



Workshop on science-policy interface regarding seaweed, their ecosystem services & impacts

June 13th 2022, Brussels

Final Report





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INTRODUCTION

In 2020, the European Commission's Directorate-General for Maritime Affairs and Fisheries (DG MARE) requested from [Eklipse](#) a knowledge synthesis on macroalgae cultivation, under the title “State of knowledge regarding the potential of macroalgae cultivation in providing climate-related and other ecosystem services”. The Eklipse mechanism put together a group of experts through an open call, to work on the request (more information on the request “Macroalgae cultivation and ecosystem services” can be found on the [webpage](#)). The final peer-reviewed report was delivered to DG-MARE on March 15th 2022.

The workshop described below is based on the submitted knowledge synthesis report and aimed to foster cross-sectoral dialogue to: a) further identify and prioritise knowledge gaps regarding macroalgae cultivation and ecosystem services (ES); b) identify structural research needs which can feed into future research initiatives of the European Commission and c) further support the development of the EU Algae initiative.

The event engaged key experts, relevant research projects ([GENIALG](#), [Pegasus](#), [GRASS](#), etc), thematic initiatives or networks ([SUBMARINER](#), European Algae Biomass Association, Knowledge Centre for Bioeconomy, [Safe Seaweed coalition](#)), key policy initiatives (EU Algae initiatives), relevant European Commission services and Science-Policy Interface (SPI) initiatives (as Science Service for Biodiversity, the [Knowledge Centre for Biodiversity](#)). The targeted outputs were the development of policy relevant recommendations and potential research questions to feed future research proposal calls

The workshop was convened by DG MARE and organised by MCI-Brussels with the support of the Eklipse team, discussions were based on the [report on the “State of knowledge regarding the potential of macroalgae cultivation in providing climate related and other ecosystem services”](#) prepared by the Eklipse Expert Working Group (EWG)) and were facilitated by Estelle Balian (Facilitation for Environmental Action-Learning-FEAL).



WORKSHOP METHODOLOGY

The workshop was organised in two sessions (see Annex 2. Workshop agenda). The morning session was dedicated to presenting the EU-Algae Initiative, Eklipse, and the EWG's knowledge synthesis. These presentations were used to trigger the dialogue in a “Samoan circle” format. The “Samoan circle” consists of concentric circles where only the inner circle is actively participating while the outer ones are listening. Anyone can join the inner circle at any time to contribute to the conversation and leave whenever they want. The “Samoan circle” format supports an active listening and an egalitarian basis for discussing a topic. The inner circle conversation is facilitated by a professional facilitator who summarizes on a regular basis the key points of the discussion. Two questions were addressed during the Samoan Circle session:

- Question 1 (30'): What do you think could already be taken into account by policy? What is current actionable knowledge?
- Question 2 (30'): Building on the Eklipse report findings, what do you think are key knowledge gaps to ensure scaling up and further development of Seaweed cultivation and associated ES?

The afternoon session was dedicated to working in small break-out groups (“knowledge café” style), addressing 4 topics identified in the morning discussion. Two rounds of discussion took place and, for each round, participants could change group/topic. A facilitator and a “volunteer” expert were assigned to each group to document the discussion and summarise it.

The rounds were tackling the following questions for each topic:

- Round 1: Building on the work of the EWG, what do you think are the most important knowledge gaps related to this topic?
- Round 2: Based on the previous discussion, how would you further elaborate/detail these knowledge gaps?

After these 2 rounds, a reporting on the results of the discussions was done for each topic and participants were invited to add their comments and to prioritize the identified knowledge gaps, evaluating them with 3 criteria: policy relevance (red stickers), potential for innovation (blue



WORKSHOP RESULTS

SUMMARIES OF KEYNOTE PRESENTATIONS

The European Green Deal and the Farm to Fork Strategy underline the potential of farmed seafood as a source of protein for food and feed with a low-carbon footprint. The Farm to Fork Strategy highlights the role of algae as an important source of alternative protein for a sustainable food system and global food security. Support to the latter has become more



pressing over recent months. Algae – both macro- (seaweed) and microalgae – can contribute to several axes of the Green Deal even beyond sustainable food and feed, as already emphasised in the EU Strategic Aquaculture Guidelines: decarbonisation, zero pollution, circularity, biodiversity, ecosystem protection and services, biofuels and replacing fossil-based products. The Sustainable Carbon Cycles Communication recognises the potential of algae in the blue carbon economy.

While today the European algae sector remains small, it has the potential to become a significant part of the EU Blue Bioeconomy. As a result of EU research and innovation, but also of enthusiast entrepreneurship, there is a growing momentum within the EU algae sector – with the UN global compact even calling it a “Seaweed Revolution”. Against this background, Europe has very good preconditions to utilise its algae potential within the next decade.

A thriving EU algae industry could become a major contributor to the European Green Deal and a flagship and source of inspiration for other industries to become more regenerative, innovative and socially exemplary, with thousands of good jobs created, notably in coastal communities. This is what the EU Algae initiative aims to achieve.



Simo Sarkki (Eklipse Knowledge Coordination Body)

[Eklipse](#) was created in 2016 to help governments, institutions, businesses and NGOs make better-informed decisions when it comes to biodiversity in Europe. Eklipse's [robust mechanism](#) for answering the need for evidence is what sets it apart. This innovative and ethical process leverages collective intelligence from a diversity of experts in a broad set of countries. It ensures synthesized knowledge will be credible, relevant and legitimate — which allows it to be used effectively, even on contested issues.

Among the 55 requests submitted to Eklipse so far, [16 were selected](#); the outcomes (evidence) of 14 of which is already publicly accessible, with the other 2 requests still on-going. These requests cover a wide array of topics, ranging from developing an evaluation framework for nature-based solutions (see [Eklipse outputs](#) and main [EC follow-up report](#)) to better understanding impacts of green and blue spaces on mental health (see [Eklipse reports](#)). Requesters can submit their questions to Eklipse and receive targeted responses based on the best available knowledge within 8-18 months, depending on the [knowledge synthesis method\(s\)](#) used.

As a European Union H2020 funded project, Eklipse was granted additional funding under the H2020 Green Deal Call, as part of the EU response to the COVID-19 pandemic, in order to organise this workshop and answer the need for evidence that will come out of it. In parallel, Eklipse is becoming financially self-standing under the [Alternet](#) umbrella.

Ricardo Bermejo & Elisa Capuzzo (Eklipse Expert Working Group -“State of knowledge regarding the potential of macroalgae cultivation in providing climate-related and other ecosystem services”)

Seaweed aquaculture can potentially provide many ecosystem services, including climate change mitigation. Nevertheless, there are still many constraints and knowledge gaps that need to be overcome, as well as potential negative impacts or scale-dependent effects that need to be considered before macroalgae cultivation in Europe can be scaled up successfully and sustainably. To investigate these uncertainties, a multiple expert consultation with Delphi



process in combination with a Quick Scoping Review (QSR) was performed. While the results of each method differed in many ways, both methods identified the following top six ecosystem services provided by seaweed cultivation: i) provisioning food and feed, ii) provisioning hydrocolloids, iii) regulating water quality, iv) provisioning habitats, v) provisioning of nurseries and vi) regulating climate.

Diverse technological knowledge gaps precluding the scaling up of a sustainable seaweed aquaculture in Europe were identified by both methods at all scales of the macroalgae cultivation process, followed by economic and environmental knowledge gaps depending on the method used. The most commonly identified potential negative impact of macroalgae cultivation both Delphi and QSR was unknown environmental impacts, e.g. to deep sea, benthic and pelagic ecosystems. One of the main hurdles recognised by the EWG was the understanding of ES themselves by the different stakeholders, as well as the reference point for scale.

There was a lack of studies in literature providing clear evidence of ES provided by seaweed cultivation, and their valorisation, and some aspects, like cultural impact, were missing in the responses to the questionnaires during the Delphi process. The issue of scale and scaling-up was present both in assessing the ES provided and in identifying knowledge gaps, constraints and potential negative impacts. For example, the ES provided will depend on the scale of cultivation, and the main technological knowledge gaps were often related to scale of cultivation. Likewise at a large scale of operations, there could be multiple associated potential side effects, which need to be further investigated. Based on the outcomes of this investigation, we provide an outlook with open questions that need to be answered to support the sustainable scaling-up of seaweed cultivation in Europe.



RESULTS OF THE “SAMOAN CIRCLE” DIALOGUE

Question 1. What do you think could have already been taken into account by policy? What is the current actionable knowledge?

Key points:

- Participants emphasised the need to have **specific common legal standards and regulation framework at EU level for seaweed production and management**. Currently, this is depending on national legislation and there are too many differences with potential risks as some species are allowed in some countries but not in others.
- A major aspect is related to seaweed market development in Europe. Current production is limited because consumption is low and production costs are too high. Many companies would like to expand the market in Europe but, currently, both the legislation and the lack of understanding and consumption are obstacles. There is also a risk of raising expectations, **as more knowledge is needed to better support this market development with a clear understanding of what seaweed production means in terms of water, pesticide use, potential environmental risk, and visual nuisances**. Consequently, there is a need to support producers and processors and to ensure cross-border knowledge transfer and not only Science to Practice.

Question 2. Building on the findings, what do you think are key knowledge gaps to answer scaling up and further development of seaweed cultivation and associated Ecosystem Services?

Key points:

- **More understanding of the benefits of seaweed cultivation** would be needed as this can provide an alternative for food.



- **Exploring further the different types of cultivation is important: at sea, offshore and coastal as well as their risks for the environment.** There is a need to support seaweed cultivation at the same scale as land agriculture, but with a good understanding of best practices for all different types of cultivations. Assessments are needed for each cultivation type regarding all aspects: legal, social, technological, environmental, etc.
- Another key research theme is the **knowledge on the different species, both biologically and ecologically**
- A specific emphasis is put **on more research on environmental risks** as this can be a major drawback for promoting seaweed in the future.
- Some large-scale experiments would be needed in order to support and integrate research identified above but also to **further explore the value chain/market, have some horizon scanning and build mixed scenarios for the future.**

RESULTS OF THE BREAK-OUT GROUP SESSION

Based on the morning discussions four topics were proposed for the afternoon break-out groups:

- Topic 1: Better understanding of biological and ecological components
- Topic 2: Better understanding of farming production systems for Europe
- Topic 3: Better understanding of environmental impacts
- Topic 4: Better understanding of value chains, market acceptance, economic scenarios.

Participants could choose which topic they wanted to discuss in the first round for about 30' and could then move to another topic for round 2 for 20'.

- Round 1: In this area/topic building on the morning discussions, what are the current knowledge gaps?
- Round 2: reflection on the identified knowledge gaps by newcomers



All participants were then gathered for a reporting on each topic and asked to prioritise on 3 criteria: policy relevance, innovation and feasibility (see Figures 1 to 4). Results of these discussions and prioritisation are reported below.

Group/Topic 1: Better understanding of biological and ecological components

Participants identified the following knowledge gaps regarding biological and ecological components:

- **Building a list of local species taking in consideration the need to have a clear definition** of what is an invasive species and what is an exotic species. Some discussion should first clarify whether this is targeting local species or local genetic species.
- **Clarifying taxonomy and further documenting genetics of Seaweed species used for cultivation.** Aspects related to population dynamics and genotypes should be included. The question of developing a biobank (Infrastructure) and which methods to do it was also highlighted.
- **Better understanding of species characteristics in terms of reproductive cycle, microbiome, biochemical composition, as well as their interactions with their environment:** uptake of nutrients and effect on food web and trophic relations, resistance to weather conditions, capacity to adapt, potential diseases.
- **Bioprospecting in new species with potential value.** An important aspect would be to better document strains selection with exploring better strain characteristics and potential uses. Research should further explore Life cycle control (quality of biomass and compounds and how to manipulate it in order to have more spores and production).
- **Supporting a large-scale monitoring program** in order to alert each other about issues and transfer knowledge on species.

Participants also discussed but did not agree on the aspect of manipulating genetics and breeding seaweed that raised the question of regulation and what could be allowed at European level.

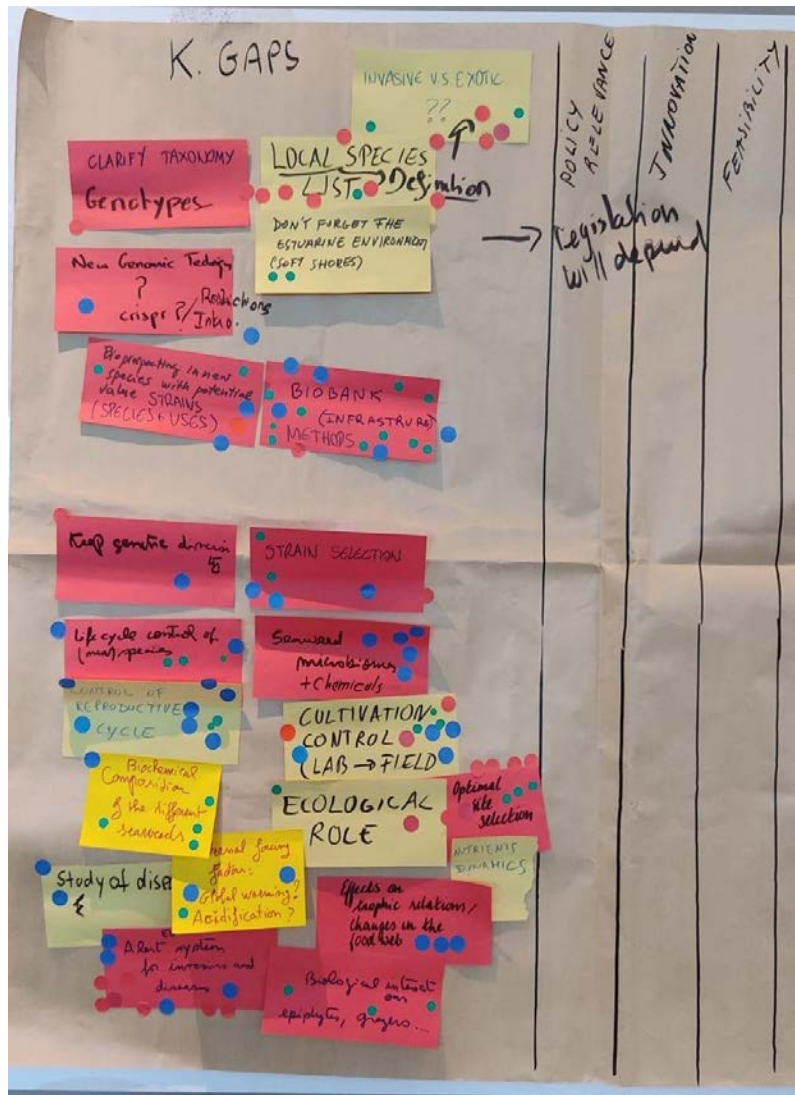


Figure 1. Results from topic 1: “Better understanding of biological and ecological components”. Stickers were distributed based on priority participants identified. Three criteria were defined: policy relevance (red), innovation (blue) and feasibility (green).

Prioritisation is indicative as reflecting the views of the participants present in the last part of the session. In terms of prioritisation, the votes were distributed as follow:



Regarding Policy relevance, most votes went to the list of local species and clarifying the definition of exotic, invasive, local species; some votes were also supporting experiments for cultivation control, the tools for optimal site selection and a EU Alert system for invasive and diseases.

For innovation, votes were more disseminated, and it is difficult to highlight a specific cluster.

Finally for feasibility, a large part of the votes concentrated on the biobank infrastructure.

Group / Topic 2: Better understanding of farming production systems for Europe, what is needed?

Participants highlighted the importance of exploring further the three dimensions: species, environment (nutrients/carrying capacity, risks etc.), and use/product to support best practices and decision making for implementing various types of production systems adapted to environmental conditions, strain selection and market/use.

More specifically the following knowledge gaps were identified:

- **Supporting a large-scale monitoring program** in order to alert each other about issues and transfer knowledge on species.
- Investigation of **differences between polycultures and monocultures**.
- Better documenting the **elements/steps between production and processing to inform both producers and markets**. This knowledge would then need to be readily available for practitioners through a one-stop shop and through toolkits for farmers and inventories but also in support of licensing systems. Along the same lines, this could also be the basis to explore how to develop and implement certification and green labelling.
- **Learn from other agricultural** systems to draw lessons learned and to implement experiments to build best practices. This could be done at various scales and engaging also local community businesses and cooperatives.



Some specific research sub-topics were proposed:

- How to optimize harvest and deployment technology?
- How seaweed could be included in existing aquaculture sites looking at benefits and limits of diversification of these existing sites?
- How to increase food safety of seaweed?
- How to predict and monitor fooling events?
- How to improve nursery systems: performance of substrate, cost-benefits and risks
- How to increase biosecurity regarding diseases at all stages of the production (transport, nursery, etc.)?
- How to improve management of seaweed genetics (question on plant passport? Nagoya)?

In terms of prioritisation, the votes were distributed as follow:

Most of the policy relevance votes supported the aspects of toolkit, licensing and green labelling as well as food safety of seaweed.

For innovation, the votes were disseminated with some cluster on the topics related to nursery technology, biosecurity regarding genetics and diseases.

There was no clear cluster for feasibility.

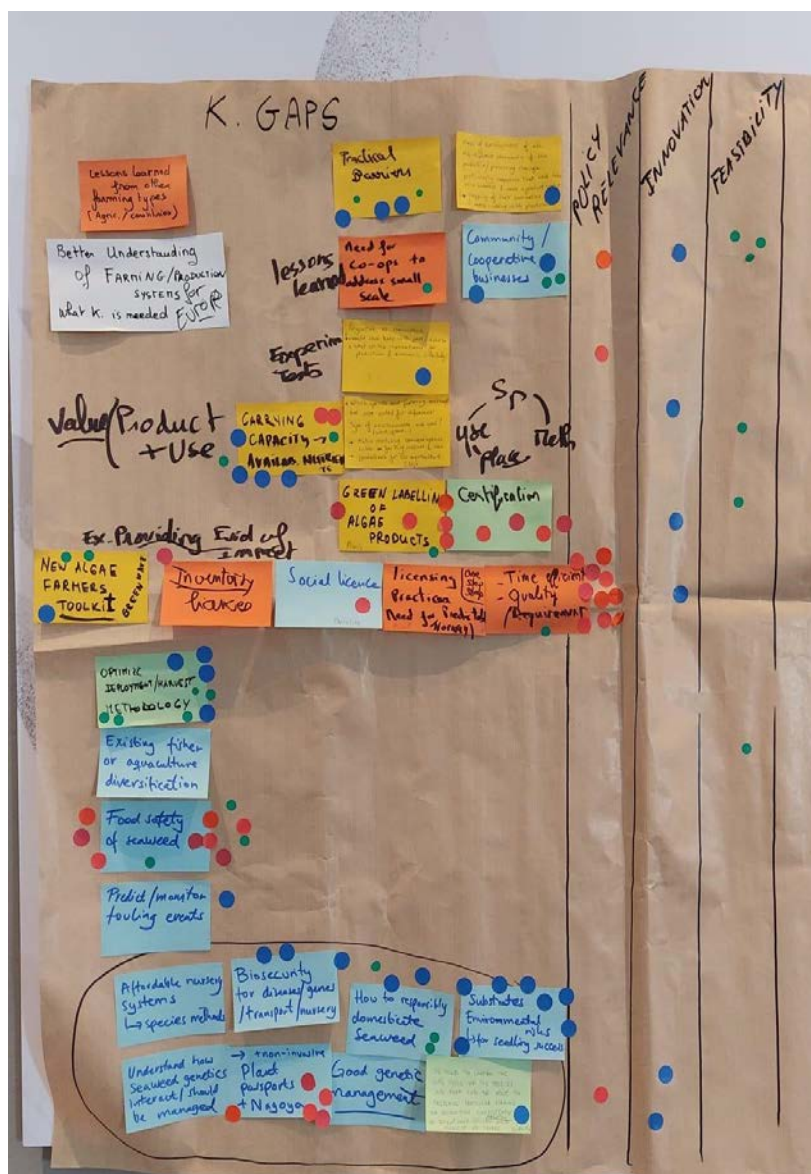


Figure 2. Results from group 2 - “Better understanding of farming production systems for Europe, what is needed?”. Stickers were distributed based on priority participants identified. Three criteria were defined: policy relevance (red), innovation (blue) and feasibility (green).



Group / Topic 3: Better understanding of environmental impacts

All participants agreed that the most important aspect is to develop a **harmonised Environmental impact assessment framework** at the EU level to systematically collect standardised indicators and use a common evaluation framework. This would help with developing a common EU regulation. This Impact framework would have to be specific to seaweed as it is a different type of aquaculture.

In addition, some more specific knowledge gaps regarding environmental impacts of seaweed cultivation were discussed:

- **Further exploring risk with regards to genetic diversity and impacts on the ecosystems.** Some research sub-topics were identified:
 - What is the effect of cultivated strains on the ecosystems?
 - How can genetic impacts be avoided?
 - What are the positive effects of seaweed on other ecosystem functions: for example of nursery function for e.g. fish (also what is the real role as habitat if we are destroying (harvesting) the habitat?)
 - How can seaweed farming contribute to enhance biodiversity?
- **Further exploring the potential risk linked invasive species and the spread of diseases.** Some sub-topics were identified:
 - How to mitigate risk during transport for potential invasive species?
 - What are positive and negative impacts? How sensitive to diseases are the current strains and what risk for spreading disease do they represent? Are control options for pests and diseases available that do not imply ecological risk?
 - What is the potential risk of Land-based cultivation as a source of invasive species?
- **Better understanding of seaweed nutrient needs and potential impacts on the food web and other ecosystem functions.** Some sub-topics were identified:
 - How are competition mechanisms for nutrients functioning (processes of nutrient extraction, cumulative effects, etc.)
 - What are potential benefits of nutrient reduction with regards to conditions for eutrophication?
 - How could seaweed cultivation represent potential sequestration means? There is a need to further documenting processes and quantification: is there carbon



- sequestration and how much? What are the influencing factors? how are processing and transport emissions compensated/taken in consideration?
- What are potential mechanisms to balance between anthropogenic nutrients (C:N:P) and anthropogenic sequestration? (mapping and timing)
 - **Better understanding of the potential role of seaweed in coastal protection.** Some sub-topics were identified:
 - Could seaweed be used as Nature Based Solution?
 - How can this role be quantified and measured?
 - What are the potential effects on sedimentation processes?
 - **Better understanding of social perception** (understand, modify) of seaweed cultivation
 - **Better understanding of the effect of harvest on the ecosystem** on hydrodynamics, on species community, etc.

In terms of prioritisation, the votes were distributed as follow:

Votes for policy relevance were mainly distributed on the EU Environmental Impact framework and the knowledge on better understanding the role and impact on carrying capacity of the ecosystems.

Innovation votes were clustered mainly on the research on carbon sequestration including compensation for transport and processing CO₂ emissions.



Figure 3. Results from group 3 - “Better understanding of environmental impact”. Stickers were distributed based on priority participants identified. Three criteria were defined: policy relevance (red), innovation (blue) and feasibility (green).



Group / Topic 4: Better understanding of value chains, market acceptance, economic scenarios. What knowledge is needed?

This last group discussion builds on results from the three other groups on key questions such as: What are the most promising seaweeds? What seaweeds would be linked to sustainable production? How can we evaluate and decrease the risk of the seaweed industry?

Participants identified four main categories of action (both research and policy) to support the seaweed industry:

- **Supporting the exchange of experiences, lessons learned and good practices.**
 - What are good practices from other continents like Asia and how to tailor them for Europe?
 - What are lessons learned from the CAP could also be investigated especially on how to reward ecosystem services provided by seaweed, or on what type of business models or farm insurance mechanisms could be implemented?
 - How to experiment innovative solutions and technologies with pilot farms to increase our knowledge on cultivation systems? Looking at improving biorefinery would also open some potential markets.

These good practices would need to be compiled in a farmers' toolkit.

- **Improving knowledge and data on the production quantification:**
 - what are valuable seaweed species?
 - What are the right conditions for optimizing yields and limiting risks?
 - How to harmonize the legal framework in Europe?
 - How to better evaluate global sectors trends?
- **Support future scenarios**
 - What are the benefits of seaweed production in relation to SDGs but also in relation to the EU Farm to Fork strategy?
 - What is the current social perception of seaweed? what are motivations and blockages to buy seaweed products in Europe?



– **Enabling conditions**

In addition to increasing knowledge on the above sub-topics, all participants agreed that key enabling conditions need to be implemented especially in relation with “bureaucracy”:

- the current situation can only be improved if the legal framework is modified with some EU harmonization and standardization. Patents and IPR for protection of Industry are also needed as well as novel food legislation in Europe.
- Skills need to be strengthened through training and capacity building of farmers and entrepreneurs: *“Entrepreneurs need to know the risks of coming to the business. They need to be trained, maybe coming from other sectors”*
- Additional investments and better regulation need to support and enable the development of producers, processors.

In brief, participants called for more support to markets, better mechanisms to share practices and knowledge and additional funds to implement and promote cultivation systems and entrepreneurship.

In terms of prioritization, the votes were distributed as follow:

Votes for policy relevance were distributed on all sub-topics quite evenly.

Innovation votes clustered more on the sharing of experiences and the aspects of knowledge/data.

Feasibility votes were distributed more on the sharing of experiences and the training and capacity building aspects.



Figure 3. Results from group 4 - “Better understanding of value chains, market acceptance, economic scenarios”. Stickers were distributed based on priority participants identified. Three criteria were defined: policy relevance (red), innovation (blue) and feasibility (green).

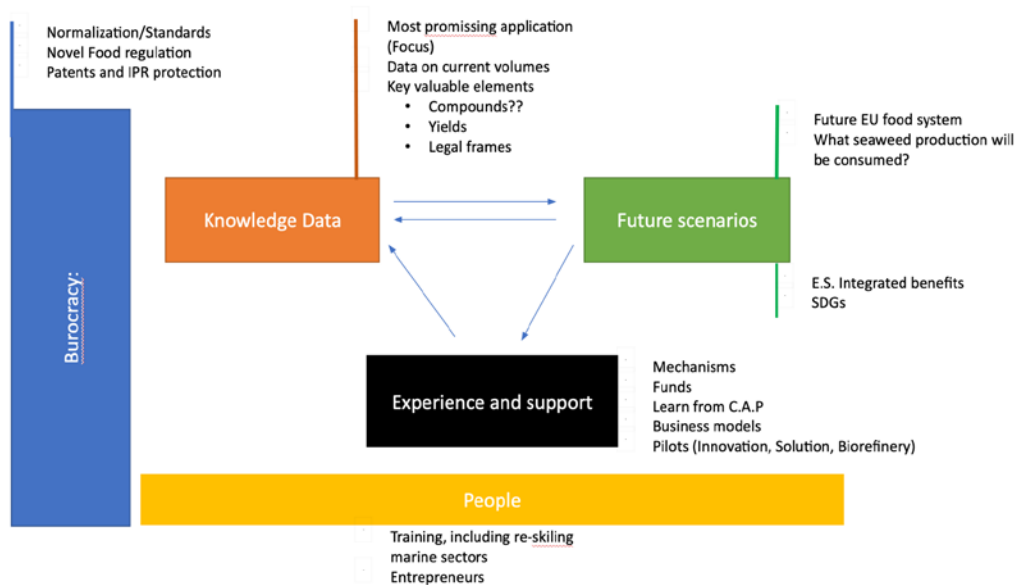


Figure 5: Scheme summarizing Group 4 results



CONCLUSIONS

The discussion highlighted important knowledge needs ut also enabling conditions to further support seaweed cultivation and market development. These knowledge needs can serve as basis to shape future research strategies and funding as participants considered they are “key pieces of the puzzle” to unleash seaweed cultivation in Europe.

In summary, the three main identified priorities were:

- More research on the **biological and ecological characteristics of seaweed species to feed into a better selection of strains**
- **A harmonized EU Impact assessment framework** to ensure environmental risks but also potential benefits for carbon sequestration are well documented and quantified
- **Analyzing and transferring knowledge to practitioners on lessons learned and best practices from other continents and from other agricultural systems.** This would also include further exploring the different seaweed cultivation types and their characteristics, risks and conditions. Tools like toolkits and a “one stop shop” of information should be developed to allow for easier sharing of these best practices and for decision support mechanisms for practitioners.

Finally, participants all agreed on the urgent need to harmonize the EU legal framework promoting standardization of regulations as well as the need to support the European seaweed market and entrepreneurs both with increasing current knowledge and capacity building.



ANNEXES

ANNEX 1: LIST OF PARTICIPANTS

Efthalia	Arvaniti	SUBMARINER Network for Blue Growth EEIG
Estelle	Balian	Facilitation for Environmental Action-Learning (FEAL)
Ricardo	Bermejo	Universidad de Málaga
Annette	Bruhn	Aarhus Universitet, Ecoscience & AlgeCenter Danmark
Alejandro	Buschmann	Universidad de Los Lagos
Elisa	Capuzzo	Cefas
Thierry	Chopin	UNIVERSITY OF NEW BRUNSWICK
Mar	Fernández-Méndez	Alfred Wegener Institute
Anna	Fricke	IGZ
Niall	Gerlitz	European Commission DG MARE
Jason	Hall-Spencer	University of Plymouth
Ignacio	Hernández	University of Cadiz
Zoi	Konstantinou	EC DG MARE
Karla	Locher	Eclipse / UFZ
Luca	Marangoni	European Commission - CINEA



Fernando	Nieto conde	cinea
Theodora	Nikolakopoulou	European Commission/ DG GROW
Simona	Paolacci	Bantry Marine Research Station
Leonel	Pereira	University of Coimbra
Tânia	Pereira	CIIMAR / University of Porto
Rui	Pereira	A4F, Algae for Future
Candice	Pouget	Helmholtz-Centre for Environmental Research - UFZ / Eklipse
Christine	Rolin	Food and Agriculture Organization of the United Nations
Isabel	Sousa Pinto	Ciimar and University of Porto
Michele	Stanley	Scottish Association For Marine Science
Maris	Stulgis	European Commission DG MARE
Norbert Francois	Tchouaffe Tchiadje	Pan-African Institute for Development
Sander	Van den Burg	Wageningen Research
Laura	Van Doorne	European Commission - DG MARE
Luca	Van Duren	Deltares
Marie	Vandewalle	Eklipse and Helmholtz Centre for Environmental Research GmbH – UFZ



ANNEX 2: WORKSHOP AGENDA



AGENDA OF THE WORKSHOP IN SCIENCE-POLICY INTERFACE REGARDING SEAWEED

13 JUNE 2022

10:00	Opening
10:30	Introduction to the EU ALGAE Initiative
10:45	Introduction to EKLIPSE
11:30	Coffee Break & Networking
11:45	Current Knowledge Marco-algae cultivation in Europe
12:45	Lunch break
13:30	Break-out Session 1
14:45	Comfort Break
15:00	Break-out Session 2
15:45	Coffee Break & Networking
16:00	Conclusion of the Break- Out Sessions
16:45	Closing Remarks and next steps



ANNEX 3: SAMOAN CIRCLE MINUTES

Detailed discussion minutes

- *KG requires a lot of actions before decisions can be made. Regulation and legal aspects are consensual as the main gap and could be started immediately. In some countries, some legal aspects try to be adapted and incorporated for e.g. Seaweed is something that is not working. We should not try to adapt but create a new one. We have to think in terms of seaweeds directly but not adapted to what exists already. In 5 years from now.*
- *the potential of co-existing activities and try to implement as key elements. A specific platform dedicated to seaweed and not within other initiatives. Even if other activities try to add seaweeds. Working together with others but planning it in advance.*
- *seaweeds are very important for the population. We are really below the ancient continents and we have to start thinking about how to improve the amount produced in Europe. We need to have legal limits. Have united standards for all the compounds. (E. What would we need? First of all to put seaweeds on the market and decide the legal limits. More engagement with potential market players but also a better framework with other food e.g. Vege*
- *If we know that some species are good to cultivate but we can't do anything because of the regulations. For e.g. Some Invasive species are allowed but are still a big issue in relation to seaweed. More transparency and acceptance to the consumers would be more costly at the beginning in order to invest. Acceptance from the consumers because it is in culture to consume seaweeds (near the coast for ex.) a big gap between people living in the coastal areas and inland. People need to get used to this new food.*
- *Market development is a big issue for ex. in a global way. The problem with Europe is that many companies would like to open a market but if the consumers are not identified, they can. Help Producers and processors. the knowledge transfer should be a Cross-borders and not only science and practice.*
- *Revalorisation in terms of species of what is allowed or not, differences between countries in Europe (an issue at the borders for e.g). Sector perspectives, provide your own food or import seaweeds? It depends on the perspective. It is hard to Need a real societal and political decision to support the producers. No one wants to produce because there is no market, and no one is consuming because there is not enough production.*
- *the discussion is not any more to understand the importance of seaweeds for humans. For ex. In Asia, seaweed is only giving taste to the food. The macroalgae need market development and we need to find or use the correct wording. Being alerted to environmental risks, we don't need fresh water and we have to regulate the use of fertilizers and pesticides. Many things are not pointed out in the literature. We have to be cautious when developing a market with expectations. Anticipate practices in relation to pesticides and fertilizers, give the precision that it is not allowed.*



- *we are the main processors of seaweeds in France and Europe maybe. But we don't have enough production to sell, so we have to buy in chile. We are still looking for local What doesn't work is the economics and to produce more, at this stage, the costs to produce are too high. The idea is to go around creating new refineries and to use the compounds in new applications. Big players (nestlé for ex) are ready to use it more but we need to bring more capacity. It is difficult to get sold if you are a small company. The legislation has to change to be more flexible. A lot of actors have to work together, from the legislation and potential environmental work. We don't know what is the volume of production in Europe, so it is very hard to assess it. We need to develop the possible producer capacities*
- *A lot of complaints about the visual production. The people don't like that. They recognize that it is useful but don't like to have them near their house. Integrated multi-traffic aquaculture in order not to use new coastal areas and people are not complaining. The social aspect is very important as in many places, we can't have seaweeds.*

Question 2. Building on the findings, what do you think are key knowledge gaps to answer scaling up and further development of seaweed cultivation and associated ES?

Detailed discussion minutes (THIS WILL BE MOVED TO ANNEX)

- *the cultural use of seaweeds is different in Europe and in Asia. We have acceptance for food, we know already which species we have and which we could develop. We also know about integration. It is an ecosystemic type of agriculture that we should promote more. Also, marine activities like green farms should be further investigated. We believe that seaweeds are good for many things and we have to be careful not to oversell them, so people think that it is good for nothing*
- *The difference between agriculture and aquaculture is that a farmer on land is not using the nutrients of his neighbours. We need to have an international agreement to be sure how far we can go. We have to be clear that the other species are not missing those nutrients. the footprint can be quite large.*
- *what would be the actions to support those aspects?*
- *Naturally went to large-scale cultivation, offshore, and coastal cultivation. It is not only sea cultivation. We have to be cautious but we shouldn't be naïve and we won't have that cultivation if we don't do it at the same scale as agriculture. If we put too many limits from the start, we won't have a production. Ever for the sake of the economy, we shouldn't use fertilizers and send them back to the waters. In Asia, production started because there was not a very strict regulation. Offshore for ex., the impacts of fertilizers would have effects far from the aquaculture. But in the case of controlled areas, maybe fertilizers can be used. The negative impacts are harder to control at the sea. The freshwater still needs to be used and we would have some waste as any human activities.*



- *For Europe, everything is very new. We have to be very careful as what we would develop in Europe would be new and we can't compare to other countries. We could take some elements from other parts of the work on how to implement new species. You have to seed the ropes to show that it also happens in the land and we have to develop close control knowledge in open areas far from the coast. there are different types of farming and we need more assessment from different angles and aspects (societal, legal, technological)*
- *we have to take one step at a time and it is not a flourishing market. We don't know everything about the species as many of them need more research. It would be a long journey (biologically and ecologically). We have limited shore cultivation in many countries. If we decide to do it offshore, we need to think again of sustainable shipping and solutions to bring back the production. We have to take it into consideration when we promote seaweeds.*
- *some experiments were not possible to extrapolate in order to have a good financial assessment, production and environmental impacts. If we want to do that, we need to move upscale (thousands of hectares). The problem that we would be facing on a bigger scale. (E)We would need to have a horizontal knowledge of these big scales. If we have different production, the values will drop. We need to have a horizon scanning of what a bigger use would imply. Knowledge of mixed scenarios for the future.*
- *we can't assume that the business model would work for different players. The price is high because we have many processes. The value chain has been explored (business plan, etc) but it has to be further research*
- *the potential environmental impacts have limited evidence, but you need to have an experiment to study the impacts. But the regulations don't allow experiments on a bigger scale. We could have a framework but it shouldn't depend on the countries. We would need to have a sharing knowledge between people from the different European activities. We have to further research with which species it could be combined, Some guidelines would help the different countries to make decisions.*
- *Upscaling the production doesn't always make it more attractive and cheaper (in the market).*
- *(Wrap-up): It seems that policy action, different types of cultivation and technical aspects, lessons learned of the large experiments,, economical value chain, discussion about the species to explore more (transversal aspects), environmental aspects. What would be the key topics that you would like to see tackled by DG Mare?*