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D4.2.3 FEASIBILITY REPORT SUPPLY CHAINS IN THE 2 SEAS REGION

DETERMINING THE FEASIBILITY OF EUROPEAN SEAWEED FOR FOOD APPLICATIONS

As part of the Interreg 2 seas ValgOrize project, June 2021



PREFACE

This report (D4.2.3) is part of the Interreg 2 seas ValgOrize project. The project is coordinated by Flanders Research Institute for Agriculture and Fisheries (BE) and includes 10 other partners among which; Flemish Institute for Technological Research (BE), Royal Netherlands Institute for Sea Research (NL), HZ University of Applied Sciences (NL), North Sea Farmers (NL), Zeewaar BV (NL), University of Littoral Côte d'Opale (FR), University of Lille (FR), University of Greenwich (UK), Marine Biological Association of the United Kingdom (UK) and Nausicaa (FR). The ValgOrize project runs for a period of four years, started in 2018 and is funded by Europe via the Interreg 2 Seas Programme. For more information about the project, visit <https://www.interreg2seas.eu/en/ValgOrize>

This report is a co-production of several team members of North Sea Farmers; Lotte Bronswijk, Marlies Draisma and Femke Prins. Stakeholders from Ocean Harvest, Bioprocess Pilot Facility, Euroma and Unilever provided input for the content of the report through qualitative interviews.

As a community of businesses with a passion for seaweed, North Sea Farmers work towards positive climate impact. By growing a sustainable seaweed sector, we aim to improve biodiversity, reduce carbon emissions and be part of the circular economy. We are a non-profit organisation with an ANBI status. For more information, visit <https://www.northseafarmers.org/>

In the ValgOrize project, North Sea Farms are leading the study on valorisation aimed at supporting and accelerating the development of a technically and commercially viable seaweed supply chain for food applications, and the development of a roadmap towards sustainable production of micro-algae for food applications.

Contact information

Questions and remarks about the report and the project can be shared with Lotte Bronswijk: lotte@northseafarmers.org

Disclaimer

All data that has been collected is used for purposes of the Interreg 2 seas ValgOrize project and only to the context it is necessary to fulfil those purposes. North Sea Farmers attempts to work only with reliable and accurate data. However, North Sea Farmers do not give any warranty or other assurance to the content of the material appearing in this report. Furthermore, no rights can be derived from this publication.

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1. INTRODUCTION

1.1 ABOUT VALGORIZE

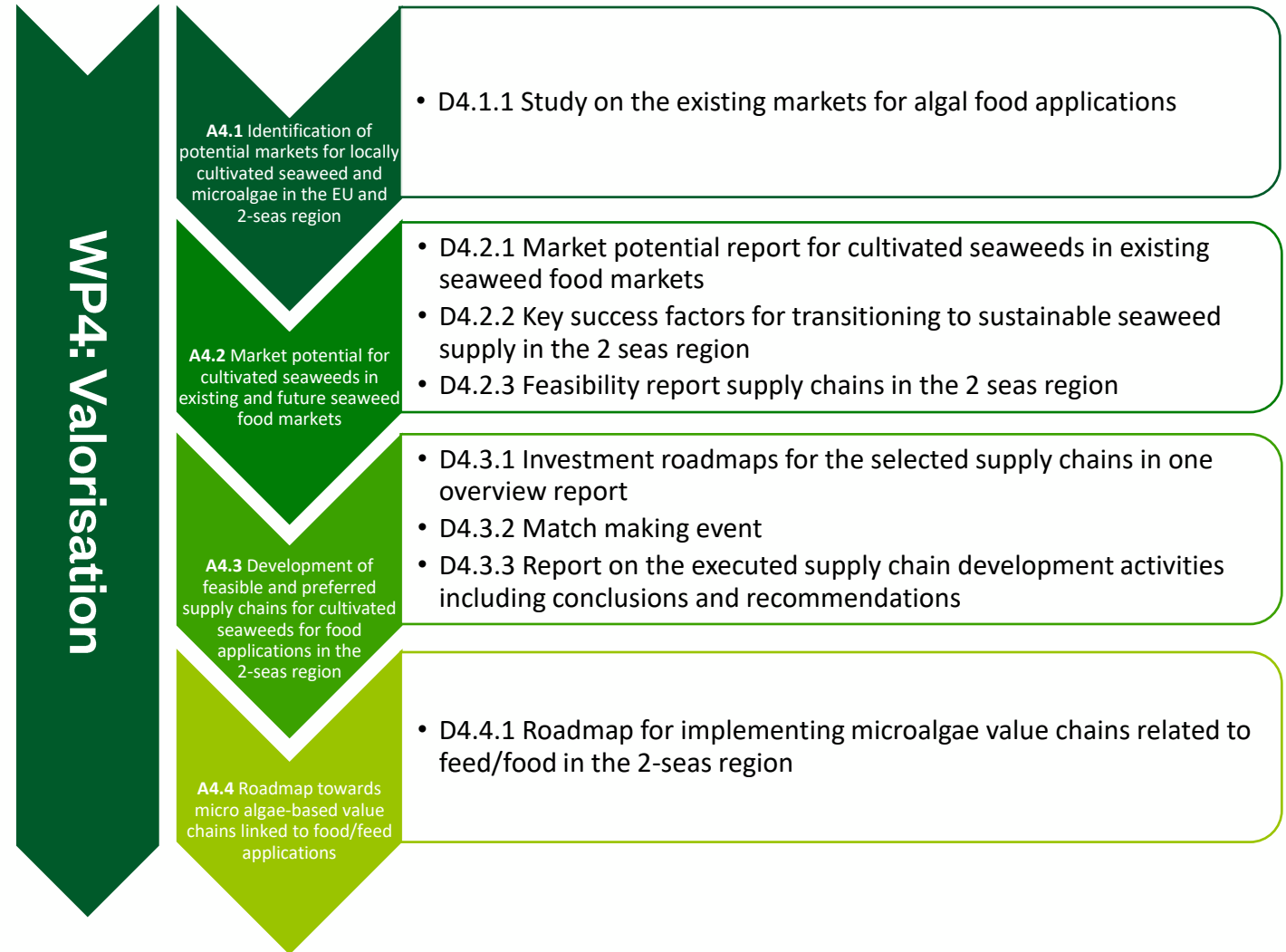
This report is part of the Interreg ValgOrize project for the European Union. The project aims at enhancing innovation in the algal sector, by creating an interdisciplinary platform for sustainable production of flavoursome, high quality algal foods that meet the requirements of the European market. The project comprises of 6 work packages:

- **Work Package 1:** Macroalgae cultivation; optimized macroalgal growth conditions (quality, reproducibility and reliability) for best food parameters.
- **Work Package 2:** Microalgae cultivation; optimization of cultivation methods for maximal productivity and yield of biochemicals and markers of taste.
- **Work Package 3:** Acceptance of the produced micro/macroalgal biomass and algae products for consumption; assessing algal safety, quality (as food product), optimal taste, product development, sustainable/zero waste.
- **Work package 4:** Valorisation; support and accelerate the development of a technically and commercially viable seaweed supply chain for food applications, and the development of a roadmap towards sustainable production of micro-algae for food applications.
- **Work Package 5:** Project management
- **Work package 6:** Communication

1.2 WORK PACKAGE 4

This report is part of Work Package 4: Valorisation; support and accelerate the development of a technically and commercially viable seaweed supply chain for food applications, and the development of a roadmap towards sustainable production of micro-algae for food applications. Within the work package, the results and insights as obtained in WP1, 2 and WP3 will be valorised. This specific report constitutes the required deliverable D4.2.3 'Feasibility report supply chains in the 2 seas region' as part of activity A4.2 'Market potential report for cultivated seaweeds in existing and future seaweed food markets'.

North Sea Farmers are responsible for Work Package 4. Furthermore, Flanders Research Institute for Agriculture and Fisheries, Flemish Institute for Technological Research, University of Greenwich and Zeewaar are involved in the Work Package. North Sea Farmers wants to thank all other partners and observer partners who contributed and shared their insights in various interviews for this deliverable.



1.3 THE DELIVERABLE

Motivation and objective

The overall objective of this report is to assess the feasibility of locally cultivated seaweeds for food applications. This feasibility study maps out the challenges of using seaweed for food, and also shows how we can increase the chance of a successful seaweed business. In this way we aim at offering companies more knowledge and certainty to enter the seaweed market for food and herewith support further development, growth and professionalisation of the seaweed sector in Europe and especially the 2 seas region.

Research question

What is the feasibility of locally cultivated seaweeds for food applications?

1.4 RESEARCH DESIGN & METHODS

Information was gathered by quantitative expert interviews with professionals throughout the seaweed value chain from farmer to producer.

For determining the feasibility, we made use of the following markers as identified in deliverable D4.2.2 :



1.6 SCOPE

	IN SCOPE	OUT OF SCOPE
TYPE	seaweed	micro-algae
APPLICATION	Food products, additives (hydrocolloids)	feed, biostimulants, pharma, nutraceuticals, cosmetics, biofuels, bio-packaging
MARKET	main focus: 2 seas region: United Kingdom, The Netherlands, Belgium, France secondary focus: other European countries	markets outside of Europe



Photo by Wolfgang Hasselmann on Unsplash

2. THE SEAWEED MARKET

2.1 THE SEAWEED MARKET

Determining the feasibility of locally cultivated seaweed for food applications, requires insights into the current status of the market. These insights are compiled in the previous deliverable of work package 4: an extensive market study to research the potential of locally cultivated seaweed for food. A summary of these results can be found in the next slides.



Visual by North Sea Farmers

2.2 GLOBAL SEAWEED PRODUCTION



32,4 million tonnes (wet weight, 2018)

- 53% red seaweeds
- 46% brown seaweeds
- 1% green seaweeds



Origin of seaweed

95% of seaweed comes from Asian countries: China is the main producing country, followed by Indonesia, Japan and Republic of Korea.

97% is obtained through cultivation

2.3 GLOBAL SEAWEED MARKET



\$ 13.3 billion (€ 10.9 billion) total seaweed market (2019)

77% seaweed for human consumption = \$ 10.2 billion (€ 8.4 billion)

2 main applications of seaweed for human consumption are food products (88%) and hydrocolloids (11%)



Largest market share

- Asia 61%
- North-America 19%
- Europe 10%
- Other 10%



Growth

Expected yearly growth: between 7% and 12%

2.4 EUROPEAN SEAWEED PRODUCTION



300,000 tonnes (fresh weight, 2018)

→ less than 1% of the global volume of 32.4 million tonnes



Origin of seaweed

1,450 tonnes of seaweed were obtained through cultivation (0,5%)

294,744 tonnes were harvested from the wild (99,5%)

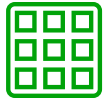
→ Unlike the global production, the European seaweed production is currently largely based on wild harvest

2.5 EUROPEAN SEAWEED MARKET



\$ 1.02 billion (€ 0.84 billion) market seaweed for human consumption (2018)

→ 10% of the global seaweed market for human consumption



Seaweed types on the market for human consumption

- 74% red seaweeds
- 24% brown seaweeds
- 2% green seaweeds

2.6 POTENTIAL OF EUROPEAN SEAWEED



Growth perspective

In 10 years the European seaweed market for human consumption can grow to a market of 2,8 billion euro.

In this high ambition scenario European cultivated seaweed should be able to cover 24% of the local demand.



Applications

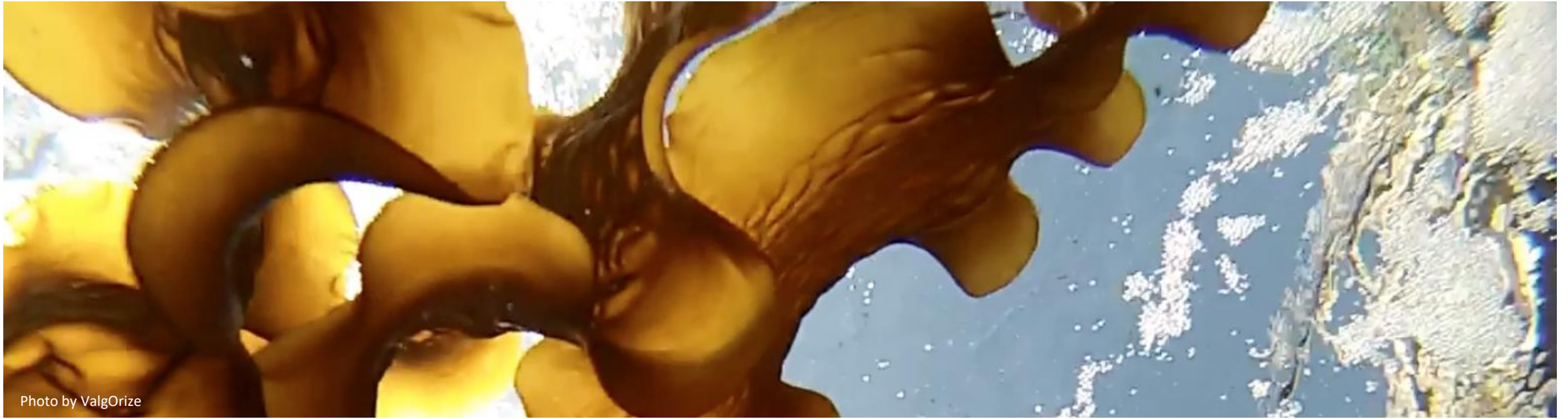
The highest potential for European seaweed can be found in the food product market, because there is still much room for innovation.

The hydrocolloid market is more mature and saturated. Therefore, it is more difficult to enter this market with new products.



Promising countries

Promising Western European countries to develop and grow a market for local, cultivated seaweeds are: Norway, Denmark, Germany, The United Kingdom, Ireland, The Netherlands, Belgium, France and Spain.



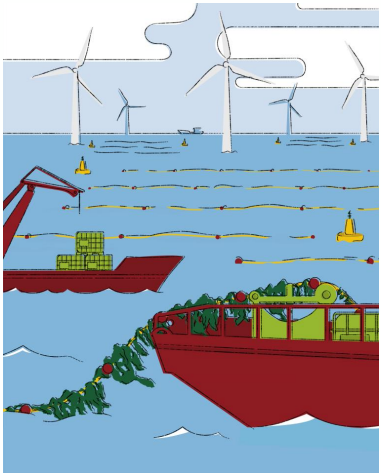
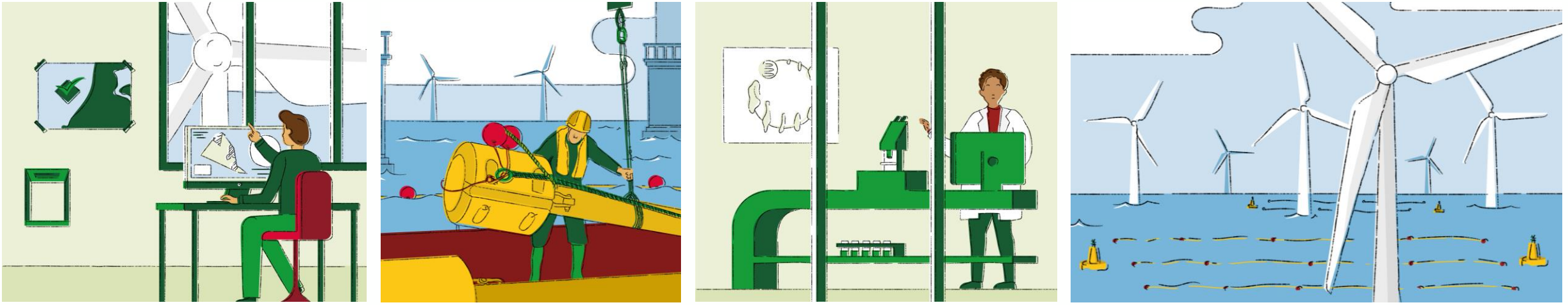
3. THE SEAWEED VALUE CHAIN

3.1 UNDERSTANDING THE SEAWEED VALUE CHAIN

In this deliverable, the feasibility of the seaweed value chain for food applications has been investigated. Hereby, the focus is on how to utilize large scale seaweed cultivation in the 2 seas region. To better understand the seaweed value chain, North Sea Farmers have put apart the different steps within this value chain:

- Designing and developing the farm
- Installing the farm's infrastructure
- Propagating the best seedlings
- Cultivating seaweed
- **Harvesting seaweed**
- **Onshore processing**
- **Creating the product**
- **End user**

For this research, we primarily focus on the second part of the value chain (indicated in green), which is most relevant for determining the feasibility for seaweed food applications. On the next page, the different steps are illustrated in an infographic.



Visual by North Sea Farmers

Focus for determining the feasibility of locally cultivated seaweed for food applications in the 2 seas region



4. THE SEAWEED VALUE CHAIN FOR FOOD APPLICATIONS

4.1 VALUE CHAIN COLLABORATION

For this research 4 parties* have been interviewed. They represent different areas of expertise in the seaweed value chain:

1. Designing and developing the farm, installing the farm's infrastructure, cultivating seaweed and harvesting seaweed;
2. Onshore processing;
3. Creating the (semi-finished) product;
4. Creating the product and marketing the product to the end user.

After interviewing these parties, we were able to analyse their input on challenges and solutions of each step in the value chain for food. Although each party has its own focus and expertise within the value chain, other parties might provide solutions to challenges they encounter, or the other way around. As it is all connected, we found it valuable to not only focus on one part of the value chain, but instead go through them all to get a more holistic view. On the next slides, we have listed the findings of these interviews for you.

**See appendix 7.2*

4.2 HARVESTING SEAWEED

Challenges

- Current limited harvesting capacity does not meet market demand.
- The seaweed must be treated after harvesting to be well preserved, because the shelf life of fresh seaweed is limited.
- The way the seaweed is handled influences the processing options, the market that can be reached and its market potential.

Solutions

- Offshore fermentation conserves the seaweed and maintains the quality.
- Cooperation between producers and market parties helps to properly align expectations about the form and volume of the seaweed to be supplied.



Visual by North Sea Farmers

4.3 ONSHORE PROCESSING

Challenges

- Lack of experience in the extraction of valuable elements, such as proteins.
- Potential presence of crustaceans can cause cross contamination: technical risk (can affect machines) and market risk (allergen).
- No cost-efficient method for drying at industrial scale.
- Processing depends on end use, because it determines the taste of the product.
- Transport: fresh seaweed is heavy and has a limited shelf life.

Solutions

- Dry or ferment (silage) the seaweed to extend the shelf life.
- Offshore processing saves, time, money and keeps the quality high.
- Processing into semi-finished products on the quay ensures continuous supply and quality control.
- Good alignment between processor and producers is essential to make sure it meets the right (taste) requirements.
- Focus on one product to be able to make choices in the process.



Visual by North Sea Farmers

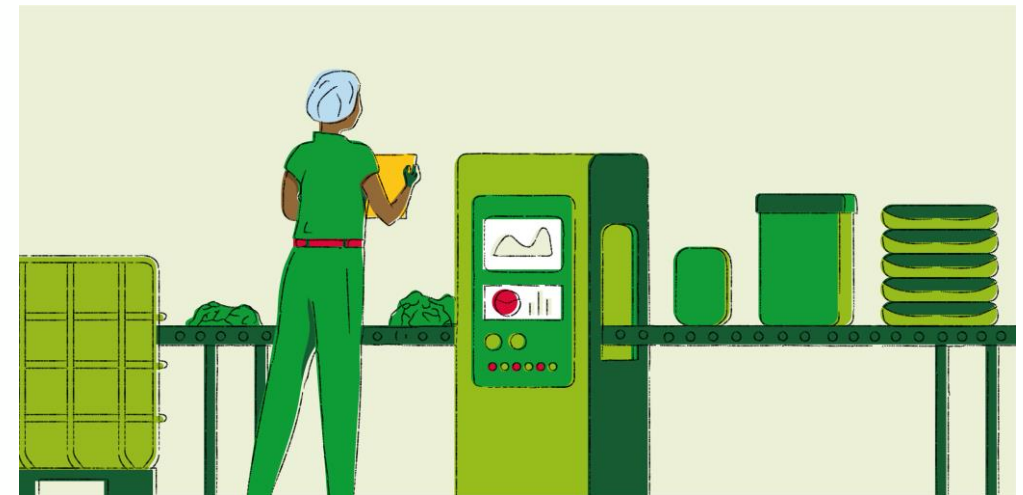
4.4 CREATING THE PRODUCT

Challenges

- Prices of local cultivated seaweed are higher than Asian competition.
- Potential high levels of contaminants and iodine cause food safety constraints.
- Producers preferably work with certified seaweed.
- Producers demand much more volume than one European farm is currently producing.
- Difficult to get an insight in the ingredients determining the taste of the seaweed.

Solutions

- Lower contaminants and iodine by processing.
- Conduct an LCA to get insights in the footprint of seaweed.
- Join forces as farmers to approach producers with a common product.
- Have a guarantee of purchase from producers to farmers.
- Implement a secondary processing step to tackle challenges such as food safety, certification, shelf life, continuous supply and quality.



Visual by North Sea Farmers

4.5 SUCCESSFUL BUSINESS WITH SEAWEED

Challenges

- Consumers find it challenging to cook with seaweed.
- Consumers are struggling to find places where they sell seaweeds.
- Not all consumers are convinced of the taste of seaweed.
- Due to its diverse applications, food producers and retailers are not always sure how to market seaweed.
- Collective Unique Selling Points for seaweed as food are missing.

Solutions

- Convince or inspire consumers about the good taste of seaweed, by showing how to use it (recipes, cookbooks, etc.)
- Apply seaweed in applications and dishes that have a logical connection with seaweed, such as fish or Asian products.
- Use restaurants as an entry point where consumers can get familiar with seaweed.
- Develop a business case with a clear focus on one product.



Visual by North Sea Farmers

4.6 SUMMARY OF FINDINGS

Coming back to the markers to identify the feasibility of locally cultivated seaweed for food applications, we can conclude the following based on the input from the experts:

Value chain collaboration

A successful business case heavily depends on good cooperation throughout the seaweed value chain. Knowledge building and sharing in terms of seaweed ingredients, ingredient extraction and taste elements are essential in this.

Consumer focus

Determining the Unique Selling Points of the product and a marketing strategy is important for a successful business case based on locally cultivated seaweed for food applications. Furthermore, food safety is a point of attention.

Provide consistent supply

Because seaweed is a seasonal product, which has a limited shelf life and is currently often produced on a small scale, the desire of processors for a consistent supply of high-quality seaweeds is a challenge. Conservation of the seaweed and coordination between parties offer solutions in this regard.

Connect supply & demand

Alignment between producers and processors is key to determine the right composition, taste, quality and quantity of the seaweed product.

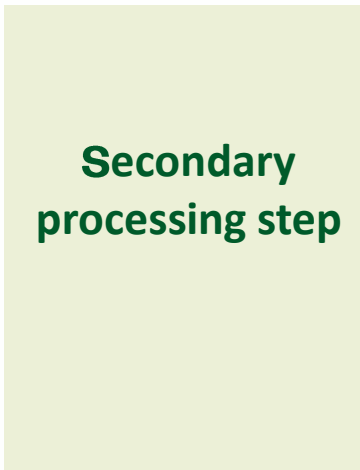
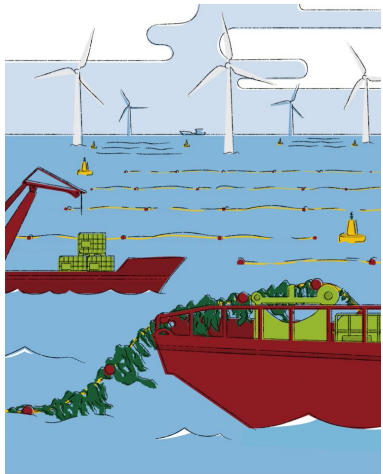


5. CONCLUSIONS

5.1 A SUCCESSFULL SEAWEED VALUE CHAIN

From the experts we learned that the visualisation of the seaweed value chain for food applications needs a few adjustments compared with the model we originally presented. For a successful business case based on locally cultivated seaweed, the following will have to be adapted:

- Adding a secondary processing step to tackle challenges such as food safety, certification, shelf life, continuous supply and quality.
- Determine the application of the seaweed before harvesting, so that the production process can be adjusted accordingly. Possible food applications/products could be hydrocolloids, proteins, seaweed as a tastemaker, a salt replacement, etc.



Visual by North Sea Farmers

5.2 FEASIBILITY OF SEAWEED FOR FOOD APPLICATIONS

A value chain for food applications based on locally cultivated seaweeds on a small scale seems feasible at the moment. However, for the large scale food industry in Europe, there are still steps to be taken. If companies make smart use of each other's knowledge and expertise and work well together, a successful value chain based on locally cultivated seaweed for food applications seems feasible:

Unilever:

“To get seaweed mainstream, we need to work with partners who can process the seaweed into ingredients that we can use in our products.”

Euroma:

“Seaweed is not the only seasonal ingredient with limited shelf life; we have experience working with similar ingredients and can help finding solutions.”

Ocean Harvest:

“We are trying to move from a research approach into an industrial production. This year we produced 200 tons of seaweed. Our bottleneck to further scale up is the market. We need to know what their requirements are so we can tailor our production according to this.”

Bioprocess Pilot Facility:

“We are interested to collaborate with seaweed and food producers to assist in scale-up of the various process steps for industrial processing of seaweed for food applications.”



Photo by [Marco Zuppone](#) on [Unsplash](#)

6. NEXT STEPS

6.1 TOWARDS AN INVESTORS ROADMAP

We have learned that the following steps need to be taken in order for investors to move forward in the seaweed for food industry in Europe:

- The seaweed value chain for food applications should be improved to meet the requirements of the large scale industry. Value chain collaboration is an important aspect to achieve this.
- A constant supply of high quality seaweed is an important requirements communicated by the stakeholders. Having technical data sheets and certification in place to prove the quality and specifications of the seaweed will help to achieve this. In addition, upscaling and a secondary processing step are required to be able to deliver a constant supply of food safe seaweed.
- Sharing knowledge among the European sector about seaweeds en specific species is needed in order to make well-founded choices for a succesfull business case. In addition to literature and lab studies, it is important to start learning by doing. A pilot project would be a valuable step to better understand the composition, taste elements and possible applications of European seaweed.

In the upcoming deliverables from the ValgOrize project we will work towards an investors roadmap to stimulate the European seaweed market for food applications. Do you have valuable information, or do you know companies that can help us, then we would like to hear from you. Get in touch with Lotte Bronswijk: lotte@northseafarmers.org.

6.2 PILOT – SEAWEED PROCESSING

The interviews with various industrial parties show that large scale processing of seaweed is a challenge which holds back the industrial use of seaweed for food. The realization of a pilot could be a first step to overcome this challenge. By creating a hands-on learning experience, we aim at inspiring and making the application of seaweed for food more tangible. Therefore, North Sea Farmers is coordinating a pilot as part of the ValgOrize project to tackle a number of challenges and test solutions as defined in this report.

This pilot can serve as input for the upcoming deliverables of WP4 of the ValgOrize project:

- D4.3.1 Investment roadmaps for the selected supply chains in one overview report
- D4.3.2 Match making event
- D4.3.3 Report on the executed supply chain development activities including conclusions and recommendations



7. APPENDICES

7.1 SOURCES

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7.2 INTERVIEWS

Quantitative expert interviews with professionals from the following companies throughout the (seaweed) value chain for food applications were held:



Thank you for your valuable insights!