

NEW OPPORTUNITIES FOR THE BIOSTIMULANT MARKET: EUROPEAN SEAWEED

A FEASIBILITY STUDY & MARKET STUDY

January 2021 | North Sea Farmers | Bio4safe, Output 8



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1. INTRODUCTION

The climate is changing, with as a consequence more extreme weather, severe droughts, etc. A common reflex in agriculture is to use more water & fertilizer, but this does not aid the situation. Additionally, societal pressure and governmental plans are driving agricultural changes towards a more sustainable and circular Europe. Various products have been developed to provide sustainable solutions to these challenges, among them seaweed biostimulants. In the Bio4safe project, the potential of using seaweed biostimulants & sensors to reduce water and fertilizer use in agri- and horticulture in the entire 2-Seas Region by 20 and 10% respectively.

Initiated in 2017, this EU Interreg project was a collaboration of North Sea Farmers, Vertify, Proefcentrum voor Sierteelt, Pôle Légumes Région Nord, NIAB EMR, and Yncréa Hauts de France. The trials performed by the associated research institutes were not only aimed at testing the effectiveness of biostimulants but will also lead to the development of a protocol for policy makers to better measure the impact of biostimulants. The Bio4safe project will be concluded by January 2022.

The main role of North Sea Farmers was to develop and assist in the validation and adoption of a business case for seaweed biostimulants. This was validated by leading the market study on the economic potential of seaweed-based biostimulants and by translating research outcomes into implementation by (and with) entrepreneurs.

Market analysis showed that the biostimulant market value has already reached €1 billion with an impressive annual growth rate of over 11%.

One of the largest growing market segments of this market are biostimulants based on seaweed, making up a third of the entire market. These numbers were further confirmed by stakeholders during in-depth interviews and workshops. However, even though biostimulants are natural products, a large amount of seaweed must be harvested annually. This limits the sustainable scaling possibilities of wild harvesting required to supply farmers in the entire 2-Seas Region with seaweed biostimulants. Alongside campaigning for reduction in fertilizer use, Europe also supports local sourcing of products¹. North Sea Farmers therefore investigated the feasibility of locally cultivated seaweed for the production of effective biostimulants. A unique international pilot was setup to find out if locally produced seaweed, sustainably cultivated offshore in Europe, can play a role in the biostimulant market. A biostimulant based on local seaweed was produced and tested on crops in the Bio4safe trails to research its effects. At the same time, a business case was developed together with partners and observer partners of the Bio4safe project as well as members of the seaweed- and biostimulant value chains. This business case aims to develop large-scale sustainable cultivation of seaweed within European offshore wind parks. Now, in this feasibility study and final report for Bio4safe (from Work Package 1), an overview of insights through this trajectory is provided.

The goal of NSF is to work towards the development of sustainable seaweed biostimulants that help farmers in the agri- and horticulture sectors to futureproof their business in line with Europe’s green ambitions. With this report, the Bio4safe project aims to support suppliers, stakeholders, and policy makers towards taking the necessary steps.

Therefore, it provides an overview of the most important outcomes of 4 years of market and validation research in the seaweed for biostimulants market. These insights will provide a crucial framework towards achieving affordable, effective, and sustainable seaweed biostimulants.

2. FEASIBILITY MARKERS FOR BUSINESS CASE IMPLEMENTATION

In order to upscale the local cultivation of seaweed for biostimulants, it must first be supported by a viable business case, including a detailed estimation of the costs and benefits of setting up and operating an offshore seaweed farm. NSF therefore worked together with Green Giraffe, who already have extensive experience in developing business cases for offshore wind parks.

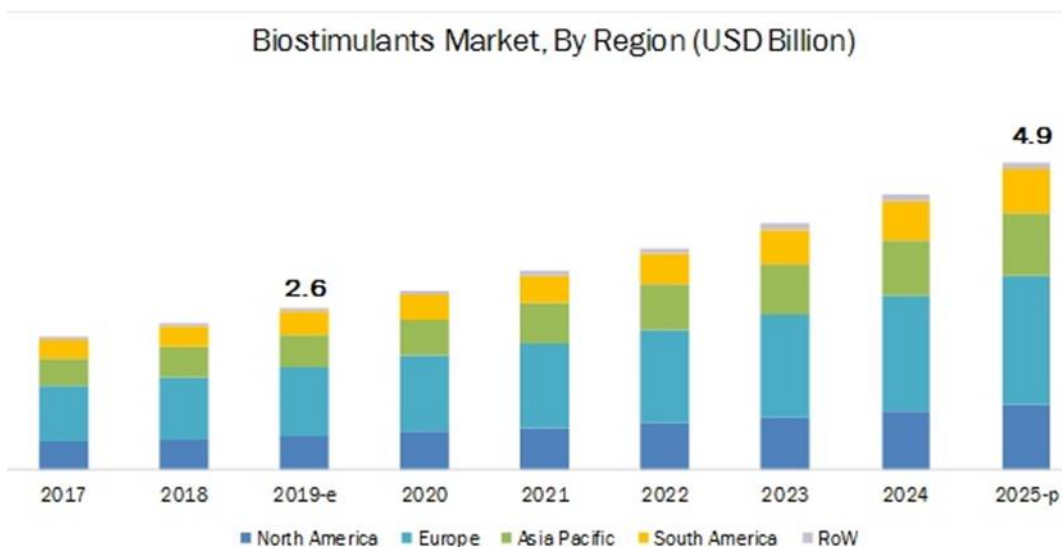
Using the expertise of Green Giraffe and veterans in the seaweed sector, a number of preconditions were identified for this business case to be adopted.

This was developed into a [roadmap](#)² and much of the subsequent work of NSF within the Bio4safe project was therefore aimed at assessing and achieving these requirements. During this time, findings and achievements were shared through workshops, news outlets and public reports. Finally, here the main requirements as well as the actions and achievements of NSF are presented, providing an indication of how close the seaweed biostimulant value chain is to be able to successfully adopt this business case and the sector can start-up cultivating seaweed for biostimulants.

2.1 INCREASING MARKET DEMAND

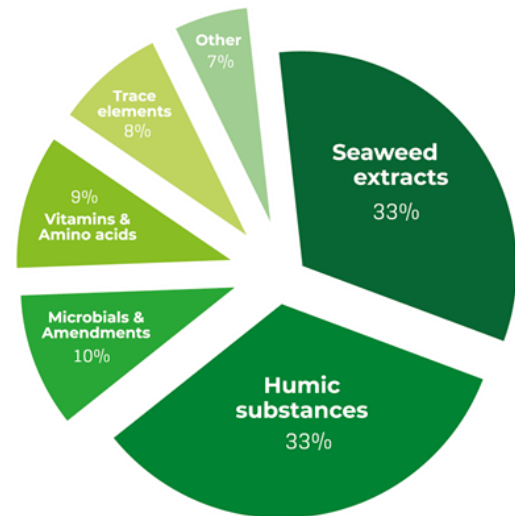
The demand for seaweed biostimulants must be sufficient and ongoing to warrant investment into their production since the envisioned seaweed farm is designed to run for up to 25 years. Therefore, not only policy makers but also agri- and horticultural sector organisations and farmers directly should be informed of the sustainable benefits of seaweed biostimulants.

Today there are limited reliable sources of public information on market and application data for biostimulants. Therefore, cross-verifying data has proved to be difficult. However, North Sea Farmers were able to verify the high-level numbers, both European and global, through online research, interviews, and workshops. These showed that, in terms of value (> €1bln), market growth (>11% CAGR), land-application (>14mln ha) and active global players/stakeholders, the biostimulant market appears to be quite a significant global market.



Graph 1: Biostimulant market global forecast to 2025 (MarketsandMarkets, 2019)

Seaweed-based biostimulants appear to cover approximately one-third of the total market of biostimulants. However, compared with the global agricultural industry (including horticulture, ornamentals & others) it is still a very small market, being comparable to about 2.5% of the total European “fertiliser” market. Nevertheless, given the benefits of biostimulants and the required global transitions towards a sustainable and circular agronomy, it is expected that the biostimulant market will continue to grow significantly in the future. Furthermore, there are sufficient “early adaptors” that are already convinced of the benefits of biostimulants such as innovative (organic) crop producers, golf course owners, etc³. This indicates that seaweed biostimulants are and will remain a biostimulant of interest to the market.



Graph 2: Seaweed biostimulant market analysis (North Sea Farmers, 2020)

2.2 PROVIDING SCIENTIFIC PROOF

Seaweeds have a long history of use as soil conditioners and only in the past two decades did agri- and horticultural growers start using seaweed extract as biostimulants⁴. Although seaweed biostimulants are perceived as promising, their relative novelty means many agri- and horticultural farmers will not immediately adopt them as part of their production process. An important boundary condition for this to occur is the widespread availability of (additional) scientific proof of their effects.

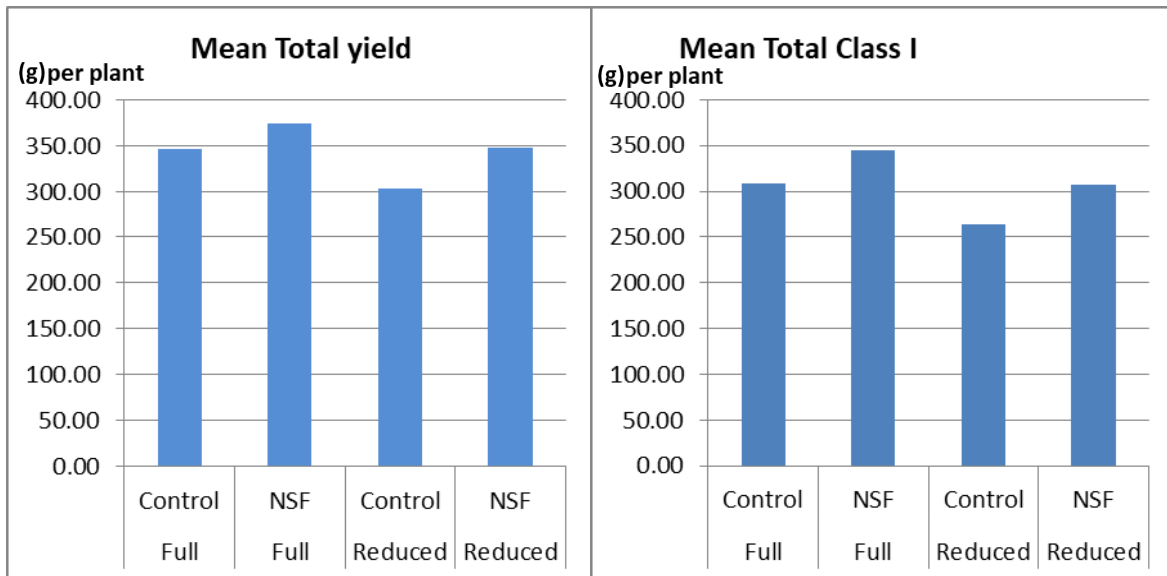
In general, biostimulants can be applied to maintain or increase crop yields and crop quality in challenging growth conditions without the need for more water or fertilizer use. As such, biostimulants may trigger a more innovative approach to crop production and land use. Instead of using chemically based substances, more natural substances will be employed to increase the plants’ robustness against abiotic influences.

Chemical analysis of the biostimulant from locally cultivated seaweeds showed the presence of significant amounts of compounds which are known to elicit biostimulant effects, including laminarins, fucoidans and mannitol. These compounds were present in similar concentrations to many commercial and trial-demonstrated biostimulants. Additionally, the local product was tested in the Bio4safe trials, in which biostimulants were applied to crops under severe levels of drought and nutrient stress, with high-tech sensors monitoring their effects.



Figure 1: Image from pilot biorefinery

These trials presented the local biostimulant as a highly promising product, most notably negating the effects of severe drought on crop yield and increasing the number marketable and high-quality fruit, even when plants were subjected to high levels of abiotic stress.



Graph 3: Strawberry trials of 2020 performed at NIAB in the UK. In each bar graph, the left two bars show the effect of applying the local extract (NSF) to control plants without abiotic stress. The right two bars show the effect of applying the local extract to plants under abiotic stress conditions. In both cases, the biostimulant increased yield.

Finally, the vast number of scientifically robust trial reports in literature regarding commercial seaweed biostimulants is strong supporting evidence that seaweed biostimulants are effective. An overview of reviewed scientific literature of seaweed biostimulants can be consulted at www.Bio4safe.eu.

Together, these results indicate that local seaweed biostimulants could help farmers (on land) deal with significant reductions in water and fertilizer inputs without loss of crop production.

2.3 SUPPORT FROM INDUSTRY

Producing biostimulants from cultivated seaweed should be financially attractive to businesses. This business case therefore contains the financial costs and benefits of large-scale seaweed cultivation. To safeguard its accuracy and suitability for those who will adopt it, the business case was developed together with the financial advisory firm Green Giraffe. Moreover, partners and observer partners within the Bio4safe project as well as members of the seaweed- and biostimulant value chains contributed their knowledge and experience. Using their input, a viable business case was developed which identified the main key factors towards achieving large-scale offshore cultivation of seaweed.



Figure 2: Visual representation of first large-scale offshore seaweed farm in the North Sea.

The first steps towards adaptation of this business case have been taken through the development of a consortium of committed stakeholders. NSF has approached investors with an interest in obtaining sustainable seaweed in Europe or reducing its price through upscaled production. This includes stakeholders throughout the entire seaweed value chain, since upscaled production of seaweed can offer benefits to everyone involved. The business case was therefore validated using the well-known seaweed species *Saccharina latissima*, which is cultivable in Europe and is also applied in both the food and animal feed industries^{5,6}.

With 2000 km² of offshore wind parks planned for the North Sea in 2030, the incorporation of these multi-use farms offers a great opportunity for upscaled production of sustainable biomass, without competing with fishing, shipping, and other uses of areas at sea. Norwegian seaweed producers Lerøy Ocean Harvest therefore also expressed their support for offshore cultivation, stating: "We view seaweed cultivation as a part of the circular economy. To become both sustainable and commercially viable, the large expansion of seaweed cultivation will take place offshore."

"TO BECOME SUSTAINABLE AND COMMERCIALY VIABLE, THE LARGE EXPANSION OF SEAWEED CULTIVATION WILL TAKE PLACE OFFSHORE."

- Lerøy Ocean Harvest, Norway -

Concerning this circular economy, the sustainable benefits of cultivating seaweed can be even further improved by using specially adapted infrastructure. The incorporation of a so-called 'eco-anchor', recently developed by NSF, allows these farms to also act as safe havens for fish throughout the year. This increases biodiversity, potentially benefiting both the ecosystem as well as seaweed quality.

As a result of performing the pilot biorefinery, which showed the potential of local seaweed for biostimulants, both seaweed farmers and producers of seaweed biostimulants have already shown their support. Joost Wouters, founder & CEO of The Seaweed Company, is among those to voice his approval, saying: "As a seaweed farmer, I am eager to find new markets for my product. The promising results of this pilot producing high quality and sustainable biostimulants with locally grown seaweed is great news. Not only for me but also for fellow seaweed farmers as it underlines the need for large-scale offshore farms. So, it seems to be a great business case for the sector!"

"THE PROMISING RESULTS OF THIS PILOT PRODUCING HIGH QUALITY AND SUSTAINABLE BIOSTIMULANTS WITH LOCALLY GROWN SEAWEED IS GREAT NEWS. NOT ONLY FOR ME BUT ALSO FOR FELLOW SEAWEED FARMERS."

- The Seaweed Company, Netherlands/Ireland -

The French biomarine ingredients company Algaia has also encouraged this development by signing a letter of intent to buy the cultivated seaweed that will be produced in this 160ha offshore farm. Franck Hennequart, R&D and Innovation Director at Algaia, stated: "Tomorrow we may need a cultivated resource of seaweed in Europe. We are already processing 40.000 tons of seaweed annually and if the seaweed sector grows in Europe, we will grow as well. We joined the biorefinery demonstration project to see the value of local cultivated seaweed for biostimulants and we think that the demonstration has been validated!"

Some of these stakeholders have already signed a letter of intent to take up this business case. Thereby announcing their "intention to collaborate in the initiative of setting up the first offshore commercial seaweed farm in a wind farm in the North Sea".

This commitment has enabled the development of both a roadmap and business case that are accurate and usable for the biostimulant industry after completion of the Bio4safe project.

Further demonstration of the increased quality and sustainability of cultivated local seaweeds will lead to increased societal and governmental support, as well as opening up possibilities for subsidies and grants supporting sustainable developments.

"TOMORROW WE MAY NEED A CULTIVATED RESOURCE OF SEAWEED IN EUROPE. WE ARE ALREADY PROCESSING 40.000 TONS OF SEAWEED ANNUALLY."

- Algaia, France -

2.4 INCREASED AWARENESS

The growing market and aforementioned support from the industry indicate those aware of the potential of seaweed biostimulants, are often eager to use or produce them. Therefore, sharing knowledge and achievements of seaweed biostimulants through the value chain and with policy makers will accelerate the widespread adoption of seaweed biostimulants. Additionally, by informing policy makers of the potential economic and sustainable benefits for the agricultural and horticultural sectors, they can help develop regulations and policies that ensure reliable products in the European market.

In order to effectively share the developments achieved in the Bio4safe project with stakeholders and policy makers, various communication approaches were used. The roadmap presented the Bio4safe project goals, activities, and achievements and was highly positively received throughout the entire seaweed biostimulant value chain. This centred around the circularity of local seaweed sourcing for the production of biostimulants, which both reuses the agricultural nutrients flowing into the ocean and helps farmers on land deal with reductions in water and fertilizer use.

By conveying this message to stakeholders and policy makers, sector developments and regulations can work towards monetising the provided ecosystem services.

Subsequently, the [pilot biorefinery was documented and filmed](#) to demonstrate the value of collaboration. Similarly, the film of the Bio4safe trials also served to enthuse and inform stakeholders to participate in the development, testing and use of local seaweed biostimulants. Alongside encouraging the seaweed biostimulant value chain, this was also aimed towards informing policy makers of this progress. This enables policy makers to develop supportive regulatory frameworks and ensure standardization between EU member states. This complements the work done in WP4 of the Bio4safe project.

Market insights, communication materials and activities towards the development and implementation of the business case were shared through workshops, events⁹, news outlets, social media, and public reports. In this way, a broad spectrum of stakeholders was reached, with contacted stakeholders estimated in the thousands.

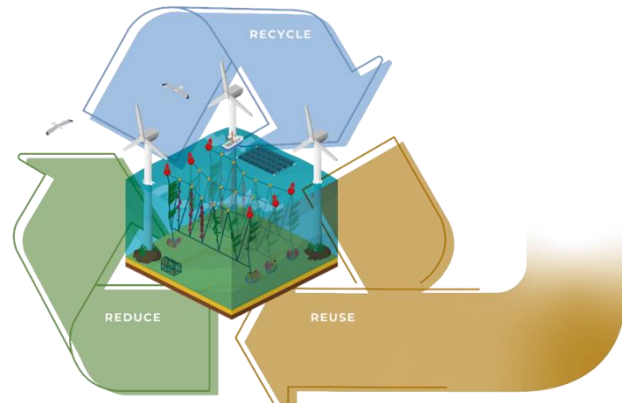


Figure 3: Illustration of the sustainable benefits provided by offshore seaweed cultivation.

3. CONCLUSION

So, does locally cultivated seaweed provide opportunities for the biostimulant market? Based on our findings during the past four years in the Bio4safe project, our conclusion is that offshore seaweed cultivation is a feasible source of effective and sustainable seaweed for use in the biostimulant market.

The market demand for biostimulants rises globally each year, due to the fact that biostimulants as a natural product can help combat current climate issues in agriculture & horticulture. This means that the demand for biostimulant resources will continue to rise. Scaling up seaweed production is the logical way to go, being one of the biggest market segments of the biostimulant market. In terms of scalability, the biggest opportunity for seaweed cultivation in Europe lies offshore, due to the many planned wind farms where seaweed can grow in a sheltered manner. The business case for offshore seaweed cultivation in wind farms, used for the application of biostimulants, is positive; especially when combined with higher value applications, like food. Furthermore, the results of our 'local biostimulant' pilot – a biostimulant made from locally cultivated seaweed - showed promising results in the trials of Bio4safe project partners. This business case was received well in the value chain and its potential was affirmed as some market in Europe have shown interest in adopting this business case.

Though the Bio4safe project is coming to an end, there are still many steps ahead to get from proving feasibility and continue adaptation and work towards actual implementation. The Bio4safe results are a first attempt to make evidence-based claims and show potential. However, more research is necessary to confirm the found results. Additionally, though the current business case and enthusiasm of some market parties is a great start, market activation throughout the value chain will be crucial to really let the seaweed biostimulant market flourish. Therefore, we have set up a few recommendations for next steps for parties across the value chain.

4. RECOMMENDATIONS

In order to meet the growing demand for biostimulants, we recommend to continue facilitating the use of biostimulants in agriculture and horticulture, as well as support the implementation of offshore seaweed cultivation in Europe. Both elements are needed to help the agricultural & horticultural sector become more sustainable and less reliant on a steady supply of fertilizers, water & chemicals.

For the development of a robust seaweed biostimulant supply chain, we believe the following steps are crucial:

1. Sourcing of high-quality seaweeds by seaweed farmers & suppliers
2. Increasing the knowledge base for biostimulants made from locally cultivated seaweed via research institutes
3. Clear policy guidelines and regulations regarding both seaweed production as well as biostimulant use in order to stimulate use & innovation.
4. Stimulate awareness of seaweed biostimulant opportunities

4.1 SEAWEED SUPPLIERS FOR QUALITATIVE SOURCING

Biostimulants can be a valuable addition to the business model of seaweed suppliers. However, locally cultivated seaweed will still need to further prove it is able to supply the growing biostimulant market. This will require more insights on the mode of action of seaweed biostimulants, which will help determine the most suitable seaweed species, as well as improve breeding, harvesting, and processing technologies. Value chain collaboration will be key here. After all, producers, farmers, and buyers are interdependent; working together to create a consistent & qualitative product for the market.

In order to create a futureproof seaweed supply chain, it is important to focus on producing seaweed sustainably. Current climate issues underline the importance of sustainable production in every sector worldwide. The seaweed sector is no exception. As offshore seaweed production is a relatively young concept, incorporating sustainability as a core business at an early stage will allow it to avoid production issues that may occur decades from now. This can be achieved for instance, by using sustainable materials in farm infrastructure like sustainable anchoring systems; via nature-inclusive farming and strengthening marine biodiversity; but also, via monetising the ecosystems services that seaweed cultivation provides. After all, ecological & economic viability go hand in hand.

What will North Sea Farmers do on this topic?

Adopting and implementing the business case for offshore seaweed cultivation will require large investments. Our added value as a connecting organisation in the seaweed sector, is to set up collaborations throughout the entire value chain, including seaweed farmers, buyers, processors investors, policy makers and end-user. This will allow the sector to move towards a more resilient and responsive industry and push for sustainable, scalable, and resilient seaweed products like biostimulants. This is why our action in 2021 will focus on:

- Building a consortium to implement the business case for offshore seaweed cultivation.
- Continue trials with an eco-anchor, enhancing ecological benefits of offshore seaweed farms, which was developed in the AFAS project.
- The harvested seaweed produced in this consortium initiative will be used for – amongst others – the application of biostimulants.
- This consortium will be a cornerstone for upscaling offshore seaweed cultivation in Europe in the upcoming years.

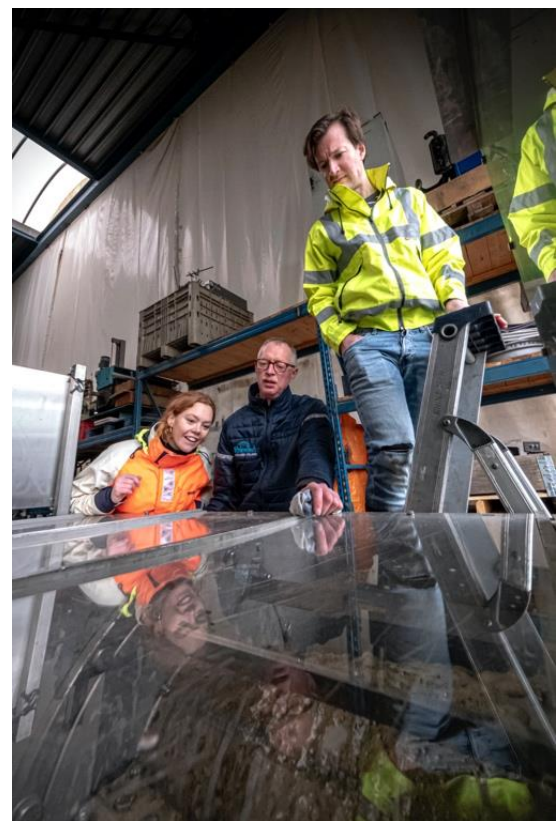


Figure 4: Unique value chain collaboration for the 'local biostimulant' pilot

4.2 RESEARCHERS INCREASING THE KNOWLEDGE BASE

An evidence-based way of working is important for future market developments. This will require more research on the effectiveness of locally cultivated seaweed as a biostimulant resource and thus create a better understanding of the quality of the cultivated seaweed, differences in seaweed species (species diversification), reliability of seaweed cultivation and biological pathways that produce the effect seen in crops. Additionally, this should be complemented with research on the overall effectiveness of these products on crops. This will both build a track record for effective seaweed biostimulant products and will help determine how economically valuable these products are to farmers.

Finally, marine research institutes can play an important role in the valorisation of the aforementioned ecosystem services provided by seaweed cultivation. These services range from enhancing biodiversity to taking up excess nutrients and providing benefits to other industries such as fisheries.

What will North Sea Farmers do on this topic?

By joining forces, innovation can be accelerated. As mentioned above, we will therefore keep in close contact with research institutes in Europe, to share knowledge and multiply new business models and ecological impact. In this respect, the abovementioned consortium will be key. In 2021, we will also focus on:

- Monitoring the outcomes of the trials in the final year of the Bio4safe project, with special attention to the biostimulant made from local locally cultivated seaweed from our pilot.
- Keeping research institutes involved in the consortium activities.

4.3 POLICYMAKERS STIMULATING INNOVATION

Policymakers can stimulate the innovative developments of biostimulants made from locally cultivated seaweed. They can do so by facilitating the use of biostimulants by farmers and growers on the one hand and by supporting offshore seaweed cultivation on the other.

There are already some national and European policy agreements in place that support the use of biostimulants. Considering their potential of allowing farmers to cope with reduced fertilizer & chemical inputs in agriculture, biostimulants can play a role in many sustainable policy plans, such as the Paris Climate Agreement, the European Green Deal and, more specifically, the European 'Farm to fork strategy'. Right now, legislation in agriculture categorizes biostimulants not as pesticides or fertilizers, but as crop strengthening agents. In practice, this means that biostimulant producers face less requirements to introduce these products to the market, compared to for instance new pesticides. Although this does allow farmers access to a larger range of products, policymakers can help safeguard this market by developing clear and unified legislation clarifying how products should be tested and used.

In contrast to the globally already established biostimulant market, the offshore seaweed sector is an emerging industry. The price of cultivated seaweed is therefore currently a multitude higher than wild harvested seaweed. This price gap will decrease with technical innovations, upscaling, and valorization of ecosystem services. Also, cultivated seaweed can provide added value through increased control over volumes, quality, and delivery times. NSF believes that governmental support for offshore local seaweed cultivation is crucial to capture the potential of seaweed. Governments are already committing to Sustainable Blue economies, like the Dutch 'Noordzeestrategie 2030', the European Green Deal and the Biodiversity strategy. Seaweeds will play an important role in these strategies and in order to further support these advancements, governments can look for similar instruments and guidelines to those developed for setting up offshore wind farms.

What will North Sea Farmers do on this topic?

Several European strategies speak of the potential of seaweed and its applications. Yet, biostimulants are not always top of mind in seaweed shortlists, even though it can play a two-sided role: both in cultivation at sea and in application on land. Since sustainable seaweed biostimulants fit perfectly within the multitude of accords and plans towards a more sustainable and circular Europe, we will focus our activities in 2021 on:

- Keeping policymakers in the loop on the Bio4safe outcomes and the broad range of benefits that come with seaweed biostimulants, in order to incorporate them into legislation and sustainable strategies.
- Communicating the outcomes to national and EU policymakers and have a dialogue on the role that seaweed biostimulants can play in the transition towards a circular European Agronomy. This may open up the way for seaweed biostimulants to become more broadly available to the market.

- Creating awareness amongst policymakers on the possibility of valorising ecosystem services provided by the application of seaweed biostimulants, e.g., climate resilience, nutrient efficiency, and fewer chemicals & fertilizer.

4.4 STIMULATING PRODUCT DEVELOPMENT & AWARENESS

In an era where sustainable and local products thrive worldwide, a sustainable and local resource in the form of cultivated seaweed can be a diamond in the rough for the biostimulant market. It enables a variety of opportunities for biostimulant producers, biostimulant sector organisations and the agricultural and horticultural sector to develop new products that are futureproof, even with regard to today's climate issues.

For biostimulant producers for instance, new business models can arise by developing products made from locally cultivated seaweed and investigating their effectiveness. By using marketing, branding and storytelling, one can address the unique selling point of locally & sustainably sourced from Europe.

Additionally, collaborations can be set up with the agricultural and horticultural sector in order to facilitate research & product development that really fits the needs of the end-user. After all, the first biostimulants made from locally cultivated seaweed in the Bio4safe project showed promising results on crops thus revealing new opportunities for the market.

What will North Sea Farmers do on this topic?

Our goal is to make climate impact with seaweed. Sustainable seaweed biostimulants that are locally sourced definitely fit that description, so we are open to help wherever we can. Our first pilot biostimulant was a success. Now, we will continue our work in 2021 by:

- Communicating our Bio4safe activities towards stakeholders throughout the value chain in the 2-Seas Region via a public relations strategy to emphasise the viability of the business case.
- Stimulate value chain collaboration via the North Sea Farmers community

For more information, please contact us via info@northseafarmers.org

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Disclaimer

All data that has been collected is used for purposes of the Interreg 2 seas Bio4safe 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.

This report is part of the Bio4safe project. We'd like to thank our fellow project partners for this unique collaboration in the past four years. For more info on the Bio4safe project, go to the Interreg website or visit the scientific database on effects & methods of biostimulants via www.bio4safe.eu. If you want to know more on seaweed biostimulants in particular, visit our project page: www.northseafarmers.org/bio4safe



APPENDIX

1. <http://www.fao.org/agroecology/database/detail/en/c/1277002/>
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