WORKING GROUP 6
TITLE OF THE WG: SOCIAL, LEGAL, AND REGULATORY ASPECTS

LEADER

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RATIONAL AND OBJECTIVES

Describe rational and objectives of the WG. Similar to a Memorandum of Understanding, but including changes and adjustments. This will be used in Final Report.

Blue Biotechnology (BB) is a multidisciplinary, knowledge- and capital-intensive technological sector, essential for innovation under the European Sustainable Blue Economy (SBE) (COM(2021) 240) and Green Deal (GD) Goals (COM/2019/640). The BB sector in Europe includes non-traditionally commercially exploited marine organisms and their biomass applications in pharmaceutical, medical, cosmeceutical, nutraceutical, aquacultural, agricultural, and energy sectors. Under the Farm to Fork strategy (COM/2020/381 final), algae biomass is recognised as a highly valuable source of structurally diverse bioactive compounds among marine organisms, and its utilisation would support society in gaining various environmental and health benefits. Therefore, in 2022, the European Commission (EC) also launched a proposal titled "Towards a Strong and Sustainable EU Algae Sector," also called the "EU algae initiative" (COM/2022/592 final), highlighting the importance of utilising algae as a renewable resource in Europe to ensure a secure supply of raw materials and energy.

As a result, the European Maritime, Fisheries and Aquaculture Fund (EMFAF) with the Blue Invest fund, already supported 97 companies in the algae business with access to finance to early-stage firms, SMEs, and scale-up, for which 39 received technical assistance from Blue Invest team and 26 reach a technology readiness (TRL)-9 (Carboni et al, 2025). Out of the 116 projects about algae financed by Horizon 2020 between 2014 and 2021 for a total of € 273.1 million, 25 projects deal with macroalgae for biofertilisers and bio-feed, biofuels and bioplastics, and biorefineries. Besides, 11 projects deal with algae in combination with other organisms such as molluscs, echinoderms, shellfish, finfish, and other sea invertebrates (Hranilovic et al., 2023).

Nevertheless, from the total macroalgae produced in the EU-27 in 2022 (94.5 thousand tonnes w.w.), only 0.7% (704 t W.W.) was created by aquaculture. The macroalgae farmed in the EU represent 0.00193% of the global seaweed aquaculture (375 t w.w. or 0.001% in 2021), while the rest of European countries contributed with an additional 336 t w.w. or 0.0009% (Rebours & Sánchez López, 2025). On the contrary, the production volume of the seaweed industry is reported to have increased worldwide since 1950 (Rebours & Sánchez López, 2025).

Despite the global trend of increased demand for algae biomass and the EC's efforts to support its development, macroalgae cultivation in Europe remains in its early stages, with limited production volumes and the lowest market quantities. In the last 20 years, the efforts have mainly focused on kelp species due to the relative ease of controlling their reproduction cycles and producing large volumes directly at sea (limiting land use and moving the production to the Ocean). However, these brown macroalgae face challenges in penetrating the market, making it difficult for the European seaweed industry to answer the existing demand for marine biomass for the production of food and feed ingredients with a low carbon footprint, calling for a need to diversify the cultivated species.

Building on the successes of previous EU and pan-European projects, and due its unique characteristics, the green macroalgae of the genus *Ulva* (Linnaeus, 1753) were identified as the most suitable candidates and model organisms for a novel European mariculture (Hofmann et al., 2025). The species of *Ulva* can effectively assimilate dissolved nutrients with high efficiency and biomass yield (e.g., Lubsch & Timmermans, 2018). Only a limited number of Ulva species are currently cultivated on a small commercial scale in Southern Europe,

predominantly in land-based systems, and in some cases under Integrated Multitrophic Aquaculture (IMTA) systems (e.g., Neori et al., 2003). In northern Europe, high biomass yields in land-based systems have also been demonstrated with *Ulva* biomass that can be valorised as food and feed ingredient (e.g., Bruhn et al., 2011).

Worldwide, *Ulva spp*. Production is estimated at 3699 t.w.w. for a value of 1,074,400 EUR with an average price of 290.41 EUR per t.w.w. (Rebours & Sánchez López, 2025), While in Europe, Ulva production remains very low, and the total production numbers are difficult to estimate. Today, the output in terms of volume and value is reported to national authorities and further communicated to Eurostat and FAO databases. In both cases, the species are not accurately named, making it difficult to oversee the size of the Ulva industry in Europe. The seaweed industry (including Ulva) also faces the challenge of being a plural sectoral activity, forcing entrepreneurs to navigate a complex regulatory framework governed by a multitude of agencies, both nationally and at the European level. This multi-sectoral distribution of the business also makes it challenging to identify the actors across Europe and to understand if segment(s) of the value chain are still missing to reach the existing market. Furthermore, even seaweed (including Ulva) extracts are already used in a wide range of products across Europe. However, this ingredient is still perceived as novel by consumers, which may lead to a significant portion of the adult population exhibiting low acceptance (neophobia) towards consuming seaweed (Losada-Lopez et al., 2021).

Therefore, the WG6 examined the regulatory framework relevant to large-scale Ulva production, investigated societal acceptance of Ulva products, and assessed economic aspects, including risk assessment across various scenarios and geographical locations. This WG fulfilled the Cost Action challenge "e" about enhancing acceptance of Ulva as food, feed, and source of bioactive products by society, and drawing recommendations for amendment or reinforcement of the current regulatory framework for Ulva-based industries.

Task 6.1, the European regulations related to the Ulva mass production (land- and sea-based) for the market of food, feed (incl. potentially highly valuable secondary metabolites) were reviewed to understand the regulatory framework that applies to food and feed safety and quality, and analysed to identify the gaps to support the development of a sustainable European Ulva industry. The existing national legislations and the implementation of these EU regulations by member states and associated EU countries were also investigated by national contact representatives (a total of 27 and their deputies) through desk study and, when possible or needed, with consultations of national authorities, NGOs, industry, and SMEs across Europe. The regulation framework addressing the environmental impact and evaluation of ecosystem services was developed in collaboration with WG5. Collaborations with WG1, 2, and 3 were also established to increase knowledge and understanding of the regulations and governance that apply to their respective segments of the value chain (e.g., WG1: Nagoya protocol and Material Transfer Agreement; WG2: EU Aquaculture Assistance Mechanism/Eu4Algae licensing tool; WG3: food, feed, cosmetics labelling).

Task 6.2: Several surveys and face-to-face consultations were conducted to better understand the impact of Ulva cultivation, processing, and marketing on various communities. Some surveys were directed to SMEs to collect their knowledge relative to, e.g., their consumers' acceptance of Ulva as food and their impact on job creation in their community. Other surveys were directed to participants of some Training Schools (TS) and Workshops (WS) to assess their knowledge, know-how, and education levels (preselection of young employees or entrepreneurs in the Ulva industry). TS and WS were also designed to increase the level of competence of these populations. In collaboration with WG7, videos were created to increase various stakeholders ' knowledge, including the general public, about the Ulva industry and the potential benefits of consuming Ulva. Under WG7, a cookbook was also published to encourage potential consumers to try Ulva in their daily food preparation.

Task 6.3 and 6.4, a survey was conducted to assess the risks (e.g. Legal / Licensing, Financial / Budget, Chain of supply, Production/Manufacturing, Personnel, Biological risks, Health and Safety Issues, Environmental/Weather/Nature, Marketing/Access to Market) related to any segment of the land and sea-based Ulva industry (e,g, culture, processing, biorefineries, marketing). Participants in the survey were also invited to indicate their countermeasures. When existing, respondents were asked to report any conflicts of interest, incl. competition for at-sea and land space for large-scale production of Ulva. The result of this survey will be transferred to related governments with suggestions for possible amendments.

References

ACTIVITIES AND KEY FINDINGS

Main activities and key findings. Please note that reports of workshops and Training Schools will be included separately in the final report document.

- *achieved its MoU deliverables,*

The WG 6 Deliverable D 6.1 (a, b, c) aimed at proposing recommendations for updating policies about seaweed production (incl. culture) regarding environmental aspects and to address eventual conflicts of interest. D6.1 ambition to report on the following topics:

a. National regulations on seaweed mass production and its marketing as food, feed, and valuable secondary metabolites.

b. The impact of Ulva cultivation on various communities concerning social aspects.

c. Ulva as food and feed, nutrition, job creation, community income, and education.

Therefore, following the investigations described under tasks 1 to 4, all the reports below were completed and fed into the deliverable 6.1 (D6.1).

a. Policy Brief

This deliverable provides the overall results for D 6.1. The document provided a brief overview of the Ulva industry and the EU's strategic roadmap for a sustainable seaweed industry. It also offered recommendations for enhancing regulatory frameworks and outlined the necessary support tools to develop a sustainable Ulva industry in Europe further.

500 words per task, including key findings + link to deliverable document (paper, report, dataset)

b. Summary of the EU policy and governance for Ulva production

This deliverable provides the results for D 6.1. The document is designed to guide young entrepreneurs through the existing EU strategies, documents, regulatory framework, and support mechanisms already available in Europe for the seaweed industry. Supplementary materials were also provided through presentations from DG Mare, DG Health, consumers, and the EU4Algae licensing toolkit. These presentations are also made publicly available.

500 words per task, including key findings + link to deliverable document (paper, report, dataset)

c. Overview of the National Legislation relevant to the Ulva industry.

This deliverable provides the results for D 6.1a. The tables 1 to 4 provide information from 20 EU27 member states (Belgium, Bulgaria, Croatia, Cyprus, Denmark, Estonia, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Latvia, Malta, Netherlands, Portugal, Romania, Spain, Sweden), 3 Countries under the stabilisation agreement (EU candidate countries, Moldova, Montenegro, Turkey) and 4 Countries with close relationship with the EU and bilateral agreements (Israel, Norway, U.K., South Africa). Each table lists the regulations that apply to the Ulva industry in each country, as well as indicates the responsible agency, the corresponding EU and /or international regulations implemented nationally. Table 1 focuses on the General legislations (e.g. Marine Spatial planning), table 2 on legislations to addressed at the planning stage (e.g. licensing), table 3 on legislation that need to be addressed when the production is in operation (e.g. hygiene practices) and table 4 presents the legislations that applies depending of the market (e.g. food, feed, biomaterials, cosmetics, pharmaceutics, agriculture and others). These four tables are planned to be published as supplementary materials in the peer-reviewed paper under preparation for the Journal of Environmental Science and Policy, and will be confidential until publication.

500 words per task, including key findings + link to deliverable document (paper, report, dataset)

d. SME platform

This deliverable provides the results for D 6.1b and c. During the project, an SME platform was created to facilitate stakeholder consultation and increase communication and potential collaboration between the various SMEs throughout the value chain. The goals of the SME platform were: i. to identify the scientific bottlenecks and regulatory issues facing the industry, and ii. Facilitate the knowledge transfer from research entities to the industry. Promote the creation of a network with other companies and research institutes to establish a consortium for future EU projects, iv. Promote European Citizens' Initiative (ECI) and connect Ph.D. and young scientists to industry.

500 words per task, including key findings + link to deliverable document (paper, report, dataset)

e. Ulva industry value chain

This deliverable provides the results for D 6.1b and c. During the project, a stakeholder analysis was conducted to identify the companies explicitly involved in the Ulva industry. 64 Companies were reported to work with Ulva spp, but only 17 participated in the CA SeaWheat. There were 21 aquaculture producers: (9 sea-based, 13 land-based, 6 IMTA); 33 harvesters: 33 (wild collection, blooms), five that both conducted aquaculture & harvesting operations, 32 processors: (extracts, food preparations), 39 B2B - sellers (raw & processed), 29 B2C – Retailers: (processed mainly) and 12 associations such as tech providers, Algaebase, R&D, stakeholder platforms, Observers. This list was used to gain a deeper understanding of the value chain, and its representatives were invited to participate in the various consultations and surveys organised under the CA SEAWHEAT. The structure of the value chain was presented at the Final SEAWHEAT conference in Bremerhaven in September 2025.

f. Online Stakeholders' Surveys

This deliverable provides the results for D 6.1b and c. During the course of the project, three surveys were conducted. The first one was done during the application of the Responsible Research and Innovation (RRI) principles after a short presentation kick-off conference meeting in Brussels (Belgium) with online participants. To understand the profile of the participants in the CA SEAWHEAT project and their level of awareness, and to introduce the RRI, Convention of Biological Diversity (CBD), Nagoya protocol (NP), Access and Benefit sharing Clearing house (ABSCH)that apply to Marine biotechnology. There were 54 respondents. The results of this survey were presented during the first SEAWHEAT conference in Cadiz (Spain) in September 2022. They were further used to design training courses, workshops, and conference meeting presentations aimed at increasing awareness and understanding of RRI, CBD, NP, and the necessity of negotiating access rights with primary owners. Additionally, the use of Material transfer agreements was emphasised to prevent future conflicts of interest.

500 words per task, including key findings + link to deliverable document (paper, report, dataset)

g. Two face-to-face stakeholders' consultations

This deliverable provides the results for D 6.1b and c. Face-to-face stakeholders' consultations were designed to understand the challenges faced by the SME and industry interested in the seaweed or Ulva sectors in developing a sustainable seaweed (Ulva) industry in Europe. The first-round table consultation, which was conducted in Brussels (Belgium) in February 2023, highlighted the low acceptance of European consumers for seaweed products and the difficulties in designing suitable and cost-efficient production/engineering systems. During the second-round table in Galway (Ireland), three main issues were identified: 1. the negative perception of the European public on seaweed, 2. the cost of production, and 3. legislation and regulatory issues. The results of the surveys were presented at the Final SEAWHEAT conference in

Bremerhaven in September 2025. Further, based on these results, efforts were made through out the project period to increase understanding of the existing regulatory framework by presenting the European regulatory framework that apply when producing Ulva for a variety of markets (e.g. food, feed, cosmetics, fertilisers) to various audiences during SEAWHEAT workshops and conference but also outside the SEAWHEAT consortium during the Nordic Seaweed Conference in Greena (Denmark) in October 2024 and the International Seaweed Symposium (Victoria, Canada) in Mai 2025. A special session was also organised during the Danish stakeholders meeting (Erhvervsnetværksmøde) in Greena (Denmark) to reinforce the understanding of the steps to achieve legal, equal, and ethical sharing of genetic resources in Blue Biotechnology early in the process of innovation in the seaweed (Ulva) sector, to avoid future conflict of interest.

500 words per task, including key findings + link to deliverable document (paper, report, dataset)

h. Risk Assessment Online Survey

This deliverable provides the results for D 6.1b and c. A final survey targeted industry stakeholders throughout the value chain to complete a risk analysis, aiming to better understand the challenges faced by the Ulva industry in Europe. Participants are invited to identify potential risks and suggest possible countermeasures. There were 28 respondents by September 23, 2025. Nevertheless, to increase participation, the survey deadline is extended to October 15 2025. The results will then be included in the peer-reviewed paper under preparation, contributing to the development of science-based guidelines for decision-makers and supporting future technological advances and interdisciplinary research.

500 words per task, including key findings + link to deliverable document (paper, report, dataset)

i. Consultations of TS and WS participants

This deliverable provides the overall results for D 6.1c. During this exercise, the participants in the TS were invited to self-evaluate their knowledge, know-how, and gaps in knowledge before and after the training/teaching session. They could also propose ways to improve the training session. Although the overall satisfaction was very high, the intensity (short time and a lot of information to cover the proposed topics) was the main negative issue reported, which could limit the student's complete understanding or retention of the information. In future training initiatives, allocating more time may be the solution. The results of these consultations were presented during the Management Committee meeting of the SEAWHEAT.

j. Collaboration with other EU-commissioned groups

This deliverable provides the results for D 6.1 to ensure that the results are further communicated to the EU Commission through its diverse working group.

- ESPP (European Sustainable Phosphorus Platform)
- EU4Algae – Licensing tool kit
- EABA – Novel food (Algae Taxonomy Changes)
- EU tender (example: Contract CINEA/2023/OP/0006 "Study to support Sustainable EU Algae Industry")
- JRC/edmonet

500 words per task, including key findings + link to deliverable document (paper, report, dataset)

WG participants from 14 countries (6 ITC countries).

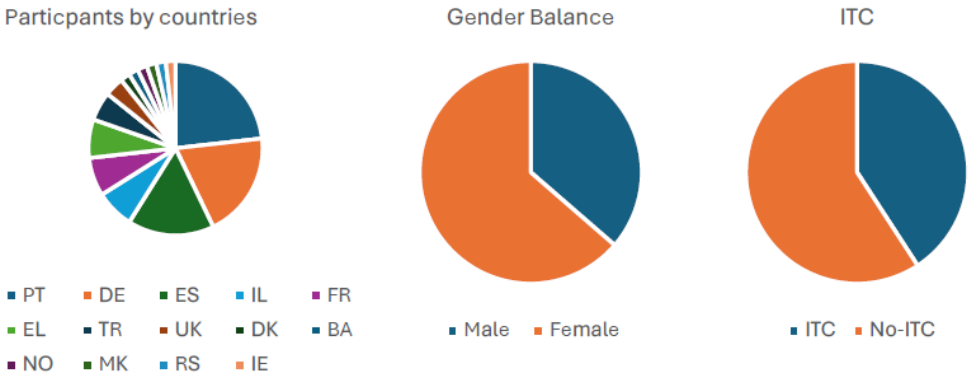

Figure 1 Distribution of the Workshop participants by countries, gender, and members of ITC

500 words:

Achieved additional outputs/achievements, including projects resulting from Action activities and co-authored publications by at least two Action participants from two countries participating in the Action, that are on the topic of the Action and for which the networking was necessary;

Achieved dissemination and exploitation of Action results

FUTURE DIRECTIONS & RECOMMENDATIONS

500 words Future research recommendations, identified knowledge gaps

The EU Governance and Strategy roadmaps illustrated that the European Commission (EC) is supportive of the development of the Algae industry.

- The Green Deal COM/2019/640
- The Clean Planet for all strategy COM/2018/773
- The European Climate Law Regulation (EU) 2021/1119
- The Blue Growth Strategy COM/2021/240
- The Farm to Fork strategy COM(2020) 381
- The Sustainable Development of Aquaculture Strategy COM(2021) 236
- The Organic Production Action Plan COM(2021) 141 final/2
- The Strong and Sustainable EU Algae Sector Strategy COM/2022/592
- The Circular Economy Action Plan For a cleaner and more competitive Europe COM(2020) 98 final (under revision)

However, the regulatory framework that applies to the seaweed (Ulva) industry is complex as this industry expands over a variety of sectors of activities, each of which has already developed its own regulatory framework. Therefore, in order to further support the sustainable development of the seaweed (and in particular Ulva) based industry, the CA SEAWHEAT WG6 participants would like to propose the following recommendations:

- Develop a unified regulatory framework for seaweed products to consolidate the Common (internal) European market and clarify the rules of access of the EU27 market by non-EU member states that want to import by developing the concept of Fair Trade (COM/99/0619 final).
- Ensure traceability of the seaweed ingredients for food and feed by ensuring that products claimed as European products are produced in Europe not only packaged in Europe by amending Regulation (EU) 1169/2011 and (EC) 767/2009.
- Homogenise the reporting of seaweed production data across Europe to increase the accuracy of the EUROSTAT (Regulation (EC) 762/2008): quantity and value reported should be done per species and location.
- Define a standard method for identification of *Ulva* species to ensure correct naming of the species in the policies and reporting frameworks (incl. Recommendation (EU) 464/2018).
- Correction of species name in the Novel Food Regulation (EU) 2015/2283.
- Increase knowledge and data about *Ulva* (seaweed production systems and products) to facilitate carbon accounting in the Regulation (EU) 2024/3012.

- Support the concept of Integrated Aquaculture/agriculture by including *Ulva* species as a tool for water quality restoration in the:
  - Water Policy Framework Directive 2000/60/EC
  - Wastewater treatment and sewage sludge Directive 86/278/EEC*
  - Urban Wastewater Treatment Directive (EU) 2024/3019
  - Nitrate Directive 91/676/EEC

Further to support both the Ulva sector young entrepreneurs in developing their economic activity and, the National and European authorities in understanding better the need of this industry and oversee its activities, the CA SEAWHEAT WG6 participants would like to propose the following tools to be established at national or European levels through close collaboration with the industry and in some case with the participation of the research community.

- Appoint national contact points to navigate and increase knowledge about the existing national and European regulatory framework.
- Include production data per location and species in the Edmonet platform.
- Define standards for production and products in the common EU markets: e.g., Management plan for disease control (e.g., bacteria, viruses), traceability, risk assessment, food and feed safety documentation, environmental requirements (including reporting methods).
- Complete the EU Aquaculture Assistance Mechanism: information about the national licensing system for all European countries and production protocols to support start-up.
- Complete the features in the Blue Invest platform with information to support Ulva (Seaweed) industrial development as sustainable solutions for almost all the identified blue sectors.
- Increase portfolio for the establishment of a sustainable Ulva (Seaweed) aquaculture under the European Maritime, Fisheries and Aquaculture Fund (EMFAF).
- Allocate Research and Innovation Fundings to increase scientific understanding and documentation of Ulva aquaculture as an agent for bioremediation of nitrogen, phosphorus emissions, and ecosystem services.

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