



**GENetic diversity exploitation for Innovative macro-ALGal
biorefinery**

Deliverable 6.7

Combining monetary and non-monetary values in a
deliberative valuation

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Combining monetary and non-monetary values in a deliberative valuation

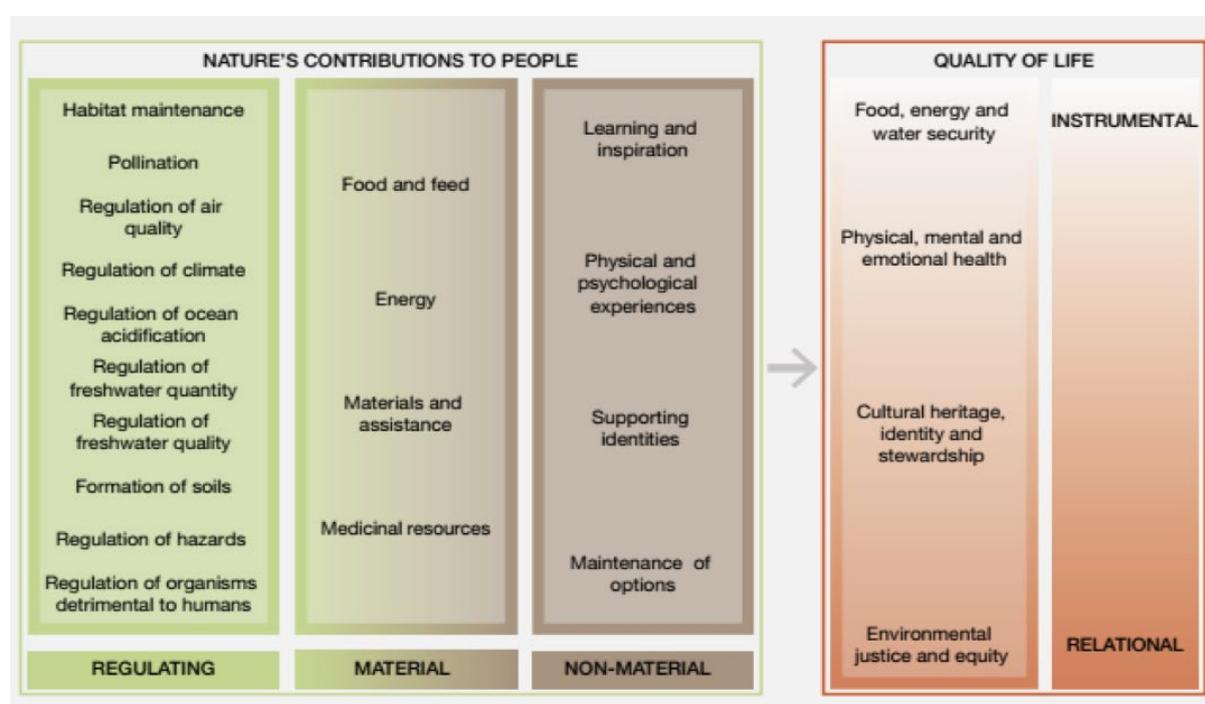
Sebastian Villasante, Itziar Burges, Isabel Sousa Pinto

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1. INTRODUCTION

Seaweed aquaculture is a socio-ecological system that contributes to the environmental quality and people's quality of life through material and non-material benefits. The concept of Nature's Contribution to People includes all contributions of living nature to people's quality of life (Díaz et al. 2015) (Figure 1). Developed by IPBES, this novel framework includes the role that humans play in the rise of benefits from nature.

Figure 1. Nature Contributions to People Framework



Source: Diaz et al. (2015).

Based on the NCP included in the framework, the objective of Deliverable 6.7 is to value the non-material benefits from seaweed aquaculture involving the stakeholders' participation and perceptions across different European Union countries.

Among all the benefits from seaweed aquaculture, there are non-material benefits that contribute to our human well-being, beyond the economic values of seaweed biomass in the market.

Table 1. Selected Nature Contributions to People (NCPs) related to seaweed farming

1. Habitat creation and maintenance	12. Food and feed
4. Regulation of climate	13. Materials, companionship and labour
5. Regulation of ocean acidification	14. Medicinal, biochemical and genetic resources
7. Regulation of coastal water quality	15. Learning and inspiration
9. Regulation of hazards and extreme events	16. Physical and psychological experiences
11. Energy	17. Supporting identities

Source: own elaboration from literature review followed by an experts' consultation to validate the presence and importance of NCPs in seaweed aquaculture (Annex 1)

Based on the NCP provided by Diaz et al. (2015), this Deliverable is focused on the identification of those NCP which are key for the development of seaweed aquaculture (Table 1).

2. METHODS

We combine quantitative and qualitative methods to value the material and non-material benefits from seaweed aquaculture. By using deliberative and participatory processes in 5 European countries or regions (France, Ireland, Norway, Portugal and Scotland) we collect stakeholders' information to elicit preferences and importance for NCP from seaweed aquaculture (Table 2).

Table 2. Number and type of participants in GENIALG's workshops

Country	Ireland	Portugal	France	Scotland	Norway
Location	Galway	Aveiro	Roscoff	Oban	Oslo
Date of Workshop	21/11/19	30/01/20	14/02/20	19/02/20	25/02/20
GENIALG partners organizers	ISC	ALGAplus	CNRS	SAMS	Bellona NGO
Stakeholders					
<i>Seaweed Producers</i>	7	3	5	8	8
<i>Researchers and academics</i>	13	14	7	18	7
<i>Seaweed Industry/users</i>	2	6	3	11	1
<i>Community organization representative</i>	3	8	12	5	4
<i>NGOs</i>	-	3	1	1	3
<i>Regulatory bodies</i>	-	2	8	4	4
<i>Donor organizations</i>	2	-	-	-	-
Total Participants	27	36	27	64	27

Source: own elaboration from workshop's results.

The organization of the workshops was able to bring between 27 to 64 attendees from different disciplines, expertise and occupations (Table 2). All of them have been organized by local partners currently involved in the GENIALG project.

2.1 Focus groups and participatory workshops

We used focus groups (Q-method) to sort 21 statements according to how those statements fit into their beliefs and understandings from most to least agree (See Table S1 at the Supplementary Material for more details). Stakeholder workshops provided the opportunity to elicit preferences about values (non-monetary and monetary) of NCPs from seaweed aquaculture in a deliberative manner.

The Q-methodology provides a foundation for the systematic study of subjectivity, a person's viewpoint, opinion, beliefs and attitudes to a given problem. The Q-methodology combines qualitative and quantitative research characteristics, exploring and identifying 'viewpoints' of people concerning different topics. Typically, in order to implement Q-methodology, respondents express their views by sorting a set of statements from most agree to most disagree (Zabala and Pascual, 2016).

Figure 2. Stakeholders participating at project workshops.



There five steps of the Q Methodology: (1) Definition of the concourse; (2) development of a set of statements (Q-sample); (3) selection of the participants (P-set) representing different perspectives; (4) Score by participants (Q-sort); and (5) analysis and interpretation.

Definition of the concourse

We provided a list of key sentences describing seaweed farming perceptions found in peer-reviewed literature and grey literature.

Q-sample

The number of statements has to be reduced to a manageable amount according to the number and type of stakeholders' participants. Chosen statements represent a general overview of the seaweed farming issues and are grouped in blocks by the benefits trying to be assessed. We are applying the Q-method to three sets/blocks of statements. Twenty-one statements are designed to cover all the different values from the different NCPs, or components of the seaweed ecosystem, by the 3 different types of values (economic indirect and option, well-being and heritage benefits) (see the full list of statement for each component in Table S1 of the Supplementary Material).

Selecting the P-set

Local stakeholders with mixed expertise are affected by the Nature Contributions to People that arise from seaweed farming facilities. We obtained a diverse and good coverage of stakeholders from different groups in the 5 EU countries (researchers, seaweed industry, recreational users, recreational anglers, artisanal fishers, NGOs, and Government authorities (see Table 2 for details).

Understanding Q-Sort

The main concern during the "Q-sorting" step is to understand the reasons behind the ranking performed by participants. The analyst should, therefore, ask for, and record, the reasons behind the completed "sort". Such open-ended comments are a vital part of the Q-methodological procedure and of the mixed mode procedure presented here. The main concern is the relative likes and dislikes, meanings, interpretations, and overall understandings that inform the participants' engagement with the Q-set. Here, we include information on:

(1) regarding how the participant has interpreted the items, given especially high or low rankings in their Q-sort, and what implications those items have in the context of their overall viewpoint;

(2) if there are any additional items that each participant might have included in their own Q-set (and why they are important);

(3) if there are any further items on which the participant would like to comment, for example, regarding those they could not understand or found confusing.

Transcriptions from questionnaires gathered in each country are presented in detail at the Supplementary Material (Table S2).

Regarding the aesthetic value of the seaweed aquaculture, we also used a Choice Experiment Method during the workshops to know what are the participant's preferences in relation to the value that two real photos they would prefer to have in their ecosystems.

Figure 3. Aesthetic preferred views for seaweed aquaculture production development

A)



B)



Source: own elaboration from workshops.

Pictures A) and B) in Figure 3 show these different examples used by the participants to answer the following question: *which landscape would you prefer?*

2.2. Integrating monetary and non-monetary values for NCP from seaweed aquaculture

In order to integrate monetary and non-monetary values of seaweed aquaculture, we carried out a Multi-Criteria Decision Evaluation (MCDE) to allow comparison of ecological objectives with socio-cultural and economic ones in a structured way. The MCDE method is a well-tried and effective tool for structuring and integrating complex decision making processes, in particular when considering environmental aspects (Proctor and Dreschler 2003).

MCE is an effective technique in which to identify trade-offs in the decision-making process with the ultimate goal of achieving compromise. It is also an important means by which structure and transparency can be imposed upon the decision-making process. For the aim of ecosystem service analysis, MCDE methods have been used in the scientific literature as (i) an alternative to economic valuation (Wegner and Pascual, 2011) (ii) a complementary method to cost-benefit analysis, and (iii) as a decision support tool that integrates monetary and non-monetary values (Newton et al., 2012). In relation to point (i), several scholars have recommended the use of MCDE methods when addressing intangible values such as cultural and heritage values. MCDE also provides a compatible methodological framework for deliberative valuation, which is considered useful in addressing plural value dimensions related to common public or environmental goods such as ecosystem services (Maxwell et al., 2011). MCDE methods are able to incorporate data from monetary valuation analysis and provide an analytical framework for integrated valuation (e.g. Newton et al., 2012), and they are also commonly used in spatial explicit land use models (Geneletti, 2013).

The key idea of MCDE methods is to evaluate the performance of alternative courses of action (e.g. policy options) with respect to criteria that capture key dimensions of the decision making problem (e.g. ecological, economic and social sustainability), involving human judgment and preferences (Saarikoski et al 2016). For the application of the MCDE we developed the following steps:

Define the scope of the problem

We asked stakeholders on how they value (weight) the components of the seaweed aquaculture systems related to the different values they can obtain from them. We identified the criteria to compare alternatives to better understand which NCPs are mostly valued according to the benefits they provide to people, and how they are valued. Decisions concerning the environment and natural resource management can often be broken down into the broad criteria groupings of 'ecological', 'economic' and 'social and cultural'. We have produced eight criteria and the decisions are broken into the three levels (economic, social, ecological).

Based on this criteria the exercise consisted of asking stakeholders to assign importance to each one of the criteria, as an indicator of the willingness to pay (WTP) for each benefit of each contribution to people in a Multi Criteria Decision Analysis. The preferences of stakeholders are accounted for by the weighting placed on each of the criteria. These weightings may range from equal importance of all criteria, to a ranking of most to least important.

Determine performance for each criteria

Our deliberative preference method allowed participants to express quantitatively which component of the multi-decision criteria matrix ranked low or high. Assuming that the preferences of each decision-maker can be expressed by a vector of quantitative weights (one weight for each criterion), we are confronted with a set of weight vectors. One may reduce this variability and reduce the set of weight vectors to a single weight vector by taking a simple average, which was the method used to provide a single and easy value to share with stakeholders.

For each criterion, the weights are sampled from the weights given by the decision-makers in a fair way, i. e. the weighting of each decision-maker contributes equally to the final results. Given the various weights from the different decision makers, the software determines for each option the mean.

Weighting the criteria

In a multi-criteria evaluation method, the preferences of the decision-maker were accounted for by the weighting placed on each of the criteria. In this study, the citizen's jury process was used in determining the weights of the criteria. The jurors discussed the relative merits of each of the criteria and called expert witnesses to help them reach a consensus on the weights.

Assessing alternative options

Beside the weightings of the criteria, the second component required in a multi-criteria evaluation is the assessment of the options with respect to each individual criterion. The result of this multi-criteria assessment was an impact matrix, where each of its elements represents the evaluation or impact of an option according to a particular criterion. Each criterion identifies a rank order of options determined by the degree to which each option performs in the particular criterion.

Aggregating the criteria

In order to obtain a single compromise rank order, these multiple rank orders have to be aggregated in some way. The aggregation procedure used in this study is based on the PROMETHEE (Preference Ranking Organization Method for Enrichment Evaluations) multi-criteria decision aid which uses an outranking procedure as the basis of its evaluation. This procedure was utilized through the software program ProDecX which is also able to explicitly account for uncertainty when assessing various options. In ProDecX, for each criterion, the weights are sampled from the weights given by the jurors in a fair way, e.g. the weighting of each decision-maker contributes equally to the final results

3. RESULTS

In this section we present the results from the empirical application of the methods aforementioned in the Method section. By following the 21 statements identified for each

component of NCPs from seaweed aquaculture (see Table S1 at the Supplementary Material), Table 3 summarizes the main aggregated results from European countries, ranging from the highest rated statements to the lowest rated statements.

Table 3. Summary of the main workshops' results from 5 European countries by using the Q-method

Economic (indirect and option values) Well-being and health Ethical values and legacy	Well-being and health	Ethical values and legacy
Highest rated statements		
Seaweed aquaculture must be economically feasible and profitable	Good coastal water quality is important for my well-being	Future generations should have access to seaweed aquaculture resources and opportunities
Seaweed aquaculture contributes to reduce the risk of eutrophication in coastal communities while providing an economic input	Seaweed provides minerals	Genetics and cutting-edge techniques is important in Europe
	Natural environments can increase my sense of pleasure	Sustainable development and Climate Change adaptation and mitigation are important
Lowest rated statements		
Economic (indirect and option values)	Well-being and health	Ethical values and legacy
Seaweed aquaculture may create the opportunity for more efficient form of renewable energy from biomass	Seaweed aquaculture facilities are places for diseases outbreaks in local flora and fauna	Seaweed aquaculture is identified as an activity that is part of the local heritage of my community

Seaweed aquaculture contributes to reduce the risk of eutrophication in coastal communities while providing an economic input	Seaweed aquaculture produces unpleasant smells	
Seaweed aquaculture is an economic profitable activity		

Source: own elaboration from workshop's results.

In this deliverable, the MCDE identifies the preferences or weights the stakeholders assign to the various components (e.g. habitat and biodiversity, carbon storing, etc.) by combining them with economic, social and ecological values. In each of the 5 workshops carried out in the project, we ask the following question: *In which component of the ecosystem would you invest for each value?* (Table 4).

Table 4. Multi-criteria decision Evaluation matrix for nature contributions to people of seaweed aquaculture

Seaweed aquaculture components		Habitat and Biodiversity	Carbon Storing	Nutrient Uptake (water quality)	Coastal Protection from floods and storms	Seaweed biomass	Sea/Land-scape	Learning and new technologies development	Supporting identities
Economic values	Indirect values (e.i.jobs creation)								
	Opportunity values (future projection)								
Social values	Instrumental value (well-being and recreation)								
	Social and community structure value								
Ecological values	Existence and Inheritance value								

Source: own elaboration.

Our workshops' results show that the highest willingness to pay (WTP) has been highlighted for seaweed biomass by stakeholders in France. The second most important WTP was "Habitat and biodiversity" by participants in Ireland. In Norway, the highest WTP was "Carbon storage", while "Nutrients absorption (water quality)" and learning development" ranked highest in Portugal, and stakeholders' expressed the highest WTP for "Habitat and biodiversity" in Scotland (Figure 4).

Figure 4. Willingness to Pay (WTP) to each component of NCPs by countries

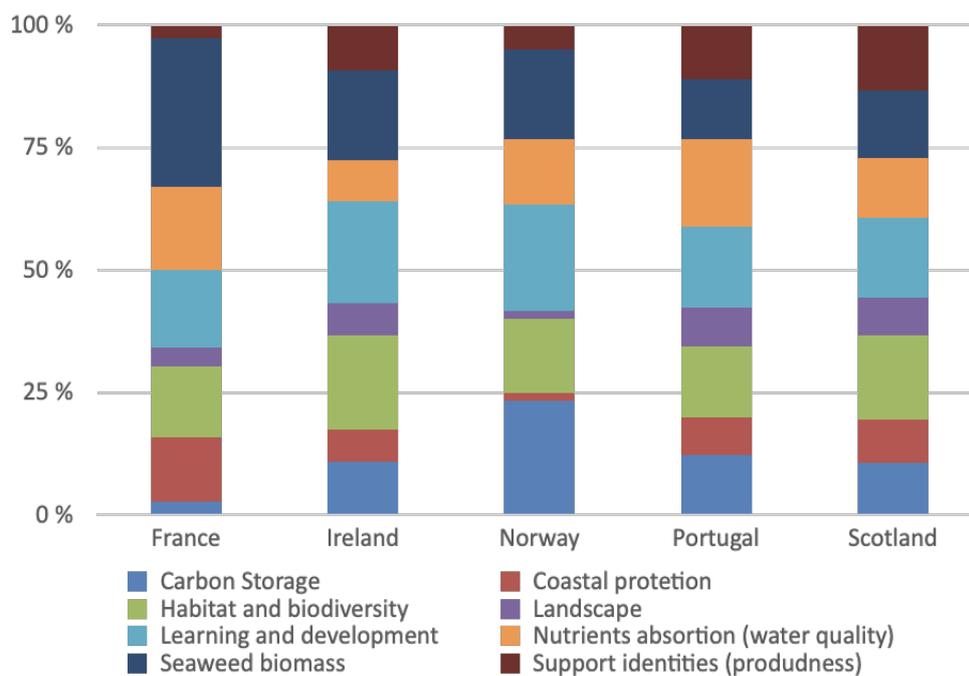
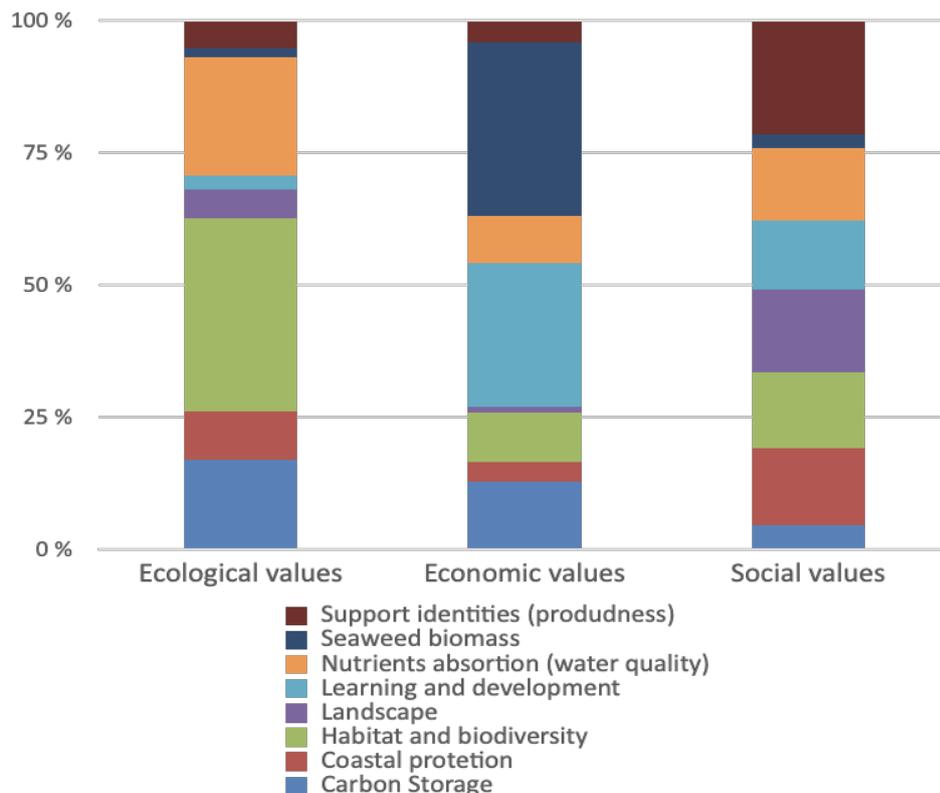


Figure 5. Willingness to Pay (WTP) for Nature Contributions to People by type of values



Source: own elaboration from workshop’s results.

The workshops’ results indicate that there were also key components for the development of seaweed aquaculture such as “Habitat and biodiversity” and “Learning and development” which have received similar WTP by participants across all countries surveyed.

However, it is important to highlight that differences among countries existed for key components of nature contributions to people such as “Coastal protection”, “Carbon storage” and “Support identities” (Figure 4).

The results are also presented by type of values in Figure 5. For ecological values, we found that, as expected, habitat and diversity are the most important components followed by nutrients absorption and carbon storage. Stakeholders participants ranked the highest seaweed biomass for economic values, which is reasonable considering that biomass is considered fundamental for the economic development and production of seaweed production systems. The second most important component was learning and development, as it is mostly related to the capacity of seaweed production to learn by doing from experience. For

the social values, the results suggest NCP from seaweed aquaculture provides a diverse and wide range of components, ranked quite similar to each of them: support identities, coastal protection, landscape, habitat and biodiversity and learning and development. These ultimate results suggest that seaweed aquaculture has the potential to provide non only material (and tangible) benefits, rather, it can also proportionate non-material values to the society.

During the workshops in each of the country, we also used the Choice Experiment Method to evaluate what are the main attributes that stakeholder’s participants value the most important for the aesthetic valuation of NCP from seaweed aquaculture. Our aggregated workshops’ results show that the highest valued attributes were, in this order, renewable energies, port area, maritime traffic, coastal biodiversity and coastal substrata present in the seaweed aquaculture (Figure 6).

Figure 6. Highest scored attributes for the aesthetic valuation of NCP from seaweed aquaculture

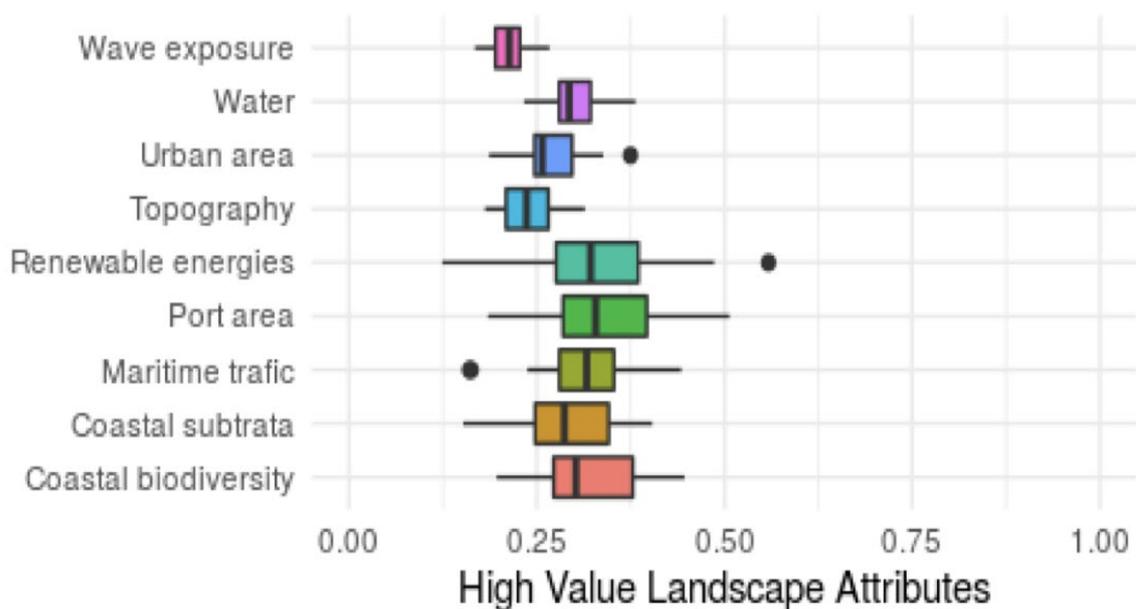
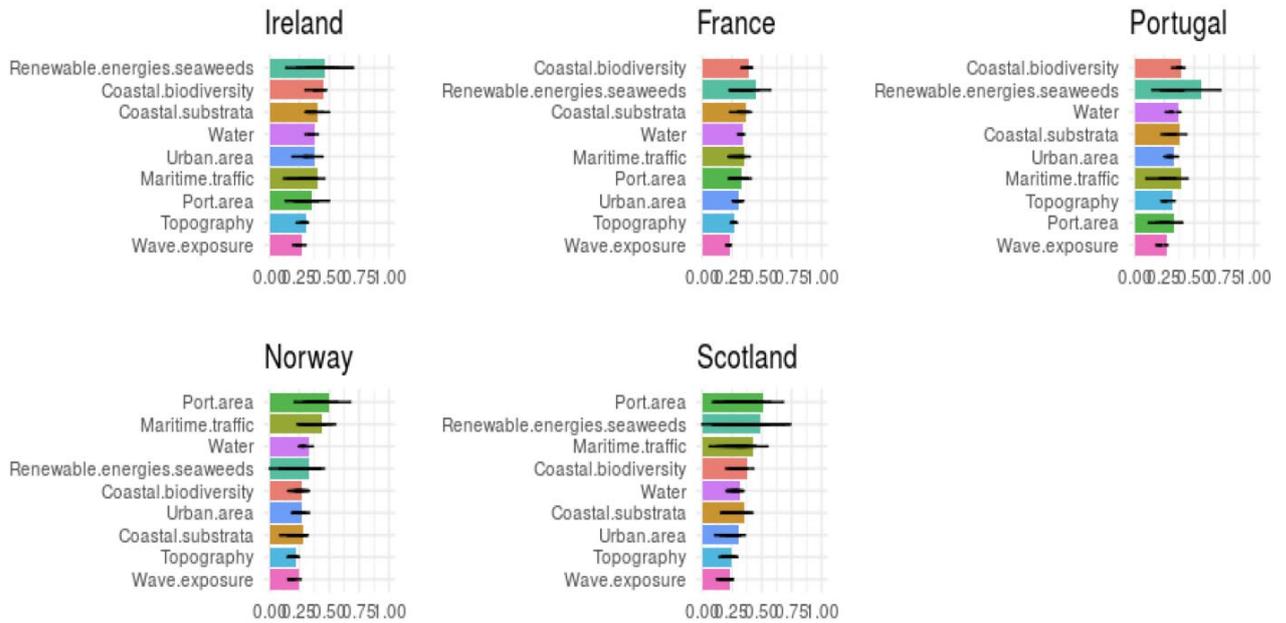


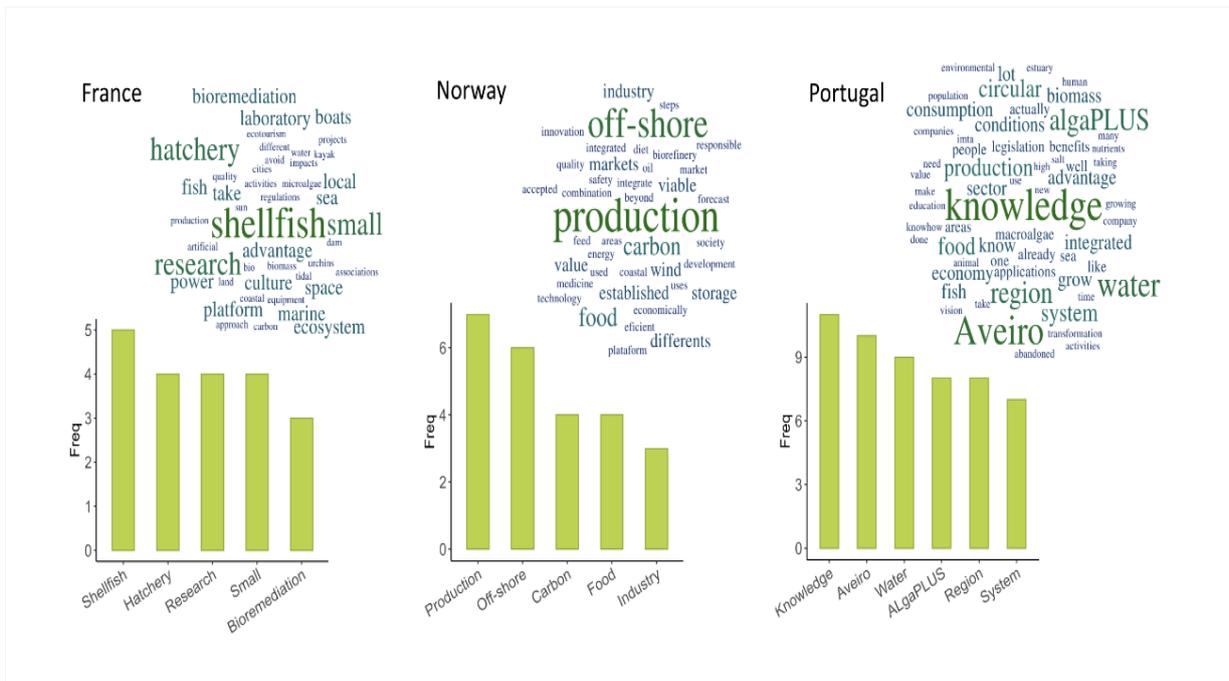
Figure 7. Highest scored attributes for the aesthetic valuation of NCP from seaweed aquaculture by European countries and regions



Source: own elaboration from workshop's results.

We also evaluated the aesthetic perception of stakeholders in the different countries (Figure 7). Participants from France perceive that the future of NCP from seaweed aquaculture is mainly associated with key words such as shellfish, hatchery, research, and bioremediation. We present results for those countries for which we have enough data to represent perceptions of participants.

Figure 8. Predicted future values of NCP from seaweed aquaculture



Source: own elaboration from workshop's results.

In Norway our results suggest that the future of the activity is associated with the capacity to produce seaweeds, off-shore systems, carbon sequestration and food and industry, while in Portugal the key words that have been frequently mentioned by participants were knowledge, Aveiro, water, AlgaPLUs, regions and systems.

3. Conclusions

Here we developed a first attempt to deliver a holistic understanding on the benefits seaweed farming can provide in Europe. As seaweed cultivation is a growing industry in Europe and globally it has a significant potential to contribute to the provisioning of ecosystem services, economic development and well-being for Europeans and many other coastal communities. There is a multidimensional importance of habitat and biodiversity, and social learning and development that can be developed with the industry as it grows and expands. There are many opportunities of using this holistic evaluation to promote seaweed aquaculture as a social, economic and environmental friendly industry to help its insertion in Marine Spatial Planning, and even as support for improving water quality and conservation.

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Annex 1 –

Identification of NCPs from Seaweed farming (KO1)

The identification of Nature’s Contributions to People from seaweed aquaculture was done through an intense literature review followed by an experts’ consultation to validate the presence and importance of NCPs. This analysis comprises two different cultivation strategies for each one of the species studied in the project, Open-sea cultivation for *Saccharina latissima* and Land-based facilities for *Ulva sp.*, as the NCPs that arise depend on the species and on the type of cultivation strategy.

Literature review

A non-systematic literature review, based on scientific peer-reviewed articles and grey literature was completed for each one of the cultivation systems, before experts’ consultation to identify potential NCPs from seaweed farming facilities.

Literature where NCPs are mentioned regarding seaweed farming is still scarce, as most of the studies often consider Ecosystem Services frameworks for their assessments. Therefore, we perform a cross over between Ecosystem Services categories to NCPs following the conversion tools for CICES and having adapted them to the seaweed farming case study.

Additionally, not many studies focus only in seaweed farming or in the specific species we are targeting but information can be inferred from other type of studies. As *Saccharina latissima* seaweed farms are often deployed in the natural environment, some of the contributions from these farms are similar or transferable from the contributions that are provided naturally in kelp meadows or kelp forest, from which we can inferred the contributions. In the case of *Ulva sp.*, no farms are deployed in the natural environment, but land-based tank cultivation techniques are commonly studied. Some of the contributions can be transferred from Integrated Multi-Trophic Aquaculture (IMTA) cases studies where they use a similar land-based set up and methodologies for cultivation of other species. For each one of the cultivation system and species is presented a selection of the main reference from the literature review in Tables 1 and 2. A brief explanation on how each one of the NCP is produced by both cultivation methods and species is provided in the same tables.

Tabla 1. Preliminary list of potential Nature Contributions to People by Saccharina latisima open-sea faming based on aquaculture and natural environments references, ()references from Natural ecosystems.*

Nature Contributions to People	Explanation of NCP in seaweed farms	Illustrating references
<i>1. Habitat creation and maintenance</i>	Kelp forests support high primary and secondary productivity, and a three-dimensional habitat structure for a diverse array of marine organisms, including fish and crustaceans.	Christie et al., 2009* Smale et al., 2013* Teagle et al., 2017

<p><i>4. Regulation of climate</i></p>	<p>Seaweed cultivation can potentially serve as a carbon sink and play an important role in the marine carbon sequestration.</p> <p>Kelp farm system, the estimated carbon sequestration values are 1350, 1800, and 1100 kg C ha⁻¹.</p>	<p>Chung et al., 2013, Kim et al., 2015 Hill et al., 2015* Duarte et al., 2017 Krause-Jensen et al., 2018</p>
<p><i>5. Regulation of ocean acidification</i></p>	<p>Seaweed farm could potentially benefit its immediate environment by stabilizing the pH of the surrounding water and by releasing oxygen during photosynthesis. As primary producers played a major role in the regulation of pH variability.</p>	<p>Krause-Jensen et al., 2015*</p>
<p><i>7. Regulation of freshwater and coastal water quality</i></p>	<p>Seaweed farming play an important role as a nutrient-removal system to alleviate eutrophication problems. Having potential for bioremediation of N Also heavy metal sequestration by some brown seaweeds.</p>	<p>Davis et al., 2003 Kang et al., 2011 Holdt and Edwards, 2014 Sanderson et al., 2012</p>
<p><i>9. Regulation of hazards and extreme events (coastal protection)</i></p>	<p>Kelp forests dissipate wave energy, providing protection to the coastal environment. The kelp cause significant wave damping and the degree of wave breaking is reduced.</p>	<p>Løvås and Tørum 2001* Gaylord et al., 2007 Blamey and Bolton 2017*</p>
<p><i>11. Energy</i></p>	<p>The production of biofuels from macroalgae biomass by biochemical and thermochemical technologies are technically possible to produce various biofuels such as methane, ethanol, and butanol.</p>	<p>Chen et al., 2015</p>
<p><i>12. Food and feed</i></p>	<p>Macroalgae as a novel and added-value dietary ingredient in formulated diets for fish. There is an increasing culinary interest in seaweeds</p>	<p>Wan et al., 2018 Lüning and Mortensen, 2015</p>
<p><i>13. Materials, companionship and labor</i></p>	<p>Extraction of fibres for textile industry and construction materials, and ornamental products. Indirect job creation.</p>	<p>Wei et al., 2013</p>
<p><i>14. Medicinal, biochemical and genetic resources</i></p>	<p>Extraction of alginates, diverse bioactive compounds and chemicals with applications in the pharmaceutical and medical industry.</p>	<p>D’Orazio et al., 2012 Mak et al., 2014 Zhang et al., 2017 Liu et al., 2019</p>
<p><i>15. Learning and inspiration</i></p>	<p>Seaweed farming has the potential to ontributions to science and education through the development of know-how for industries, as well as capabilities to prosper through education, acquisition of knowledge and development of skills for well-being and seaweed farming industry development.</p>	<p>Christie et al., 2019 Zhang et al., 2017</p>
<p><i>16. Physical and psychological experiences</i></p>	<p>Provision, by seascapes free of fishing ships, habitats or organisms, of opportunities for physically and psychologically beneficial activities</p>	<p>Hasselström et al., 2018</p>

	for tourism or relaxation. Enhanced by the biodiversity they might enclose in the farming area.	
17. Supporting identities	By providing an opportunity for people to develop a sense of place, belonging or connectedness with the natural provisioning processes of seaweed farming. As a source of satisfaction derived from knowing that a particular Production system exists, and also proudness of having that type of cultivations systems.	Hasselström et al., 2018

Tabla 2. Preliminary list of potential Nature Contributions to People by *Ulva* sp. in-land farming based in aliterature review of *Ulva* cultivation and IMTA systems. (*)IMTA cultivation Systems

Nature Contributions to People	Motivation factors for selection	Illustrating references
4. Regulation of climate	Seaweed cultivation can potentially serve as a carbon sink and play an important role in the marine carbon sequestration. Methane production rate can be improved by co-digesting macroalgae with manure (<i>Ulva</i> sp.). Gas production of the <i>Ulva</i> products was below that of the reference feed materials. Also, harvest before the production of halocarbons.	Bikker et al 2016 Gao et al 2018
5. Regulation of ocean acidification	Seaweed farm could potentially help to stabilize the pH of the immediate environment and by releasing oxygen during photosynthesis, especially in the exponential growth phase. As primary producers played a major role in the regulation of pH variability.	Chung et al 2011 Krause-Jensen et al., 2015
7. Regulation of freshwater and coastal water quality	Species of <i>Ulva</i> were soon identified as ideal candidates for filtering fish effluents due to their capacity to rapidly absorb and metabolize nitrogen, their high growth rates, and their worldwide distribution.	Cohen and Neori 1991 * Jimenez de Rio et al 1996 Kang et al 2011 * Lawton et al 2013
9. Regulation of hazards and extreme events	Seaweeds meadows have the capacity of dissipating wave energy, providing protection to the coastal environment.	Løvås and Tørum 2001* Gaylord et al., 2007 Blamey and Bolton 2017*
11. Energy	Green seaweeds, including <i>Ulva</i> sp. have the potential to be used as feedstock for the production of biofuels, given their high content in rhamnose.	Van der Wal et al 2013 Bikker et al 2016
12. Food and feed	The chemical composition of <i>Ulva</i> sp. indicates that it has a good potential for its use in human and animal food.	Peña-Rodríguez et al 2011 Shpigel et al 2017 Wan et al 2018 Marinho et al 2013
13. Materials, companionship and labor	Various <i>Ulva</i> polysaccharides can be a source of rare sugar precursors for the synthesis of fine chemicals.	Lahaye and Robic 2007 Jung et al 2013 Helmes et al., 2018

	Production of Lactic Acid for Bioplastics from <i>Ulva</i> spp. Is being investigated Indirect jobs creation.	
<i>14. Medicinal, biochemical and genetic resources</i>	Polysachrides da <i>Ulva</i> can be a source of rare sugar precursors for the synthesis of fine chemicals	Peña-Rodriguez et al 2011 Thanigaivel et al 2016
<i>15. Learning and inspiration</i>	Seaweed farming has the potential to contribute to the development of know-how for industries, including research endeavours, as well as capabilities that allow humans to prosper through education, acquisition of knowledge and development of skills for well-being and seaweed farming thriving.	Conclusion from this study
<i>16. Physical and psychological experiences</i>	Provision, by seascapes free of fishing ships, habitats for organisms, of opportunities for physically and psychologically beneficial activities for tourism or relaxation. Enhanced or diminished at the seaweed farming area.	Conclusions from this study
<i>17. Supporting identities</i>	By providing an opportunity for people to develop a sense of place, belonging or connectedness with the natural provisioning processes of seaweed farming. As a source of satisfaction derived from knowing that a particular Production system exists, and also proudness of having that type of cultivations systems.	Conclusions from this study

Experts Consultation

To validate the presence and importance of NCPs from seaweed farming, an on-line survey was designed and directed to the partners on the GENIALG consortium and external collaborators in the area of seaweed production, considered experts. An expert is a person having relevant and extensive knowledge or in-depth experience in relation to the topic, in this case: seaweed farming (Krueger et al., 2012). Among the consortium we were able to reach a wide variety of experts: researchers, ecologist, biotechnologist, economist and industry developments as well.

The questionnaire consists in a total of 10 questions separated into three blocks and diverted in two groups: one for open-sea farming and another one for in-land farming activities. With the aim of validating the presence of NCPs and their importance for both types of cultivation systems, the same questions were asked to both groups, having the possibility to answer regarding both cultivation methods and to answering twice, once for each type of cultivation. First block of questions aimed to identify the presence of NCPs on seaweed farming activities. Second block contains questions regarding the importance of the identified NCPs by ranking them and about the reasons for its importance. Finally, the third block of questions was directed to identify the experts profile and time devoted to this field.

Participants on the survey were reached through their institutional e-mail address with an access link to the questionnaire for its completion during several months between June 2019 to November 2019. A first trial version of the survey was presented during December 2018 to

March 2019 to a few consortium members with the aim of testing the questions, a small number of responses was retrieved (15 responses). The Survey was latter modified to be shorter and more accurate to the objectives. The results presented in this Deliverable come from the improved second version that can be found in the Supplementary material.

Results from the survey

Answers were obtained from a total of 68 experts from most of the partners at the consortium, being CIIMAR, CNRS, SES and ALGApplus the most frequent respondents. The majority of the experts reached are researchers (45,6%) from the natural sciences along with producers (Figure 2). On average, experts consulted have 11,45 years of experience in the seaweed cultivation expertise, being 1,5 years the shortest and 35 years the longest.

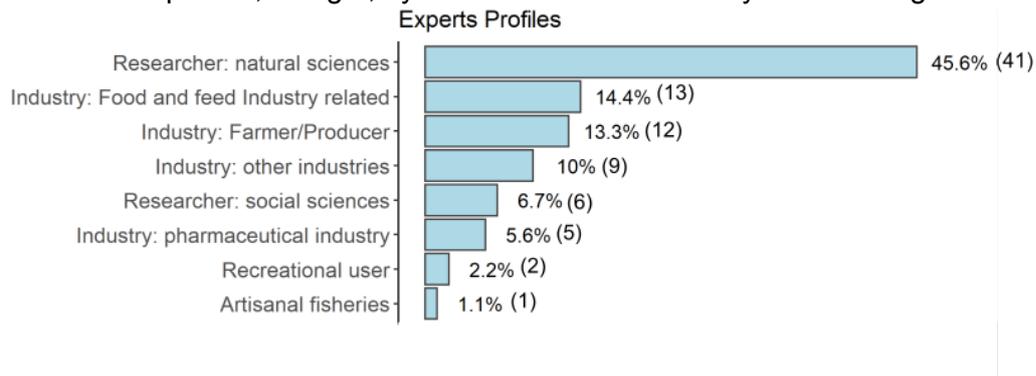


Figure 1. Profiles of Respondents expertise's form the Survey. In brackets the number of respondents that stated their expertise. Some choose two expertise's; therefore, the total count is higher than 68.

There are differences between the identified NCPs at Open-sea farming and Land-based farming activities. The technical differences of those two cultivation systems are also reflected in the NCPs recognized to be provided. We obtained 34 responses for both types of cultivation, 12 for Land-based and 22 for Open ocean, as some experts chose to respond regarding both cultivation methods.

For Open-sea farming activities all the NCPs were identified to be provided. The more selected ones were "Food and Feed" (100%), "Regulation of Ocean acidification" (85%) and "Habitat Creation and maintenance" (85%). The less selected were "Regulation of hazards and extreme events" and "Energy". For Land-based farming activities the more selected were "Regulation of water quality" and "Food and feed" (85%) and "Regulation of coastal water quality" (85%). One of the NCPs presented for Land-based farming as well was not identified to be provided as for "Habitat Cretin and maintenance" due to the fact that these cultivation systems are not deployed in natural habitats or environments. Open sea farming activities provides with more NCPs than Land-based farming activities (Figure 3).

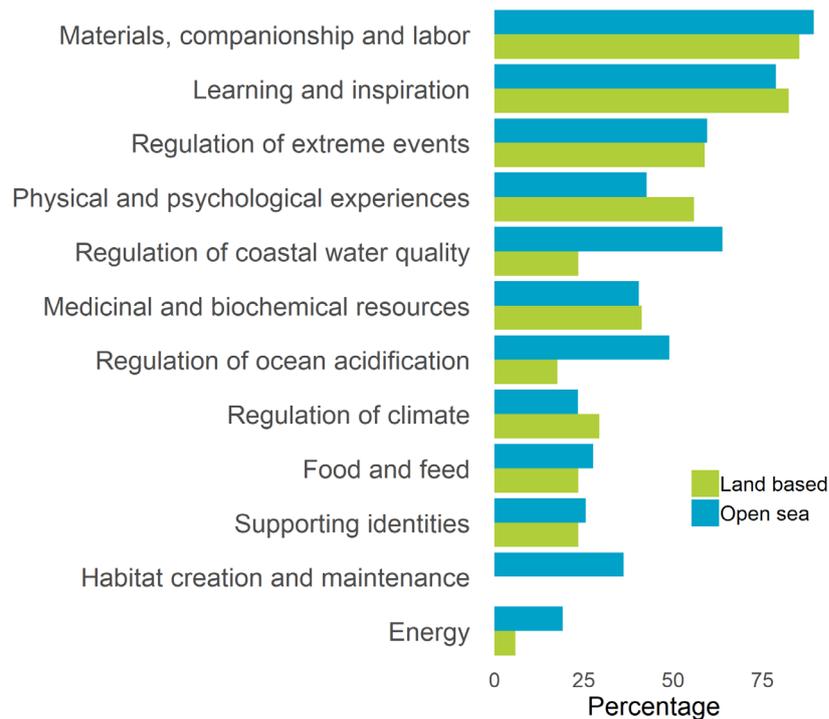


Figure 2. Frequency of identification of the selected NCPs provided by seaweed farming for each one of the cultivation systems. Results from the survey (n=68 respondents).

Experts were asked to Rank the NCPs in five levels: ‘Very important’, ‘Important’, ‘Moderately important’, ‘Slightly important’, ‘Not important’, ‘Do not know’. The results from the ranking shows that the more rated for Open-sea are “Food and feed”, “Regulation of Ocean acidification”. And for Land-based activities the ones rating higher are “Food and feed”, “Medicinal resources” and “Regulation of water quality”.

The ranking corresponds with the previously chosen NCPs presence and the selection of the most important NCPs on the previous answers. Through this method, by asking three time about the presence, importance and rank of the NCPs provided by seaweed farming facilities it can be validated the presence and importance of NCPs in seaweed farming activities.

The relation between the presence and the importance of NCPs was explored by plotting the frequency on which NCPs were selected against the ranking given to each one of them. The categorical ranking levels were transformed into numerical values from 5 (Very Important) to 0 (Do not know) and the frequency goes from 0 to 1 (Figure 4). This representation lead to a classification of the NCPs in four categories: i) services validated and very important, ii) services validated and of medium importance, iii) services controversially validated and ranked, iv) and services not validated to be present (Table 3).

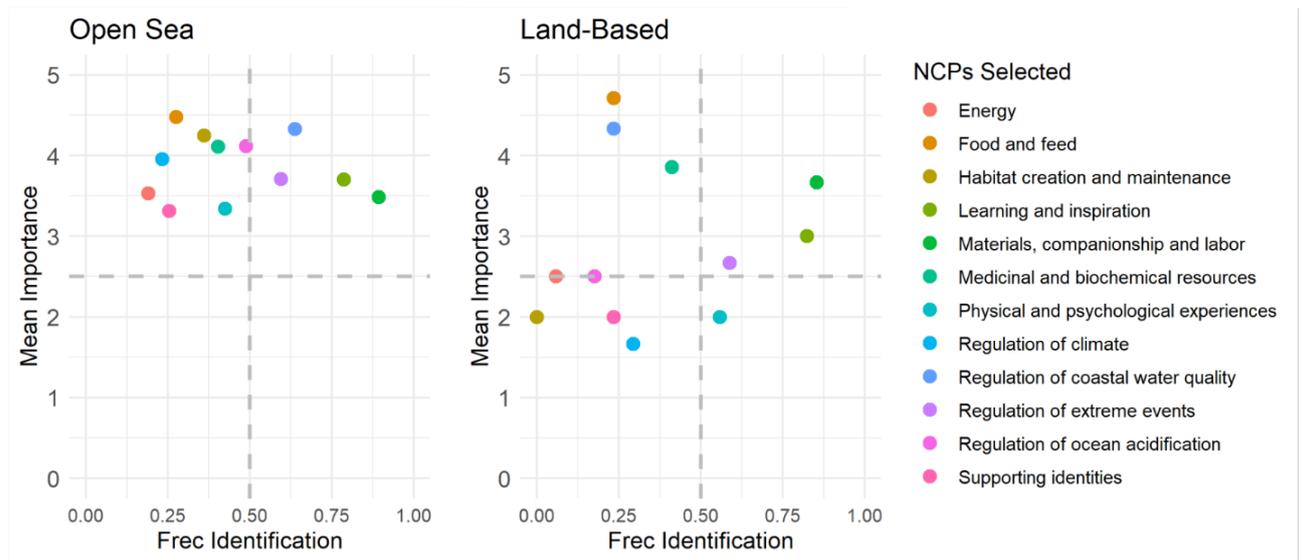


Figure 3. Scatter plot on Frequency on identification and mean of importance of the NCPs from seaweed farming regarding Land-based and Open sea cultivation systems.

Table 3. Classification of NCPs from seaweed farming according to the assessment of the respondents in the survey (n=68 respondents).

	Open sea farming	Land-based
i) Validated and important	<ul style="list-style-type: none"> - Regulation of Climate - Regulation of extreme events - Materials, companionship and labour Learning and inspiration 	<ul style="list-style-type: none"> - Regulation of extreme events - Materials companionship and labour - Learning and Inspiration
ii) Validated and from medium importance	<ul style="list-style-type: none"> - None 	<ul style="list-style-type: none"> - Regulation of Climate
iii) Controversially validated and highly ranked	<ul style="list-style-type: none"> - Habitat creation and maintenance - Regulation of coastal water quality - Regulation of ocean acidification - Energy - Food and feed - Medicinal and biochemical resources - Supporting identities - Physical and psychological experiences 	<ul style="list-style-type: none"> - Regulation of coastal water quality - Regulation of Ocean acidification - Energy - Food and Feed - Medicinal and biochemical resources.
iv) Not validated to be present	<ul style="list-style-type: none"> - None 	<ul style="list-style-type: none"> - Habitat Creation and maintenance - Physical and psychological experiences - Supporting identities

Regarding the question on the criterion in which the previous responses on the ranking were based the frequencies of respondents, percentage was calculated and have been plotted

separately for Open-sea and Land based types of farming. There were no responses for other reason with an open box, so no transcriptions are reported.

For both of the types of farming the most frequent criterion to address the importance of NCPs area the same: because they ‘support others’ and because they ‘impact a large population’. Perception of NCPs by the population does not seem to be an important criterion to choose the NCPs that are more important or not as it classifies the last for both types of seaweed farming facilities.

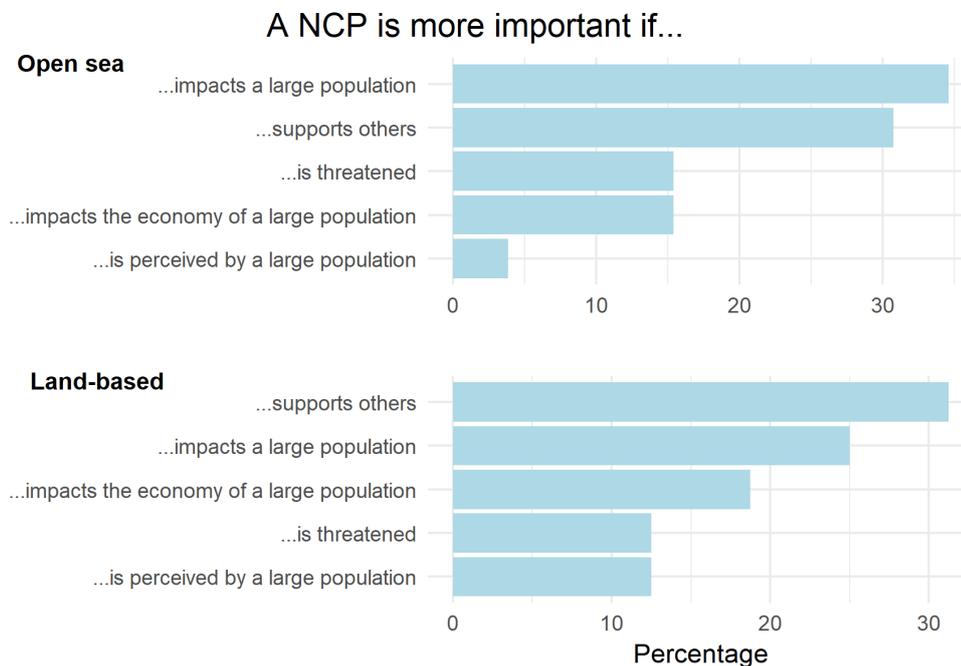


Figure 4. Importance of NCPs in seaweed farming industry. Results from the survey (n=68 respondents)

BOX 1. Highlights form the survey

- There were collected 68 valid answers from 11 different partners and 8 different expertise (mainly researchers and industry partners).
- The NCPs identified to be provided by Open-sea and Land-based activities are different.
- Open sea activities provide with more NCPs than Land-based activities, including “Habitat creation and maintenance” only produced by Open sea systems.
- The selection of more important NCPs and the ranking of NCPs suggest that the more important NCPs for Open-sea are: “Food and feed”, “Regulation of ocean acidification” and “Habitat maintenance”. For Land-based farming facilities are the “Medicinal and genetic resources”, “Food and feed” and “Regulation of fresh water and coastal water”.
- The correlation between ‘identified’ and ‘importance’ can classify the NCPs in four levels: i) validated and very important, ii) validated and of medium importance, iii) controversial validated and ranked and iv) not validated to be present. (See Table 4).

- The reason why a NCP is more important is because the ‘support others’ NCPs and ‘affect a large population’.

Perceptions on Seaweed farming Contributions in a protected area

As a first attempt to understand the benefits that arise from seaweed farming in open water facilities, the perception of the impacts in well-being of this interventions in a coastal area were explored. A Survey on public perceptions in northern Portugal was performed in autumn 2018. We surveyed 453 residents and visitors from a coastal area in northern Portugal (Esposende, Braga district in the North of Portugal). Esposende is a small municipality with an extension of 95,18 square Km with 16 km of coastal area, populated by 33.325 registered habitants that receive tourist during summer time and pilgrims from the Saint James way that passes by the area.

For this survey specifically, we were interested in assessing whether residents and visitors support and how they perceived the positive and negative impacts of open-water seaweed farming. We focused in aspect as local job creation, tourism, aesthetics, fisheries, marine life, among other local relevant aspects, related to the material and non-material benefits that can be provided by seaweed farming facilities with an impact on human well-being.

Overall, our preliminary results show that for some local aspects (marine life, recreational nautical activities, property value) most interviewees did not have an opinion about the impacts of open-water seaweed farming (figure 1). But a considerable share of interviewees did have an opinion. For example, 42% of interviewees perceive that open-water seaweed farming would improve local job creation, 36% believe that would improve beach tourism, and 24% believe it would improve marine life. An important share of interviewees believe that open-water seaweed farming would have no impact on nature tourism (38%), ocean aesthetics (34%), and local fisheries (32%). On the other hand, 15% of interviews perceive that open-water seaweed farming would harm local fisheries, 13% that ocean aesthetics would be worse, and 12% believe that nature tourism as well as recreational nautical activities would be negatively affected.

Besides descriptive statistics, we are analysing how interviewees' social-economic characteristics and characteristics of seaweed farms (e.g., size, distance to coast, open-water vs. land-based) affect public support for seaweed farming.

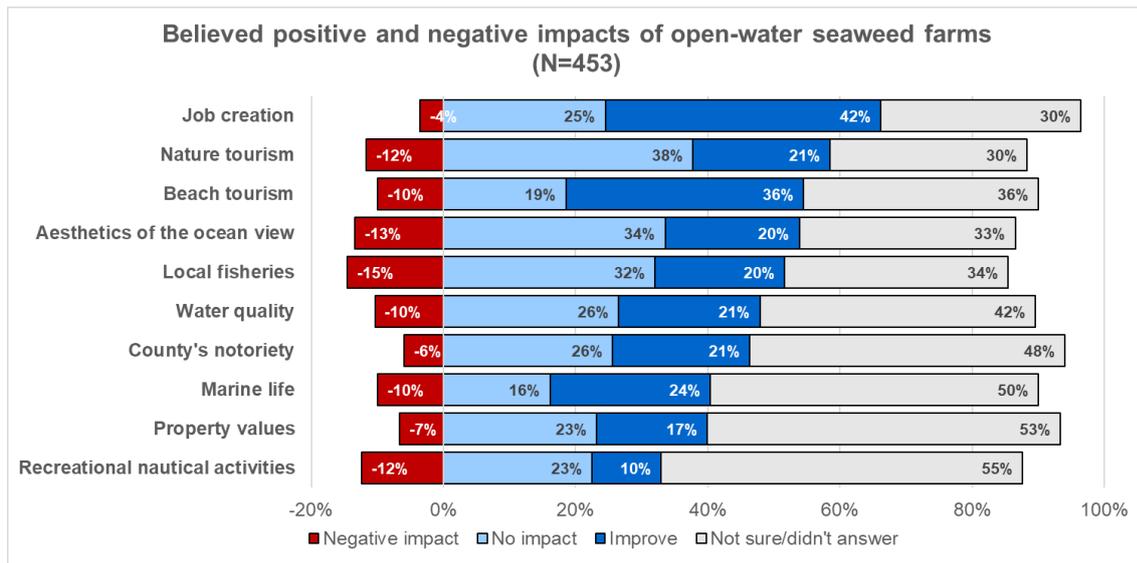


Figure 5. Perceptions on positive and negative impacts of open-water farms in Esposende, natural area in the North of Portugal from autumn-winter 2018.

This result is important to understand the impact benefits from seaweed farming can have on local communities and how complex valorisation of these benefits is. As there is a large percentage of benefits that are not assessed and described and people often responded «Not sure/didn't answer», as a reflexion of the lack of understanding on the productions and impact of the benefits from seaweed farming in general. Unravelling the benefits and value of these benefits remains a major challenge, where multiple techniques need to be applied.

Supplementary Material

Table S1. Statements codes used for each component of Nature Contributions to People in seaweed aquaculture

Block	#	Statement	Direction	Value	Component
Economic benefits: Indirect and Option values	1	Seaweed aquaculture is an industry with the potential to contribute positively to water quality in the local economy.	Positive	Economic -indirect	Nutrient uptake
Economic benefits: Indirect and Option values	2	Seaweed aquaculture is an economically profitable activity.	Positive	Economic -indirect	Biomass
Economic benefits: Indirect and Option values	3	Seaweed aquaculture brings good quality jobs for local people.	Positive	Economic -indirect	Biomass
Economic benefits: Indirect and Option values	4	Seaweed cultivation is largely developed in other countries and represents a competition.	Negative	Economic -indirect	Biomass
Economic benefits: Indirect and Option values	5	Seaweed aquaculture must be economically feasible and profitable.	Positive	Economic -indirect	Biomass
Economic benefits: Indirect and Option values	6	Seaweed aquaculture is an alternative source of income that could play a role in climate change mitigation.	Positive	Economic -indirect	Carbon storage
Economic benefits: Indirect and Option values	7	Space competition among marine activities has a negative effect on the local community.	Negative	Economic -indirect	Landscape
Economic benefits: Indirect and Option values	8	Seaweed aquaculture has little impact on the marine environment (landscape)	Positive	Economic -indirect	Landscape
Economic benefits: Indirect and Option values	9	Technological development and innovation on seaweed aquaculture is necessary.	Neutral	Economic -indirect	Learning
Economic benefits: Indirect and Option values	10	Seaweed aquaculture may provide an alternative income option for coastal communities.	Positive	Economic - opportu nity	Biomass
Economic benefits: Indirect and Option values	11	Seaweed aquaculture contributes to reducing the risk of eutrophication in coastal communities while providing an economic input.	Positive	Economic - opportu nity	Nutrient uptake

Economic benefits: Indirect and Option values	12	Organic certification of seaweed aquaculture products will increase the economic value.	Positive	Economic - opportunity	Legacy
Economic benefits: Indirect and Option values	13	Seaweed aquaculture offers a bundle of opportunities to mitigate and adapt to climate change as sea level rise	Positive	Economic - opportunity	Coastal protection
Economic benefits: Indirect and Option values	14	Seaweed aquaculture may create the opportunity for a more efficient form of renewable energy from biomass.	Negative	Economic - opportunity	Carbon storage
Economic benefits: Indirect and Option values	15	The growth of the seaweed aquaculture industry is good for the economy and for the ocean.	Positive	Economic - opportunity	Legacy
Economic benefits: Indirect and Option values	16	Seaweed farms create safe and healthy nursery grounds for commercially important fish and crustaceans.	Positive	Economic - opportunity	Habitat
Economic benefits: Indirect and Option values	17	Seaweed aquaculture will decrease genetic biodiversity in the local seaweed populations.	Negative	Economic - opportunity	Legacy
Economic benefits: Indirect and Option values	18	Ecosystem sustainability relies on the proper management of marine resources	Positive	Economic -indirect	Habitat
Economic benefits: Indirect and Option values	19	Seaweed aquaculture may present a disease risk for local marine resource-based economic activities.	Negative	Economic - opportunity	Habitat
Economic benefits: Indirect and Option values	20	Seaweed aquaculture is a source of invasive species that can affect the local biodiversity and economy	Negative	Economic - opportunity	Habitat
Economic benefits: Indirect and Option values	21	Seaweed aquaculture regulations need to be adaptable and revised by scientists to optimize development	Positive	Economic -indirect	Learning
Bequest/Ethical values	1	The use of seaweeds as fish feed can reduce overexploitation of fish stocks.	Positive	Existence value	Habitat
Bequest/Ethical values	2	The use of seaweed as feed for livestock can reduce the effects of sea level rise.	Positive	Existence value	Coastal protection
Bequest/Ethical values	3	Seaweed aquaculture is an alternative to land produced products in food and feed applications.	Positive	Existence value	Biomass

Bequest/Ethical values	4	Seaweed is one of the few food alternatives that can have a positive environmental impact.	Positive	Existence value	Biomass
Bequest/Ethical values	5	Future generations should have access to seaweed aquaculture resources and opportunities	Positive	Existence value	Landscape
Bequest/Ethical values	6	Sustainable development and Climate Change adaptation and mitigation are important to me.		Existence value	Carbon storage
Bequest/Ethical values	7	Seaweed aquaculture acts as a carbon and nitrogen sink that offsets ocean acidification.		Existence value	Carbon storage
Bequest/Ethical values	8	Shift away from animal-based foods decreases greenhouse emissions.		Existence value	Carbon storage
Bequest/Ethical values	9	Seaweed aquaculture plays a possible ecological role in pollutants and CO2 sequestration.		Existence value	Carbon storage
Bequest/Ethical values	10	Seaweed aquaculture plays a key ecological role in coastal protection of erosion.		Existence value	Coastal protection
Bequest/Ethical values	11	Seaweed aquaculture can maintain local biodiversity.		Existence value	Habitat
Bequest/Ethical values	12	Seaweed aquaculture plays a key ecological role in supporting the food web.		Existence value	Habitat
Bequest/Ethical values	13	The future utilization of seaweed based foods represent a more efficient use of water and its quality.		Existence value	Nutrient uptake
Bequest/Ethical values	14	Research on seaweed genomics, genetics and cutting-edge techniques is important in Europe.		Existence value	Learning
Bequest/Ethical values	15	Seaweed aquaculture plays a key ecological role in bioremediation by removal of nitrogen or phosphate.		Existence value	Nutrient uptake
Bequest/Ethical values	16	Knowing that sustainable development is being pursued in my local area makes me proud.		Existence value	Support
Bequest/Ethical values	17	Seaweed aquaculture products in animal feeds increase animal welfare.		Existence value	Support
Bequest/Ethical values	18	Seaweed used as food and feed can have a positive environmental impact (landscape)		Existence value	Landscape
Bequest/Ethical values	19	Seaweed farming is environmentally important because it encourages local people to protect and value their resources.		Existence value	Support
Bequest/Ethical values	20	Seaweed aquaculture is identified as an activity that is part of the local heritage of my community.		Existence value	Support
Bequest/Ethical values	21	Seaweed aquaculture has always been part of the cultural and local activities.		Existence value	Support

Benefits to human well-being and health	1	Food and feed provision from alternative sources, like seaweeds is important for my sense of security.	Positive	Instrumental use	Biomass
Benefits to human well-being and health	2	Seaweed is a highly nutritious food that contributes to my well-being.	Positive	Instrumental use	Biomass
Benefits to human well-being and health	3	Seaweed provides minerals, essential amino acids and high-quality protein important for my well-being	Positive	Instrumental use	Biomass
Benefits to human well-being and health	4	Seaweeds are extensively used in traditional medicine which is important for my well being.	Positive	Instrumental use	Biomass
Benefits to human well-being and health	5	Research and development of medicinal and biochemical resources from seaweeds is important for my well-being.	Positive	Instrumental use	Learning
Benefits to human well-being and health	6	Seaweed aquaculture can protect and keep coastal communities safe from extreme events.	Positive	Instrumental use	Coastal protection
Benefits to human well-being and health	7	Eating too much seaweed can be harmful for your health.	Negative	Instrumental use	Biomass
Benefits to human well-being and health	8	Seaweed intake is incorporated into our society as beneficial to our well-being.		Instrumental use	Support
Benefits to human well-being and health	9	Seaweed aquaculture's contribution to Climate Change mitigation is important for my well-being and sense of security.	Positive	Instrumental use	Carbon storage
Benefits to human well-being and health	10	The fact that seaweeds store carbon is important for my well-being and sense of security.	Positive	Instrumental use	Carbon storage
Benefits to human well-being and health	11	Coastal erosion protection by seaweed aquaculture is important for my well-being and sense of security.	Positive	Instrumental use	Coastal protection
Benefits to human well-being and health	12	Habitats that provide shelter for biodiversity are important for my well-being.	Positive	Instrumental use	Habitat
Benefits to human well-being and health	13	Seaweed aquaculture facilities are places for disease outbreaks in local flora and fauna.	Negative	Instrumental use	Habitat
Benefits to human well-being and health	14	Seaweed aquaculture facilities will deteriorate the landscape of the local area.	Negative	Instrumental use	Landscape
Benefits to human well-being and health	15	Natural environments can increase my sense of pleasure, comfort and satisfaction.	Positive	Instrumental use	Landscape
Benefits to human well-being and health	16	Contact with nature helps them to develop a sense of place and wonder for the world which is important for my well-being.	Positive	Instrumental use	Support
Benefits to human well-being and health	17	Seaweed aquaculture facilities are good places to visit and learn about nature.	Positive	Instrumental use	Learning

Benefits to human well-being and health	18	Seaweed aquaculture produces unpleasant smells.	Negative	Instrumental use	Landscape
Benefits to human well-being and health	19	The natural environment provides valuable options for our holidays and leisure activities	Positive	Instrumental use	Landscape
Benefits to human well-being and health	20	The fact that seaweed aquaculture activities increase water quality is important to my well-being.	Positive	Instrumental use	Nutrient uptake
Benefits to human well-being and health	21	Good coastal water quality is important for my well-being.	Positive	Instrumental use	Nutrient uptake

Table S2. Q-method Questionnaires Transcriptions

COUNTRY: IRELAND					
Block	Question	Group 1	Group 2	Group 3	Group 4
<i>Economic benefits: Indirect and Option values</i>	<i>Implications for extreme positions</i>	Bigger picture ideas appear to be less relevant. Associated urgency. First order problems of profitability or industry appear more relevant currently	They are either incorrect or irrelevant	Organic certification is not the expense, it is pretty much all organic	Conflict between relevance of local economy and a lack of expectation of "good quality" jobs
	<i>Additional Statements</i>	none	Impact on CO2 absorption (Carbon sink). \$ replicate statement regarding impacts sin the local economy	An issue with profitability vs. Cheap imports from Asia. Due to 20-30 years of stagnant activity, a lot of jobs have been lost. Now the focus is to help develop an indigenous industry again and give local communities an opportunity for jobs and growth.	none
	<i>Difficulties in Understanding</i>	Statements need more context or qualifiers.	"Seaweed aquaculture is an economically profitable activity". This statement is ambiguous in a non-monetary valuation	A lot of the statements are more relevant to a well-developed industry, and would be rue given further development. "Seaweed aquaculture is an economically profitable activity": This aim, not yet the case, needs development. "Seaweed aquaculture regulations need to be adapted and revised by scientist": This also needs input from industry	none
<i>Bequest/Ethical values</i>	<i>Implication for extreme positions</i>	We decided lower rate items referred to seaweed aquaculture against nature, statement and we thought that was wrong	Questionable or not proven or ambiguous claims for the benefit of seaweed culture	Aquaculture smell, outbreak of diseases seems to be uninformed statements. Many are true statements but not at the forefront of people's minds	No known outbreak, the facility would be good for the environment
	<i>Additional Statements</i>	none	Ocean science should be in the curricula of primary and secondary education. Local employment	none	none
	<i>Difficulties in Understanding</i>	Some questions were difficult to answer because our knowledge of the science (or the science itself) is not fully developed.	none	Negative impact of seaweed aquaculture on a local landscape depends on scale.	none

Benefits to human well-being and health	<i>Implication for extreme positions</i>	Context dependent again. Many of the lower rated statements seem susceptible to green-wash and heritage wash	They mostly concern local communities and their attitude to seaweed culture	Regarding the shift from animal based foods, more research. Seaweed aquaculture is not always part of local activities, it's a new one, harvesting is an old industry.	no comments
	<i>Additional Statements</i>	none	Research on genetics is important FOR Europe but is not currently important IN Europe. Maybe you need two statements for this matter, one FOR and one IN	Stem cast seaweeds: not a lot being done about it but it's an available resource. Ex: enhanced anaerobic digestion	no comments
	<i>Difficulties in Understanding</i>	Cleaner than the yellow cards	You need to differentiate micro and macro algae. The word seaweeds are too generic. Also seagrasses?	Seaweed plays an important role in supporting the food web: is this aquaculture or just seaweeds? Harvesting, not aquaculture, is part of local heritage. Seaweed is a very general term. Theoretically a lot of the statements are true but require proof of concept.	no comments

COUNTRY: NORWAY					
Block	Question	Group 1	Group 2	Group 3	Group 4
<i>Economic benefits: Indirect and Option values</i>	<i>Implication for extreme positions</i>	Seaweed aquaculture will definitely have an impact. There is a need to balance positive and negative impacts	1. Because we will not be able to produce and transport enough volumes at low cost/2.1 Currently not very profitable (small scales)/2.2 currently small production with high water exchange//2.3 Small production volumes	It is not scientifically proved, it is most probably to be wrong	1. Seaweed aquaculture and fisheries are not overlapping industries/2. Seaweed aquaculture is still a small-scale industry in Norway. / 3. We don't have sufficient knowledge about some of the potential effects yet.
	<i>Additional Statements</i>	Key topics missing such as stakeholders participatory collaboration	none	There is a need for market development for seaweed aquaculture	none
	<i>Difficulties in Understanding</i>	Question with double negatives	Unclear what means "revised by scientist" and "good quality jobs".	Space competition as it is not mean to compete with fisheries. Good for the ocean and for the economy should not be together in the same sentence, as this can be "opposite"	Several of the statement were difficult to place because there are many thing we don't know yet, and we need more knowledge to be sure./ Some were also difficult

					to place because we weren't sure whether the statements were based on the industry as it is today, or how it potentially can look like in the future.
<i>Bequest/Ethical values</i>	<i>Implication for extreme positions</i>	none	Wild harvesting has been tradition, but not aquaculture in Norway or Europe	In Norway, seaweed aquaculture has not been a traditional activity	none
	<i>Additional Statements</i>	none	none	Validation of the concept sustainability in relation to seaweed farming is important to me. Seaweed farming can have a negative impact on local communities access to sea space	none
	<i>Difficulties in Understanding</i>	any questions relating to legacy and/or cultural significance of seaweeds will vary greatly depending on the Norwegian vs. Global context (or specific countries, like China, Indonesia or Japan)	none	The one about reduced water and energy (or perhaps agree on that one was more challenging)	none
<i>Benefits to human well-being and health</i>	<i>Implication for extreme positions</i>	Not very Strong opinion in the group, but other stakeholders likely hold strong opinions about this	1. We are not aware of a link between erosion and seaweed aquaculture/ 2.1. Not true unless the seaweed is retaining. / 2.2. we are not aware of documentation. /2.3. not an issue at current production scale	Seaweed contain about 10-15% protein and about 1% lipids, not nutritious, not energy	none
	<i>Additional Statements</i>	none	none	Lack of documentation on health effects affects the seaweed to have the freedom of choice, we need more documentation of health effects.	none
	<i>Difficulties in Understanding</i>	the definition of well-being were perhaps somewhat hard to understand and apply to the concrete questions	none	Nothing in particular	none

COUNTRY: SCOTLAND						
Block	Question	Group 1	Group 2	Group 3	Group 4	
<i>Economic benefits: Indirect and Option values</i>	<i>Implications for extreme positions</i>	NA	NA	NA	NA	
	<i>Additional Statements</i>	NA	NA	NA	NA	
	<i>Difficulties in Understanding</i>	NA	Some questions were misleading and very open ended.	Questions are rather imprecise and open to interpretation	Assumed all being managed properly, and therefore some of the statements won't be admissible. Not clear if it does apply only to Scotland	
		Group 5	Group 6	Group 7	Group 8	
<i>Bequest/Ethical values</i>	<i>Implication for extreme positions</i>	NA	placed cultural and heritage related items lower, we think it would take time for seaweed farming to be part of Scottish culture	NA	NA	
	<i>Additional Statements</i>	Education and Jobs not covered	NA	NA	NA	
	<i>Difficulties in Understanding</i>	Interesting that some statements were about seaweed and others about seaweed aquaculture	Does seaweed play a key ecological role in supporting food webs: is food web natural or human?/Shift away from animal-based food represent a more efficient use of water and energy is quite general and it could depend on type of animal-based food.	NA	Questions are not neutral or factually correct. Questions duplicate themes.	
General comments (plenary, not per group)						
<i>Benefits to human well-being and health</i>	<i>Implication for extreme positions</i>	Smell and diseases as there is no true or not evidence that could happen				
	<i>Additional Statements</i>	Some not relevant to seaweed, and how can seaweeds affect water quality				
	<i>Difficulties in Understanding</i>	Security meaning is not clear, is all subjectivity. There is no science to prove the statements available				

COUNTRY: FRANCE						
Block	Question	Group 1	Group 2	Group 3	Group 4	Group 5
<i>Economic benefits: Indirect and Option values</i>	<i>Implication for extreme positions</i>	L'etai da recherche, doncl'emploi, ne peuvent pas une algoculture rentable. La cache	Non	Aspect economic tres important/Aspect environmental: manque de donnees (activite ecoute). Eviter la monoculture	Propositions irrealistics.	L'algoculture un imfael sur la vie marine et la diversite

		reglementaire doit etre construit en consulant toces les secteurs. En mer, la qualite d'eau n'est pas		(s maladies) / Emploi de qualite: pas d'accord par rappotra le penibilite		
	<i>Additional Statements</i>	Encouragement à l'istalation le lien avec la qualite du lileu (ecuse côtieres). Accès à la reglamentation. Sensibilisation du grand public/Education à l'alimentation.	L'agoculture doit beneficier d'aides publiques	Manque le volet Recherche e Development (pour rapportrait rentabilite)/ Aspect culturel non-developé(regime alimentaire) /Traçabiite des produits.	Impacts positifs sur d'autres activites maritimes	Quella priorote entre imperatif environmental et imeratif econmique./ La bioremediation est un element important./Il y a ausi l'agoculture à ferre.
	<i>Difficulties in Understanding</i>	Il incerfuait le cache de refereia (local, natinal Nondial et precision des adjectives	Non	Redouance sur 3 costes: Activivte local, amelioration e niveau de vie.	Non	Quelques ambiguetés: Exo 1 chercheur/sci entifiques
<i>Bequest/Ethical values</i>	<i>Implication for extreme positions</i>	Il y a une tradition gremoniere et alimentaire. L'agoculture ne fait pas parte de l'identitè local du territoire.	L'effort est plutot local que gereal	L'agoculture ne fait pas partie de notre culture. Les algues ne sont pas une alternative completes pour l'alimentation aniale	L'agoculture n'as pas encore de valeur patrimoniale ou de l'histoire.	L'agoculture est encore pour de faire partie dus activites cualturels et localis
	<i>Additional Statements</i>	Il manquereit une component sur les conditions de travail d'aspect eco-responsable de l'agoculture, la favaisatia du monche, l'economie circular.	L'agoculture est elle comu du grand public?/ Estre que le patrimoine que estre un freuc au development de l'agoculture?	Recherche applique pour reduire le cout de muient de l'agoculture	L'agoculture peut prolonger les activite et la valeur patrimoniale es algues em Bretagne	Non
	<i>Difficulties in Understanding</i>	Non	certaines un que trop evidente	Non	Oui, l'ecoligment des alimentes d'origen animal.	Non
<i>Benefits to human well-being and health</i>	<i>Implication for extreme positions</i>	Sur l'aspect negtif de l'agoculture: oudeurs et maladies	Non	Pas d'accord: Faux pour oderers car ressources viventes/ Pas asses de suivis long terme privaluer le developpement de maladies/ Pas asses d'instalations en mer pour valuer effect des filieres sur èrosion côtieres/Pas assez d'instalations à ce jour pour avoir un effet sur changement cimatique	Parce que ces declarations ne sont pas la realitè eu sont trop louain de l'aquaculture.	Ne pas amalgamer "Maures Verdes" de Aquaculture

	<i>Additional Statements</i>	L'aspect cosmétique (peau)/ alimentation et bien-être animaux.	L'algoculture procure-t-il du bien-être au producteur.	Questions/affirmations sur les aspects santé (innovations)/ Affirmations sur métiers (qualité de travail)/ Qualité de la ressource, approvisionnements/traçabilité, ressource locale.	Ils ne cherchent pas des aspects sensoriels: toucher, visuel./ Le Gulf St. Jean contribue à notre bien-être.	Propriétés médicinales (en cours d'étude)
	<i>Difficulties in Understanding</i>	Redondance sur l'alimentation/Antynomie entre médecine traditionnelle et reconnue	Non mais certaines un peu trop évidentes (voir*: "L'environnement naturel offre des précieuses possibilités pour nos vacances et nos loisirs")	Protection de l'érosion côtière (qui est-ce qu'il y a derrière le mot "protection")/ Installations aquaculture dégradent le paysage (quelles installations?, à terre ou au large??)	Non	La contribution de l'algoculture à l'atténuation... la question trop hégémonique à notre sens
Extra comment		Group 1 was a little controversial at the beginning.... did not respect the pyramid shape, they did not want to follow the rules for the first pyramid.				

COUNTRY: PORTUGAL							
Block	Question	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
<i>Economic benefits: Indirect and Option values</i>	<i>Implication for extreme positions</i>	none	En geral, as frases colocadas na classificação mais baixa têm conotações negativas (Compatência com outras atividades, impactos no ambiente...) que deveriam ser evitadas	Dependendo da escala, a aquacultura de algas terá sempre impactos (negativo e positivo)	A aquacultura de algas actual é negligível para a produção de energia	A aquacultura de algas marinhas diminuirá a biodiversidade genética das populações locais de algas marinhas: discordamos porque a regulamentação já existente não permite que sejam criadas algas invasoras de modo que possam ser retiradas as licenças.	A energia não é ainda um sector viável para a utilização de biomassa de algas produzidas na Europa. Escala de produção é baixa e não há mercado adequado por custo de produção
	<i>Additional Statements</i>	none	1. Qual é o potencial de biorremediação da aquacultura de algas marinhas? 2. Qual é a pegada de CO2 desta indústria?	A aquacultura de algas marinhas tem potencial económico na área da biotecnologia marinha	Aquacultura de algas em Portugal pode oferecer novos produtos no contexto Europeu e Mundial	a aquacultura de algas marinhas pode trazer benefícios por exemplo de bioremediação de nutrientes.	Quais os detritos atuais e viáveis para aquacultura de algas. Se preconceito sobre aquacultura animal afecta opinião pública sobre aquacultura de algas
	<i>Difficulties in Understanding</i>	none	As perguntas alternam demasiado entre o cenário da economia	"A aquacultura de algas marinhas deve ser	"A aquacultura de algas marinhas tem pouco	A aquacultura de algas marinhas tem pouco impacto na vida marinha	Impacto: pode ser negativo ou positivo. Pergunta de viveros é locais

			local e economia global.	economicamente viável e rentável, leva a interpretações diferentes. A aquacultura das algas deve ser autosustentável ou a aquacultura de algas marinhas deve ser continuamente subsidiada? (isto é confuso)	impacto na vida marinha e no ambiente marinho: Não está claro se deve considerar o impacto como positivo ou negativo.	e no ambiente marinho: Colocamos nos "discordos" porque consideramos que tem imensos impactos positivos.	de produção de azeites não aplicável aos sistemas em terra.
<i>Bequest/Ethical values</i>	<i>Implication for extreme positions</i>	A aquacultura não é uma atividade das comunidades locais mas sim apanha, logo a aquacultura não é uma atividade de património local	A aquacultura tradicional está presente apenas na Ásia e sudeste asiático	Que tenhamos conhecimento, não existe tradição de cultivo de algas a nível local	Aquacultura é algo recente	a aquacultura de algas marinhas sempre fez parte das atividades culturais e locais: infelizmente na região de Aveiro, apenas apanha e não a cultura de algas (moloço) é tradição	Em Portugal não há registro de aquacultura de macroalgas à exceção de AlgaPlus desde 2012
	<i>Additional Statements</i>	none	none	A aquacultura de algas marinhas devem usar apenas algas endémicas ou autóctones	Não, mas terem sido incluídos menos sobre peço animal	None	O papel da aquacultura no reaproveitamento das infraestruturas das marinhas abandonadas
	<i>Difficulties in Understanding</i>	O significado não. Mas entendemos que algumas têm significados idênticos	Sem informação sobre o impacto de alimentação com algas em gado.	none	Não, compreendemos bem a questão de futuras gerações ter acesso à aquaculturas das algas	Houve uma discussão no grupo "investigação fundamental em genómica" e "o afastamento dos elementos à base de animais diminui as emissões de gases com efeito de estufa", no final do preenchimento da tabela, porque metade	Houve algumas frases que a própria gramática e utilização da palavra "Pode" deixa espaço para diversas interpretações.

						dos elementos do grupo concorda mais com uma do que a outra e vice-versa.	
<i>Benefits to human well-being and health</i>	<i>Implication for extreme positions</i>	Porque demente a visita previa o cheiro era bom	O conceito de Mudança climática é demasiado generalista	A aquacultura das algas marinhas ser locais onde se produzem algas. Como em qualquer produção, poderá haver um sector, mas não necessariamente	A proteção da erosão costeira pela aquacultura de algas marinhas é importante para o meu bem-estar e sensação de segurança: não temos percepção se a proteção for necessária parte ser fornecida por estruturas artificiais.	As instalações de aquacultura de algas irão deteriorar a paisagem na zona envolvente, discordamos porque, por exemplo, a AlgaPlus veio trazer via ao espaço pre-existente, tendo recuperado este espaço de forma a ser também de interesse turístico.	Porque a aquacultura trabalha com organismos vivos e não vai qualquer tipo de resíduos ou efluentes. É um processo natural.
	<i>Additional Statements</i>	Sentimos falta de questões referentes a liberdade	As questões não abordam a perspectiva cultural distinta	Algumas algas marinhas podem contribuir para o consumo adequado de iodo e /ou outros minerais.	none	none	1. Aplicação da aquacultura em áreas industriais. 2. O impacto positivo para os trabalhadores numa aquacultura. 3. Integração de pessoas com dificuldades em integrarem-se no mercado de trabalho
	<i>Difficulties in Understanding</i>	Não, detetamos uma grelha numa das perguntas	Questões vagas que não se adaptam a toda a necessidade prática		"Medicina tradicional" pode ter significados diferentes dependendo do background pessoal	none	Pressão sanguínea se calhar devia ser substituída por doenças cardiovasculares.

Source: own elaboration from workshop's results.