around organic aquaculture applicable in RAS system, will make it difficult to obatin organic certification							18. Economic sustainability for public/private organisations	Economy
Belgium	Belgian strategic Plan Aquaculture 2021-2030; vision report on AQUACULTURE in the Belgian part of the North Sea	diverse background	offshore aquaculture (fish,shrimps)	cultivation; retail	Flanders	High level of knowledge (pioneers in offshore extractive aquaculture); Small coastline, small offshore area; A lot of other activities in the offshore	Challenges, threats and weaknesses	Most of the above but extra: The development of offshore aquaculture requires the provision of quality hatchery equipment, development of appropriate technology for rearing and harvesting in harsh North Sea conditions and suitable landing sites in ports; Bringing the North Sea into good conservation status (*: carrying capacity necessary for aquaculture); Good and thorough permit criteria; Removing administrative obstacles; Central monitoring / alert / knowledge platform; funds - Addressing knowledge gaps - Working out opportunities	Lack of data on suitable aquaculture species for the Belgian part of the North Sea; Missing knowledge on the use of aquaculture for coastal defence; Challenging natural conditions to launch aquaculture start up in the open sea; Limited number of zones defined in the belgium MSP for mariculture nearshore/close to the shoreline							18. Economic sustainability for public/private organisations	Economy
Belgium	diverse background	diverse background	fisheries	fisheires; retail	flanders	Small fishing fleet; reduced in 50% in last 20 years													15. Minimal infrastructure, technologies and processes at support of human well-being	Economy
Lithuania	Interview with fishing company	fishery	fishing value chain	harvesting	Klaipeda	Uneven distribution of quotas	Fishery management	Government support	low	low interest, low development perspectives	Availability of a fair quota system.	unitless	Yes	provisioning	food, biomass	Not achieved	18. Economic sustainability for public/private organisations	Economy
Lithuania	Interview with fishing company	fishery	fishing value chain	harvesting	Klaipeda	Lack of competent employees	Personell	Educational platforms, courses	low	low interest, low career potential	Availability of sector specialists	unitless	No	not relevant	not relevant	Not achieved	5. Work and economy: access to varied and satisfying opportunities for work and business, especially rural depressed areas, 17. Economic sustainability for individuals, 18. Economic sustainability for public/private organisations	Social system
Lithuania	Interview with fishing company	fishery	fishing value chain	harvesting	Klaipeda	Limited financial resources	Funding, profitability	Government support	low	low interest, low development perspectives	Availability of funding programmes	unitless	No	not relevant	not relevant	Not achieved	18. Economic sustainability for public/private organisations	Economy
Lithuania	Interview with fishing company	fishery	fishing value chain	harvesting	Klaipeda	Salaries are not competitive	Funding, profitability	Government support	low	low interest	Salary growth	%	No	not relevant	not relevant	Not achieved	17. Economic sustainability for individuals	Economy
Lithuania	Interview with producer	fish farming, processing	aquaculture value chain	farming, processing	Klaipeda	Limited financial resources	Funding, profitability	Government support	high	non-effective distribution of resources	Availability of funding programmes	unitless	No	not relevant	not relevant	Not achieved	18. Economic sustainability for public/private organisations	Economy
Lithuania	Interview with producer	fish farming, processing	aquaculture value chain	farming, processing	Klaipeda	Lack of competent persons capable of attracting funding	Funding, personell	Training, business development programmes, enterprenurship	high	lack of experts in blue bioeconomy	Availability of sector specialists	unitless	No	not relevant	not relevant	Not achieved	18. Economic sustainability for public/private organisations	Economy
Lithuania	Data summarized by fisheries and aquaculture experts	RAS aquaculture	aquaculture value chain	farming	Klaipeda	Lack of competent employees	Personell	Educational platforms, courses	high	low interest, low career potential	Availability of sector specialists	unitless	No	not relevant	not relevant	Not achieved	5. Work and economy: access to varied and satisfying opportunities for work and business, especially rural depressed areas, 17. Economic sustainability for individuals, 18. Economic sustainability for public/private organisations	Social system
Lithuania	Data summarized by fisheries and aquaculture experts	RAS aquaculture	aquaculture value chain	farming	Klaipeda	Low applications of innovations	Innovations	Good practice examples, more funding opportunities	high	high risk, slow development	Number of innovations implemented	number	No	not relevant	not relevant	Not achieved	18. Economic sustainability for public/private organisations	Physical infrastructure
Lithuania	Data summarized by fisheries and aquaculture experts	RAS aquaculture	aquaculture value chain	farming	Klaipeda	Lack of know-how at development stage (innovations)	Innovations	More help from outside experts	medium	lack of experts	Number of innovations implemented	number	No	not relevant	not relevant	Not achieved	18. Economic sustainability for public/private organisations	Physical infrastructure
Lithuania	Data summarized by fisheries and aquaculture experts	RAS aquaculture	aquaculture value chain	farming	Klaipeda	Slow growth in scale	Development	more funding opportunities	high	low priority at governmental level	Share of aquaculture products in the market	%	No	not relevant	not relevant	Not achieved	18. Economic sustainability for public/private organisations	Physical infrastructure
Lithuania	Data summarized by fisheries and aquaculture experts	RAS aquaculture	aquaculture value chain	farming	Klaipeda	Complicated and insufficient funding possibilities	Funding	more funding opportunities	high	low priority at governmental level, high requirements for development projects	Availability of funding programmes	unitless	No	not relevant	not relevant	Not achieved	18. Economic sustainability for public/private organisations	Economy
Lithuania	Data summarized by fisheries and aquaculture experts	RAS aquaculture	aquaculture value chain	market, catering	Klaipeda	Low local market capacity for local aquaculture production	Market capacity	Culture shift towads seafood, good quality	medium	Meat dominated mentality	Share of aquaculture products in the market	%	No	not relevant	not relevant	Not achieved	18. Economic sustainability for public/private organisations	Economy
Lithuania	Data summarized by fisheries and aquaculture experts	RAS aquaculture	aquaculture value chain	farming	Klaipeda	Low diversity of cultured species: catfish in RAS dominated	Technology development	Technological advancements for cheaper and more effective cultivation	medium	low priority at governmental level	Diversity of aquaculture products in the market		No	not relevant	not relevant	Not achieved	18. Economic sustainability for public/private organisations	Economy
Lithuania	Data summarized by fisheries and aquaculture experts	RAS aquaculture	aquaculture value chain	farming, market	Klaipeda	High installation and operational costs, low profit of product	Profitability	Technological advancements for cheaper and more effective cultivation	medium	low priority at governmental level	Share of RAS production in the market	%	No	not relevant	not relevant	Not achieved	18. Economic sustainability for public/private organisations	Physical infrastructure
Lithuania	Data summarized by fisheries and aquaculture experts	RAS aquaculture	aquaculture value chain	farming	Klaipeda	High energy costs	Profitability	Technological advancements for cheaper and more effective cultivation	medium	low priority at governmental level	Share of aquaculture products in the market	%	No	not relevant	not relevant	Not achieved	18. Economic sustainability for public/private organisations	Economy
Lithuania	Data summarized by fisheries and aquaculture experts	RAS aquaculture	aquaculture value chain	market, catering	Klaipeda	Lack of social recognition in aquaculture production	Market capacity	Culture shift towads seafood, good quality	medium	Meat dominated mentality	Share of aquaculture products in the market	%	No	not relevant	not relevant	Not achieved	18. Economic sustainability for public/private organisations	Social system
Lithuania	Data summarized by fisheries and aquaculture experts	RAS aquaculture	aquaculture value chain	farming	Klaipeda	Low intention to work in rural areas	Personell	Government support for aquaculture developers; practical training programmes for local aquaculture practitioners	low	low priority at governmental level	Availability of sector specialists	unitless	No	not relevant	not relevant	Not achieved	5. Work and economy: access to varied and satisfying opportunities for work and business, especially rural depressed areas, 17. Economic sustainability for individuals, 18. Economic sustainability for public/private organisations	Social system
Lithuania	Data summarized by fisheries and aquaculture experts	RAS aquaculture	aquaculture value chain	farming	Klaipeda	Domination of traditional pond aquaculture (better conditions for investments)	Funding	Technological advancements for cheaper and more effective cultivation, Government support for aquaculture developers	medium	low priority at governmental level	Share of RAS products in the market	%	No	not relevant	not relevant	Not achieved	18. Economic sustainability for public/private organisations	Economy
Lithuania	Data summarized by fisheries and aquaculture experts	RAS aquaculture	aquaculture value chain	farming	Klaipeda	Lack/low quality of stocking material (shrimps)	Technology	Development of hatcheries in Europe	low	high investment costs, difficulties to achieve high quality requirements and stable production	Share of aquaculture products in the market	%	No	not relevant	not relevant	Not achieved	18. Economic sustainability for public/private organisations	Economy
Lithuania	Data summarized by fisheries and aquaculture experts	RAS aquaculture	aquaculture value chain	farming	Klaipeda	Micro enterprices dominated in RAS aquaculture with low development potential	Technology development	Technological advancements for cheaper and more effective cultivation, Government support for aquaculture developers	medium	low funding intensity of governmental programmes, lack of large investors	Size of RAS enterprices		No	not relevant	not relevant	Not achieved	18. Economic sustainability for public/private organisations	Economy
Lithuania	Data summarized by fisheries and aquaculture experts	sea aquaculture	aquaculture value chain	farming	Klaipeda	Low growth potential in sea aquaculture sector	Technology development	Multiuse	low	Environmental constraints				not relevant	not relevant	Not achieved	18. Economic sustainability for public/private organisations	Economy
Lithuania	Data summarized by fisheries and aquaculture experts	pond aquaculture	aquaculture value chain	farming, market	Lithuania	Lack of communication and collaboration with science and other stakeholders	Technology development	Networking events	medium		Number of innovations implemented	number	No	not relevant	not relevant	Not achieved	18. Economic sustainability for public/private organisations	Economy
Lithuania	Data summarized by fisheries and aquaculture experts	pond aquaculture	aquaculture value chain	farming	Lithuania	Low growth potential in pond aquaculture sector	Technology development	Shift to RAS aquaculture	low	need for large investments	Number of innovations implemented	number	No	not relevant	not relevant	Not achieved	18. Economic sustainability for public/private organisations	Economy

Lithuania	Data summarized by fisheries and aquaculture experts	pond aquaculture	aquaculture value chain	farming	Lithuania	Environmental issues for pond aquaculture sector	Environment	Shift to RAS aquaculture	medium	need for large investments	Number of companies that have changed their profile	number	No	regulating	water quality, nutrient cycling and storage	Not achieved	3. No systematic release of substances, exceeding the capacity of the environment to neutralise their harmful effects.	Natural system		
Lithuania	Data summarized by fisheries and aquaculture experts	pond aquaculture	aquaculture value chain	farming	Lithuania	Low applications of innovations	Innovations	cooperation with scientists	medium	lack of competences of pond aquaculture sector	Number of innovations implemented	number	No	not relevant	not relevant	Not achieved	Physical infrastructure	Physical infrastructure		
Lithuania	Data summarized by fisheries and aquaculture experts	pond aquaculture	aquaculture value chain	farming	Lithuania	Lack of competent employees	Personell	Educational platforms, courses	high	low interest	Availability of sector specialists	unitless	No	not relevant	not relevant	Not achieved	5. Work and economy: access to varied and satisfying opportunities for work and business, especially rural depressed areas, 17. Economic sustainability for individuals, 18. Economic sustainability for public/private organisations	Social system		
Lithuania	Data summarized by fisheries and aquaculture experts	pond aquaculture	aquaculture value chain	farming	Lithuania	Low intention to work in rural areas	Personell	Government support for aquaculture developers; practical training programmes for local aquaculture practitioners	low	low priority at governmental level	Availability of sector specialists	unitless	No	not relevant	not relevant	Not achieved	5. Work and economy: access to varied and satisfying opportunities for work and business, especially rural depressed areas, 17. Economic sustainability for individuals, 18. Economic sustainability for public/private organisations	Social system		
Lithuania	Data summarized by fisheries and aquaculture experts	pond aquaculture	aquaculture value chain	market, catering	Lithuania	Low local market capacity for local aquaculture production	Market capacity	pilot projects for public awareness, increase availability of more diverse aquaculture production	medium	high prices, low diversity of production	Share of aquaculture products in the market	%	No	not relevant	not relevant	Not achieved	18. Economic sustainability for public/private organisations	Economy		
Lithuania	Data summarized by fisheries and aquaculture experts	pond aquaculture	aquaculture value chain	farming, market, catering	Lithuania	Low diversity of cultured species: carp in open ponds dominated	Technology development	Increase diversity from RAS development	medium	high investments, low competences	Number of aquaculture species	number	Yes	provisioning	food, biomass	Not achieved	18. Economic sustainability for public/private organisations	Economy		
Lithuania	Data summarized by fisheries and aquaculture experts	coastal and inland fishery	fishing value chain	harvesting	Klaipeda	Seasonality and unpredictability of production	Technology development	combination of fishery and aquaculture value chains	medium	high hygiene regulations, lack of competences in governmental sector				provisioning	food, biomass	Not achieved	18. Economic sustainability for public/private organisations	Economy		
Lithuania	Data summarized by fisheries and aquaculture experts	coastal and inland fishery	fishing value chain	harvesting	Klaipeda	Changing ecosystems and fish communities	Environment	Habitat management, EU directives, HELCOM actions	low	hardly manageable environmental processes, climate change	Increasing stock			regulating	biodiversity	Not achieved	1. Ecological system integrity: maintaining biological diversity and productivity	Natural system		
Lithuania	Data summarized by fisheries and aquaculture experts	coastal and inland fishery	fishing value chain	harvesting	Klaipeda	Lack of communication and collaboration with science and other stakeholders	Science, collaboration	Governmental actions -specific collaboration measures	high	high buercracy level	collaboration projects			not relevant	not relevant	Not achieved	18. Economic sustainability for public/private organisations	Economy		
Lithuania	Data summarized by fisheries and aquaculture experts	coastal and inland fishery	fishing value chain	harvesting	Klaipeda	Low local market capacity for local fisheries production: Lithuanian fisheries production is mostly sold outside the country	Market capacity	Local market support measures: short value chains, integration of fishery and aquaculture	high	limited competences of public sector	Share of fishery products in the market	%	No	not relevant	not relevant	Not achieved	18. Economic sustainability for public/private organisations	Economy		
Lithuania	Data summarized by fisheries and aquaculture experts	coastal and inland fishery	fishing value chain	harvesting	Klaipeda	Fishing fleet is old and inefficient	Fishery management	renovation	medium	limited competences of public sector				not relevant	not relevant	Not achieved	18. Economic sustainability for public/private organisations	Economy		
Lithuania	Data summarized by fisheries and aquaculture experts	coastal and inland fishery	fishing value chain	harvesting	Klaipeda	Staff is old and not changing	Personell	awareness raising in a perspectives of blue bioeconomy	low	no interest for young generation	Availability of sector specialists	unitless	No	not relevant	not relevant	Not achieved	5. Work and economy: access to varied and satisfying opportunities for work and business, especially rural depressed areas, 17. Economic sustainability for individuals, 18. Economic sustainability for public/private organisations			
Lithuania	Data summarized by fisheries and aquaculture experts	coastal and inland fishery	fishing value chain	harvesting	Klaipeda	Unsatisfactory stock status	Environment	more effective stock management, EU directives, HELCOM actions	low	hardly manageable environmental processes, climate change	stock quality			provisioning	food, biomass	Not achieved	1. Ecological system integrity: maintaining biological diversity and productivity	Natural system		
Lithuania	Data summarized by fisheries and aquaculture experts	coastal and inland fishery	fishing value chain	harvesting	Klaipeda	fishery restrictions	Fishery management	keep good stock quality; adaptation (new species, new fishery methods)	low	decisions at EU level				provisioning	food, biomass	Not achieved	18. Economic sustainability for public/private organisations	Social system		
Lithuania	Data summarized by fisheries and aquaculture experts	coastal and inland fishery	fishing value chain	harvesting	Klaipeda	Complicated management system: marine fishery – Ministry of Agriculture, inland fishery – Ministry of Environment	Fishery management	improve management system	medium	political decision needed				not relevant	not relevant	Not achieved	18. Economic sustainability for public/private organisations	Economy		
Lithuania	Data summarized by fisheries and aquaculture experts	open-sea fishery	fishing value chain	harvesting	Klaipeda	Lithuanian pelagic catches mostly landed in other Baltic Sea ports	Fishery management	to create value chain	low	difficult management, high investments				not relevant	not relevant	Not achieved	18. Economic sustainability for public/private organisations	Economy		
Portugal	Data summarized by Blue Bioeconomy Experts (Blue Bioeconomy Roadmap for Portugal)	fisheries; algae; aquaculture	fisheries; algae; aquaculture	harvesting; biomass production; bioprospecting	Portugal	1. Missing capacity to replicate bioresources in laboratory 2. Difficulty in accessing water test facilities 3. Harvesting and sampling approaches are not adequate to biodiscovery	Science; technology; logistics	network that centralises requests for infrastructures related to bioresources; prototyping and pilot upscaling facilities	high	Not available informations in an easy single point. Lack of cooperation, network	Types of infrastructures (categorisation)	unitless	yes	regulating	diverse	Not achieved	15. Minimal infrastructure, technologies and processes at support of human well-being	Physical infrastructure	https://blueandgreen.climar.up.pt/wp-content/uploads/2019/05/Roadmap_DIGITAL.pdf	
Portugal	Data summarized by Blue Bioeconomy Experts (Blue Bioeconomy Roadmap for Portugal)	fisheries; algae; aquaculture	fisheries; algae; aquaculture	innovation development and product differentiation	Portugal	1. Difficulty in hiring specialised human resources 2. Difficulty in getting sustainable and reproducible batch supply (adequate culture / harvest , adequate manufacturing technologies, adequate volumes yield) 3. Lack of innovation department / staff 4. Difficulty with separation and purification downstream protocols 5. Difficulty in determining specific mode of action 6. Difficulty in determining specific mode of action 7. Difficulty in discovering novel marine natural products and bioactives 8. Difficulty with safety and efficacy testing protocols and timeframes 9. Difficulty in innovating on screening technologies and platforms 10. Difficulty in determining correct formulation for future desired / predicted route of administration	Science; technology; logistics	Funding scheme for equipment networks and upgrading ship equipment for modern bioprospection; Reformulation of training programmes for young scientists enrolled in blue biobased courses to implement optional and compulsory training sessions	medium	Lack of specialized human resources in labour market; Role of academia in capacity building for strategic skills; Lack of dedicated public funding	Number of patents created; number of spinoffs/startups; Sectorial VAB	count	yes	Provisioning	diverse	Not achieved	15. Minimal infrastructure, technologies and processes at support of human well-being	Physical infrastructure	https://blueandgreen.climar.up.pt/wp-content/uploads/2019/05/Roadmap_DIGITAL.pdf	
Portugal	Data summarized by Blue Bioeconomy Experts (Blue Bioeconomy Roadmap for Portugal)	fisheries; algae; aquaculture	fisheries; algae; aquaculture	Commercialisation & Market Entry	Portugal	1. Difficulty in penetrating existing value chains 2. Need to create new value chains 3. Logistics too complex or heavy 4. Lack of knowledge on the predicted / desired route of administration / type of formulation for final application	Science; technology; logistics	Co-fund projects to install pilot units close to local industries, and improve commercial connections and logistical platforms surrounding blue bioresources production centres Public-private partnerships for sharing equipment and facilitate access to bioprospecting missions Create a quota system for marine algae	low	Bridges and synergies missing, lack of co-creation communities	Number of new products /value chains	count	no	Provisioning	diverse	Not achieved	15. Minimal infrastructure, technologies and processes at support of human well-being	Physical infrastructure	https://blueandgreen.climar.up.pt/wp-content/uploads/2019/05/Roadmap_DIGITAL.pdf	
Portugal	Data summarized by Blue Bioeconomy Experts (Blue Bioeconomy Roadmap for Portugal)	fisheries; algae; aquaculture	fisheries; algae; aquaculture	Support Services	Portugal	1. Difficulty in accessing laboratory spaces 2. Difficulty in accessing water test spaces	Science; technology; logistics	network that centralises requests for infrastructures related to bioresources, prototyping and pilot upscaling facilities	high	Not wided disseminatedn of servies/platforms available	Number of different infrastructures	count	yes	regulating	R&D	Not achieved	15. Minimal infrastructure, technologies and processes at support of human well-being	Physical infrastructure	https://blueandgreen.climar.up.pt/wp-content/uploads/2019/05/Roadmap_DIGITAL.pdf	
Portugal	Data summarized by Blue Bioeconomy Experts (Blue Bioeconomy Roadmap for Portugal)	fisheries; algae; aquaculture	fisheries; algae; aquaculture	Harvesting, Biomass Production & Bioprospecting	Portugal	1. Access to bioresources/ biobanks is complicated or not clear 2. Unawareness of scientific techniques or specialised services 3. Difficulty in accessing robotics, ROVs and drones, as well as sensors materials and expertise	cooperation	Promote national and international matchmaking events, roadshows and collaborative actions between stakeholders Promote synergies through Blue Bioeconomy acceleration programmes Continue to support initiatives like the Blue Demo Network and Collaborative Laboratories (Co-LABs)	high	Not available informations in an easy single point. Lack of cooperation, network	Types of infrastructures (categorisation)	unitless	yes	regulating	R&D	Not achieved	15. Minimal infrastructure, technologies and processes at support of human well-being	Physical infrastructure	https://blueandgreen.climar.up.pt/wp-content/uploads/2019/05/Roadmap_DIGITAL.pdf	
Portugal	Data summarized by Blue Bioeconomy Experts (Blue Bioeconomy Roadmap for Portugal)	fisheries; algae; aquaculture	fisheries; algae; aquaculture	Innovation Development & Product Differentiation	Portugal	1. Difficulty in accessing pilot scale units 2. Difficulty in finding national cooperation partners 3. Difficulty in accessing local laboratory facilities for product development and prototyping 4. Unawareness of scientific techniques or specialised services that could behelpful 5. Difficulty in finding international cooperation partners 6. Lack of necessary skills or specialised training 7. Lack of knowledge on how to innovate 8. Unawareness of international or regional regulation issues 9. Difficulty in accessing water test facilities for prototyping	cooperation	Create open innovation-based calls to address industry challenges and promote blue economy innovation vouchers Promote access to opportunities for public and private R&D institutions National blue pilot infrastructure to be used through the value chain	medium	Lack of specialized human resources in labour market Role of academia in capacity building for strategic skiks Lack of dedicated public funding	Types of infrastructures (categorisation); Sectorial VAB	unitless	yes	Regulating	diverse	Not achieved	15. Minimal infrastructure, technologies and processes at support of human well-being	Physical infrastructure	https://blueandgreen.climar.up.pt/wp-content/uploads/2019/05/Roadmap_DIGITAL.pdf	
Portugal	Data summarized by Blue Bioeconomy Experts (Blue Bioeconomy Roadmap for Portugal)	fisheries; algae; aquaculture	fisheries; algae; aquaculture	Commercialisation & Market Entry	Portugal	1. Difficulty in accessing manufacturing facilities	cooperation	Create a blue biobank national infrastructure with clear access rules Development and implementation of acceleration programmes	medium	Not available informations in an easy single point. Lack of cooperation, network	New Products; Sectorial VAB	unitless	yes	Regulating	Industry	Not achieved	11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions	Economy	https://blueandgreen.climar.up.pt/wp-content/uploads/2019/05/Roadmap_DIGITAL.pdf	
Portugal	Data summarized by Blue Bioeconomy Experts (Blue Bioeconomy Roadmap for Portugal)	fisheries; algae; aquaculture	fisheries; algae; aquaculture	Support Services	Portugal	1. Difficulty in finding national cooperation partners 2. Lack of international business development support 3. Inappropriate political focus or strategy 4. Difficulty in accessing training and education tailored to individual needs 5. Lack of national business development support 6. Difficulty in accessing specialised legal, contractual services 7. Difficulty in finding international cooperation partners 8. Difficulty in accessing incubation/office services and spaces 9. Need help in accounting and other business support services	cooperation	Public support and implementation of a Blue Hub Portal with information about all stakeholders, their expertise, products and services.	medium	Learning curve Burocratic legal and support system	New sectorial companies; Sectorial VAB	unitless	yes	Regulating	diverse	Not achieved	11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions	Economy	https://blueandgreen.climar.up.pt/wp-content/uploads/2019/05/Roadmap_DIGITAL.pdf	
Portugal	Data summarized by Blue Bioeconomy Experts (Blue Bioeconomy Roadmap for Portugal)	fisheries; algae; aquaculture	fisheries; algae; aquaculture	Commercialisation & Market Entry	Portugal	1. Difficulty in reaching out to clients 2. Difficulty in communicating the added value of product to clients 3. Lacking marketing tools and development capacity 4. Need for new packaging	communication and marketing	SMEs trainee vouchers for communicating industry reality to students Implement a Blue Hub National portal with information about stakeholders, bioresources, and available infrastructures	low	Reformulation of training programmes for young scientists enrolled in blue biobased courses to implement optional and compulsory training sessions in entrepreneurship, management and industrial skills to match current industry and economy needs	Academic dedicated programmes	count	no	regulating	academia	Not achieved	11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions	Social system	https://blueandgreen.climar.up.pt/wp-content/uploads/2019/05/Roadmap_DIGITAL.pdf	
Portugal	Data summarized by Blue Bioeconomy Experts (Blue Bioeconomy Roadmap for Portugal)	fisheries; algae; aquaculture	fisheries; algae; aquaculture	Support Services	Portugal	1. Difficulty to find the right events to showcase products and find new clients	communication and marketing	Funding for promotional actions, professional outreach and disseminationand branding campaigns of national blue bioproducts. Revise training programmes for scientists, executives and public bodies to improve entrepreneurship, management and industrial skills. Policy and position papers by national stakeholders	high	Engagement of people	Number of events related per year	count	no	cultural	social events	Not achieved	11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions	Social system	https://blueandgreen.climar.up.pt/wp-content/uploads/2019/05/Roadmap_DIGITAL.pdf	

Portugal	Data summarized by Blue Bioeconomy Experts (Blue Bioeconomy Roadmap for Portugal)	fisheries; algae; aquaculture	fisheries; algae; aquaculture	Harvesting, Biomass Production & Bioprospecting	Portugal	1. There is no market demand for innovative added-value products 2. Do not know what to focus on or what the market needs	market and consumer demand	Communication materials to promote the sector and inform stakeholders and consumers Update the satellite account of the sea to include novel blue/biobased activities	medium	Society awareness of circularity and sustainable and potential of seaproducts	Number of new products in the market; Sectorial VAB	count	yes	cultural	food, cosmetics	Not achieved	11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions	Human well-being	https://blueandgreen.ciimar.up.pt/wp-content/uploads/2019/05/Roadmap_DIGITAL.pdf
Portugal	Data summarized by Blue Bioeconomy Experts (Blue Bioeconomy Roadmap for Portugal)	fisheries; algae; aquaculture	fisheries; algae; aquaculture	Innovation Development & Product Differentiation	Portugal	1. Difficulty in determining real market need 2. Need to build consumer awareness 3. Lack of knowledge on how to develop a business plan 4. Consumer/market demands are not aligned with the limitations in production methods 5. Competition (similar products)	market and consumer demand	National market study on blue bioproducts and their applications	high	Society awareness of circularity and sustainable and potential of seaproducts	Number of new products in the market; Sectorial VAB	count	yes	cultural	food, cosmetics	Not achieved	11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions	Human well-being	https://blueandgreen.ciimar.up.pt/wp-content/uploads/2019/05/Roadmap_DIGITAL.pdf
Portugal	Data summarized by Blue Bioeconomy Experts (Blue Bioeconomy Roadmap for Portugal)	fisheries; algae; aquaculture	fisheries; algae; aquaculture	Commercialisation & Market Entry	Portugal	1. Need help in defining and developing a business model	market and consumer demand	Promote synergies through Blue Bioeconomy acceleration programmes Revise training programmes for scientists, executives and public bodies to improve entrepreneurship, management and industrial skills.	high	Engagement of people, non attractive topics lack of continuous support beyond creation (mentorship)	Number of startups	counts	yes	cultural	business support services	Not achieved	11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions	Economy	https://blueandgreen.ciimar.up.pt/wp-content/uploads/2019/05/Roadmap_DIGITAL.pdf
Portugal	Data summarized by Blue Bioeconomy Experts (Blue Bioeconomy Roadmap for Portugal)	fisheries; algae; aquaculture	fisheries; algae; aquaculture	Support Services	Portugal	1. Complex mechanisms to receive funding 2. Access to ocean is difficult or expensive 3. Reduced cost-efficiency of discovering novel marine natural products and bioactives	funding and costs of operations	Simplify national funding schemes, reduce time for evaluation, and implement fast track processes from decision to payment Blue acceleration programmes and funding for risky entrepreneurial exploratory projects Intellectual property and PhD vouchers for SMEs and startups	low	Legal, regulamention and public fund not adapted to the needs and timings	new solutions; public funds raised	euros	yes	regulating	diverse	not achieved	11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions	economy	https://blueandgreen.ciimar.up.pt/wp-content/uploads/2019/05/Roadmap_DIGITAL.pdf
Portugal	Data summarized by Blue Bioeconomy Experts (Blue Bioeconomy Roadmap for Portugal)	fisheries; algae; aquaculture	fisheries; algae; aquaculture	Harvesting, Biomass Production & Bioprospecting	Portugal	1. Difficulty in attracting reliable funding	funding and costs of operations	Broaden the scope of blue funding schemes to cover industrial processes, upscaling and de-risking technological development processes Incentives for foreign investors to invest in the national Blue Bioeconomy	low	Legal, regulamention and public fund not adapted to the needs and timings	new solutions; Public funds raised	euros	yes	regulating	diverse	not achieved	11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions	economy	https://blueandgreen.ciimar.up.pt/wp-content/uploads/2019/05/Roadmap_DIGITAL.pdf
Portugal	Data summarized by Blue Bioeconomy Experts (Blue Bioeconomy Roadmap for Portugal)	fisheries; algae; aquaculture	fisheries; algae; aquaculture	Innovation Development & Product Differentiation	Portugal	1. Can not match desired price tag/ unit	funding and costs of operations	Incentives for promoting circular economy processes in SMEs Create a public-private blue investment fund Specific bank support credit lines for the blue sector	low	Legal, regulamention and public fund not adapted to the needs and timings Lobbys pressure	sectorial VBA	euros	yes	regulating	diverse	not achieved	13. Virtuous policy and high moral values social structures and institutions support human rights and development and to the environmental sustainability, absence of corruption, transparency, accountability, ethics, wisdom and phronesis	economy	https://blueandgreen.ciimar.up.pt/wp-content/uploads/2019/05/Roadmap_DIGITAL.pdf
Portugal	Data summarized by Blue Bioeconomy Experts (Blue Bioeconomy Roadmap for Portugal)	fisheries; algae; aquaculture	fisheries; algae; aquaculture	Commercialisation & Market Entry	Portugal	1. Need help in attracting or securing funding 2. Lack of knowledge of available funding mechanisms 3. Difficulty in accessing public grants 4. Difficulty in accessing private investement 5. Lack of dedicated or suitable crowdfunding platforms	funding and costs of operations	Simplify national funding schemes, reduce time for evaluation, and implement fast track processes from decision to payment Blue acceleration programmes and funding for risky entrepreneurial exploratory projects Intellectual property and PhD vouchers for SMEs and startups	low	Legal, regulamention and public fund not adapted to the needs and timings	New solutions; Public funds raised	euros	yes	regulating	diverse	not achieved	11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions	economy	https://blueandgreen.ciimar.up.pt/wp-content/uploads/2019/05/Roadmap_DIGITAL.pdf
Portugal	Data summarized by Blue Bioeconomy Experts (Blue Bioeconomy Roadmap for Portugal)	fisheries; algae; aquaculture	fisheries; algae; aquaculture	Support Services	Portugal	1. Complex licensing and regulation	legal and regulatory	Simple and efficient rules to access blue bioresources	low	Legal, regulamention and public fund not adapted to the needs and timings	licensing time	days	yes	regulating	diverse	not achieved	11. Business prosperity, competitiveness and self-sufficiency especially for of small scale business and depressed areas, bottom-up approaches of cooperation and avoidance of monopoly or dominant positions	Social system	https://blueandgreen.ciimar.up.pt/wp-content/uploads/2019/05/Roadmap_DIGITAL.pdf
Portugal	Data summarized by Blue Bioeconomy Experts (Blue Bioeconomy Roadmap for Portugal)	fisheries; algae; aquaculture	fisheries; algae; aquaculture	Harvesting, Biomass Production & Bioprospecting	Portugal	1. Complex licensing and regulation 2. Find several Legal/IP constraints to innovate and develop new products	legal and regulatory	Simpler and faster regulatory approval paths for blue bioproducts Blue simplex to Blue Bioeconomy activities Faster regulatory process for blue intellectual property protection	low	Legal, regulamention and public fund not adapted to the needs and timings	licensing time	days	yes	regulating	diverse	not achieved	13. Virtuous policy and high moral values social structures and institutions support human rights and development and to the environmental sustainability, absence of corruption, transparency, accountability, ethics, wisdom and phronesis	Social system	https://blueandgreen.ciimar.up.pt/wp-content/uploads/2019/05/Roadmap_DIGITAL.pdf
Portugal	Data summarized by Blue Bioeconomy Experts (Blue Bioeconomy Roadmap for Portugal)	fisheries; algae; aquaculture	fisheries; algae; aquaculture	Innovation Development & Product Differentiation	Portugal	1. Intellectual property issues 2. Difficulty in understanding or in complying with heavy regulatory requirements 3. Complex design of certification schemes	legal and regulatory	Implement market importation barriers to non-EU suppliers Faster legislation approval mechanisms for aquaculture	low	Legal, regulamention and public fund not adapted to the needs and timings	licensing time	days	yes	regulating	diverse	not achieved	13. Virtuous policy and high moral values social structures and institutions support human rights and development and to the environmental sustainability, absence of corruption, transparency, accountability, ethics, wisdom and phronesis	Social system	https://blueandgreen.ciimar.up.pt/wp-content/uploads/2019/05/Roadmap_DIGITAL.pdf
Portugal	Data summarized by Blue Bioeconomy Experts (Blue Bioeconomy Roadmap for Portugal)	fisheries; algae; aquaculture	fisheries; algae; aquaculture	Commercialisation & Market Entry	Portugal	1. Lack of financial sector's knowledge on the Blue Bioeconomy aspects 2. Difficulty in dealing with IP issues 3. Complex international or regional regulatory issues	legal and regulatory	Support policies makers with true knowledge of technology and blue biotech sector reality	low	Availability of people in learning and deep search. Restricted meetings for policy makers	Number of startups	count	yes	cultural	business support services	Not achieved	13. Virtuous policy and high moral values social structures and institutions support human rights and development and to the environmental sustainability, absence of corruption, transparency, accountability, ethics, wisdom and phronesis	Economy	https://blueandgreen.ciimar.up.pt/wp-content/uploads/2019/05/Roadmap_DIGITAL.pdf
Sweden	Interview with oyster farmers	aquaculture	European Oysters	Cultivation	Bohuslän	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)	legal and regulatory	National plan for oyster industry is needed to make a strategy	low	new regulations take time	volume of wild oysters produced in Sweden which results in higher nutrient removal by oyster farming		yes				13. Virtuous policy and high moral values social structures and institutions support human rights and development and to the environmental sustainability, absence of corruption, transparency, accountability, ethics, wisdom and phronesis	Social system	
Sweden	Interview with oyster farmers	aquaculture	European Oysters	Cultivation	Bohuslän	permitting process, several authorities and long time for approval	legal and regulatory	support industry actors in dialog with authorities - branch organisation	low	industry matrurity is low, but potential is high	volume of wild oysters produced in Sweden which results in higher nutrient removed by oyster farming	kg nitrogen, kg phosphorus	yes				13. Virtuous policy and high moral values social structures and institutions support human rights and development and to the environmental sustainability, absence of corruption, transparency, accountability, ethics, wisdom and phronesis	Social system	
Sweden	Interviews and workshops with mussel farmers	aquaculture	Blue Mussels	Mussel valorization	Bohuslän	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 propperties in the side streams to explore valorization	technology	Mussel sorting and processing together with processes to extract the valuable proteins, lipids and minerals	medium	Market obstacles: too small-size volumes of side streams for commercial actors to establish expensive extraction methods - commercial applications require specific volumes and circular business models to be viable	decreasing volume of side-stream waste, increased use of side-streams in new applications	ton					15. Minimal infrastructure, technologies and processes at support of human well-being	Economy	
Sweden	Interviews and workshops with mussel farmers	aquaculture	Blue Mussels	Harvesting	Bohuslän	minimize waste (crushed shells) in harvest methods, increase harvest volumes reduce shell crush	technology	Mussel harvest methods to reduce crushing	medium								15. Minimal infrastructure, technologies and processes at support of human well-being	Economy	
Sweden	Interviews and workshops with mussel farmers	aquaculture	Blue Mussels	Permit	Bohuslän	permitting process, several authorities and long time for approval	legal and regulatory	working together with authorities to develop streamlined processes together with industry organisations	low		amount of nutrients removed by mussel farming	kg nitrogen, kg phosphorus	yes				13. Virtuous policy and high moral values social structures and institutions support human rights and development and to the environmental sustainability, absence of corruption, transparency, accountability, ethics, wisdom and phronesis	Economy	
Sweden	Interviews and workshops with mussel farmers	aquaculture	Blue Mussels	Cultivation	Bohuslän	calcium deposits from "spiral worms" make the shells unattractive to consumers, increases waste streams	science and technology	research on methods of reducing this "fouling" of mussel shells, or side-stream valorization methods to use the extra calcium	medium								8. Education and capabilities' expansion: Independent and free education, open scientific debate, wisdom, phronesis and precaution	Social system	
Sweden	Interviews and workshops with mussel farmers	aquaculture	Blue Mussels	Cultivation	Bohuslän	algae blooms - optimal placement of growings sites to avoid toxins	technology	Testing and monitoring of algae blooms - better system needed - today it takes too much time and is done by hand - could be automated	medium	Research in this area and monitoring systems need to be developed.							8. Education and capabilities' expansion: Independent and free education, open scientific debate, wisdom, phronesis and precaution	Natural system	
Sweden	Interviews and workshops with mussel farmers	aquaculture	Blue Mussels	Cultivation	Bohuslän	invasive species (sea squirts) attach to the ropes, outcompete mussels and reduce the volumes in cultivation	technology	Methods to reduce the amount of sea squirts - or to harvest and sell sea squirts as a secondary revenue stream	medium	market uptake, only one company working with fresh sea squirts (limited market)							8. Education and capabilities' expansion: Independent and free education, open scientific debate, wisdom, phronesis and precaution	Natural system	
Sweden	Interviews and workshops with mussel farmers	aquaculture	Blue Mussels	Processing	Bohuslän	processing equipment, results in a lot of crushed shells	technology	Process machines to reduce the amount of crushed shells	medium								15. Minimal infrastructure, technologies and processes at support of human well-being	Economy	
Sweden	Interviews and workshops with mussel farmers	aquaculture	Blue Mussels	Cultivation	Bohuslän	mussel filaments - contribute to the problem of crushed shells in processing as they are difficult to remove in seperation	technology	Process to "loosen" the filment material	medium	research and process technology							15. Minimal infrastructure, technologies and processes at support of human well-being	Economy	
Sweden	Interviews and workshops with mussel farmers	aquaculture	Blue Mussels	Retail	Bohuslän	packaging materials (plastic nets) for sale to end cosumer pose a challenge for food markets/stores, leaking and smelly	technology	Test various consumer packaging to increase attractiveness and ease of use.	medium								15. Minimal infrastructure, technologies and processes at support of human well-being	Economy	
Sweden	Interviews and workshops with mussel farmers	aquaculture	Macroalgae, sugar kelp	Cultivation to food	Bohuslän	iodine and cadmium content, unclear consumer guidelines from food authorities what are allowed values and how to communicate to consumers, hinders industry growth	regulatory	working to help authorities develop food safety guidelines together with industry	medium								13. Virtuous policy and high moral values social structures and institutions support human rights and development and to the environmental sustainability, absence of corruption, transparency, accountability, ethics, wisdom and phronesis	Economy	
Sweden	Interviews and workshops with mussel farmers	aquaculture	Macroalgae, sugar kelp	Processing	Bohuslän	processing technology and efficient drying	science and technology	industry needs better processing technology, more energy efficient drying	medium								15. Minimal infrastructure, technologies and processes at support of human well-being	Economy	
Sweden	Interviews and workshops with mussel farmers	aquaculture	Macroalgae, sugar kelp	Harvest	Bohuslän	harvest techniques are manual and heavy, limiting the volumes able to be harvested	technology	examine possibilities for automation of processes	medium								15. Minimal infrastructure, technologies and processes at support of human well-being	Economy	
Sweden	Interviews and workshops with mussel farmers	aquaculture	Macroalgae, sugar kelp	Permit	Sweden	Site selection and permit processing are long and expensive processes, reducing the number of companies that can begin seaweed cultivation operations	regulatory	streamlined processes, larger areas for permits where several farmers can cultivate	medium								15. Minimal infrastructure, technologies and processes at support of human well-being	Economy	

Sweden	Interviews and workshops with mussel farmers	aquaculture	Macroalgae, sugar kelp	Cultivation	Sweden	marekt demand is low - need to increase market uptake to stimulate more cultivation	market demand	focus on macroalgae as food	medium		8. Education and capabilities' expansion: Independent and free education, open scientific debate, wisdom, phronesis and precaution	Social system
Sweden	Interviews and workshops with mussel farmers	aquaculture	Sea squirts	Processing	Sweden	side streams from processing with valuable ingredients	technology	Methods of extraction and utilization of side-streams in new applications			15. Minimal infrastructure, technologies and processes at support of human well-being	Economy
Sweden	Interviews and workshops with mussel farmers	aquaculture	Sea squirts	Permits	Sweden	several different authorities and long waiting times for approval	regulatory				13. Virtuous policy and high moral values social structures and institutions support human rights and development and to the environmental sustainability, absence of corruption, transparency, accountability, ethics, wisdom and phronesis	Economy
Sweden	Workshops and interviews with various stakeholders in off-shore wind energy project	energy / aquaculture	offshore wind / aquaculture	Planning (MSP)	Sweden	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.	regulatory	The regulatory framework and the co-existance model needs to be developed/determined for the actors involved.	There is a huge potential for macroalgal cultivation at offshore wind sites, but the practicalities are not yet clear. There could be many obstacles in terms of the actual models for these cultivation practices, the investment, the access, the ownership models, etc. If it does not prove viable, it will not happen.		8. Education and capabilities' expansion: Independent and free education, open scientific debate, wisdom, phronesis and precaution	Social system
Scotland	Interviews-report	Seaweed cultivation and harvest	Seaweed	Cultivation	Scotland							
Scotland	A Blue Bioeconomy Vision for Scotland	Energy/aquaculture	Everything under the Blue Bioeconomy banner	Cultivation/biotechnology	Scotland	Scotland's vision for Blue Bioeconomy with 3 elements: Social, Economic and Environment.						