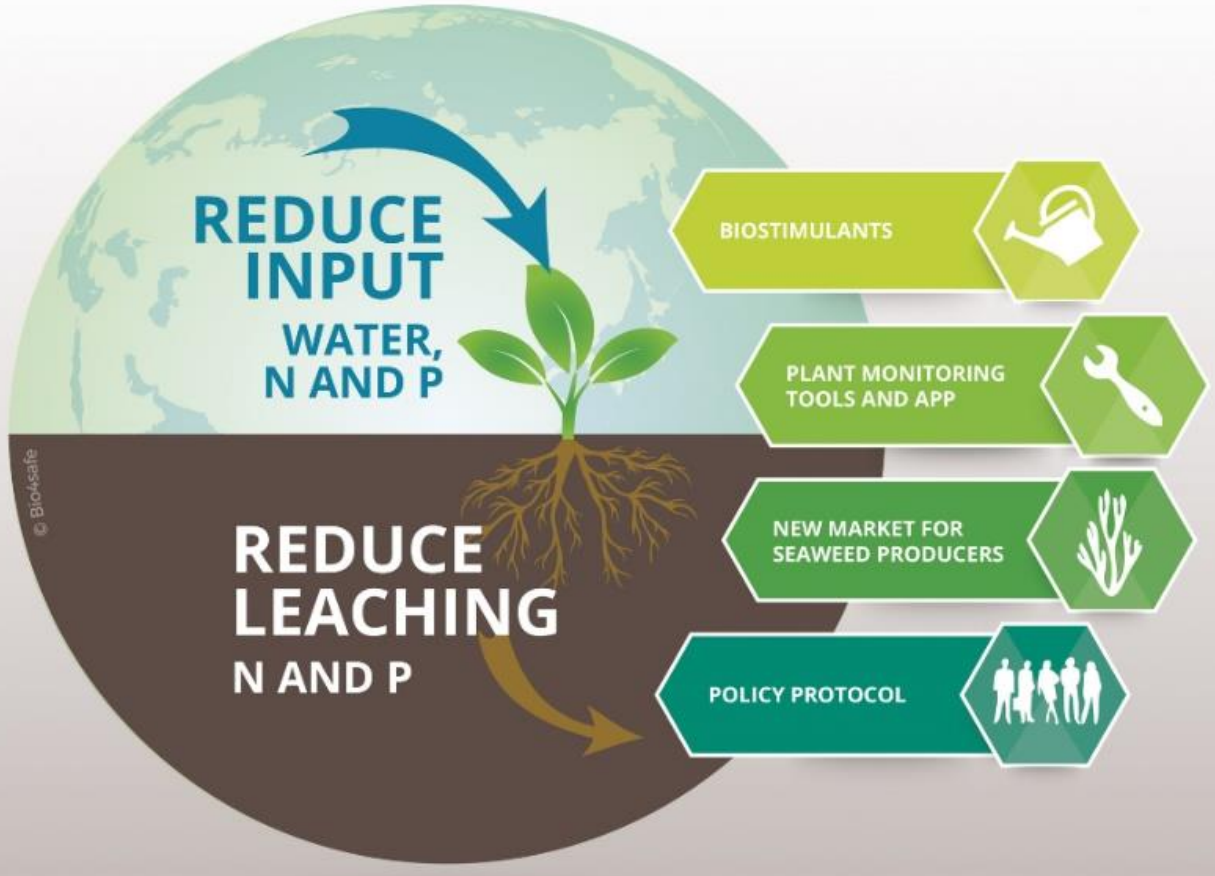
Deliverable 1.2.2: Report on the goals and strategy towards increasing usage of seaweed biostimulants as part of the Bio4safe project



Preface

This report is part of the Interreg 2 seas project Bio4safe. The project is coordinated by PCS Ornamental Plant Research (Belgium) and includes 7 other partners including Research Station Proeftuin Zwaagdijk (NL), North Sea Farm Foundation (NL), Yncréa Hauts de France, establishment ISA Lille (France), Pôle Légumes Région North (France), NIAB (UK), Dove Associates (UK) and Ghent University (Belgium). The Bio4safe-project runs for a period of four years, started in 2017 and is funded by Europe via the Interreg 2 Seas Programme.

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Project partners:

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1 Introduction

This report is part of the Bio4safe Interreg project for the European Union. This project aims to reduce water use and fertilizer use in horticulture by using biostimulants and innovative tools. This combination will result in up to 20% reduction of water and 10% of fertilizer usage, depending on the crop. By specifically including biostimulant based on seaweeds, economic opportunities for seaweed producers will be explored and developed.

The project comprises of 6 work packages:

- Work Package 1: Market study: development of business models for producing biostimulants from seaweeds
- Work Package 2: Demonstration, implementation and adoption of biostimulants and sensor tools
- Work Package 3: Collecting and analysing cross-border data to develop information database and apps to access the information
- Work Package 4: Policy protocol
- Work Package 5: Project management
- Work Package 6: Communication

This report is part of **Work Package 1: Market study: development of business models for producing biostimulants from seaweeds** and as such constitutes the required **deliverable D1.2.2 Report on goals and strategy towards increasing usage of seaweed biostimulants** as part of activity **WP1.2 – Development and strategy for market penetration.** Figures 1 & 2 on the next page briefly demonstrate the relation between these various elements.

<u>Setup of Work Package 1</u>

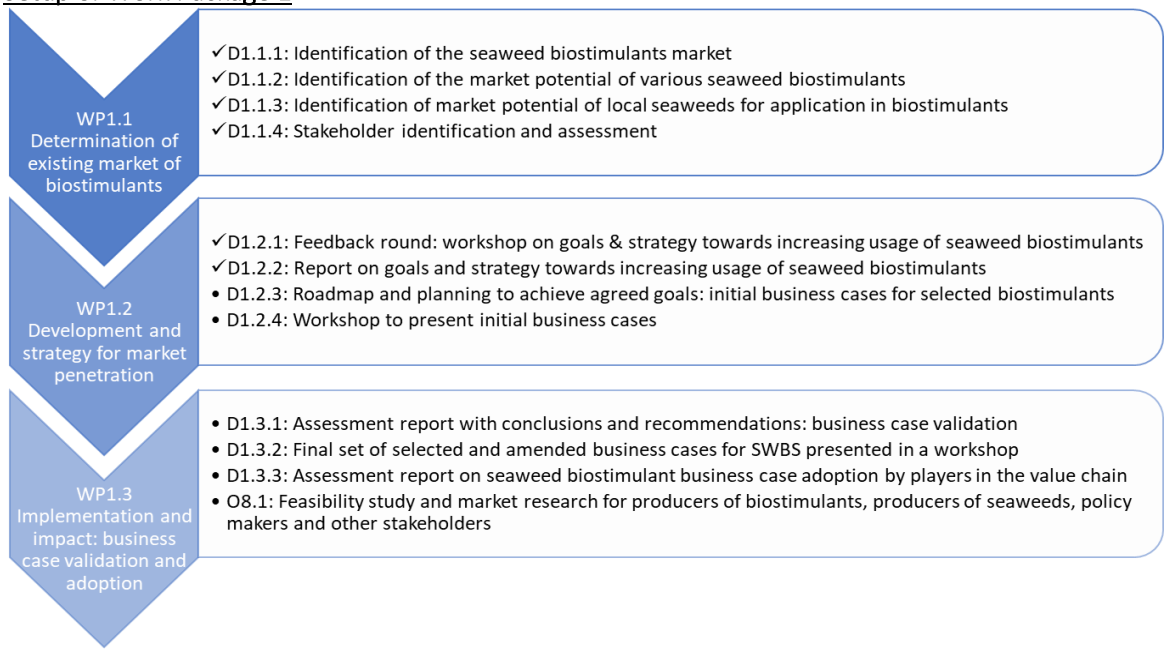

Figure 1: Setup of Work Package 1

Setup of Activity 2

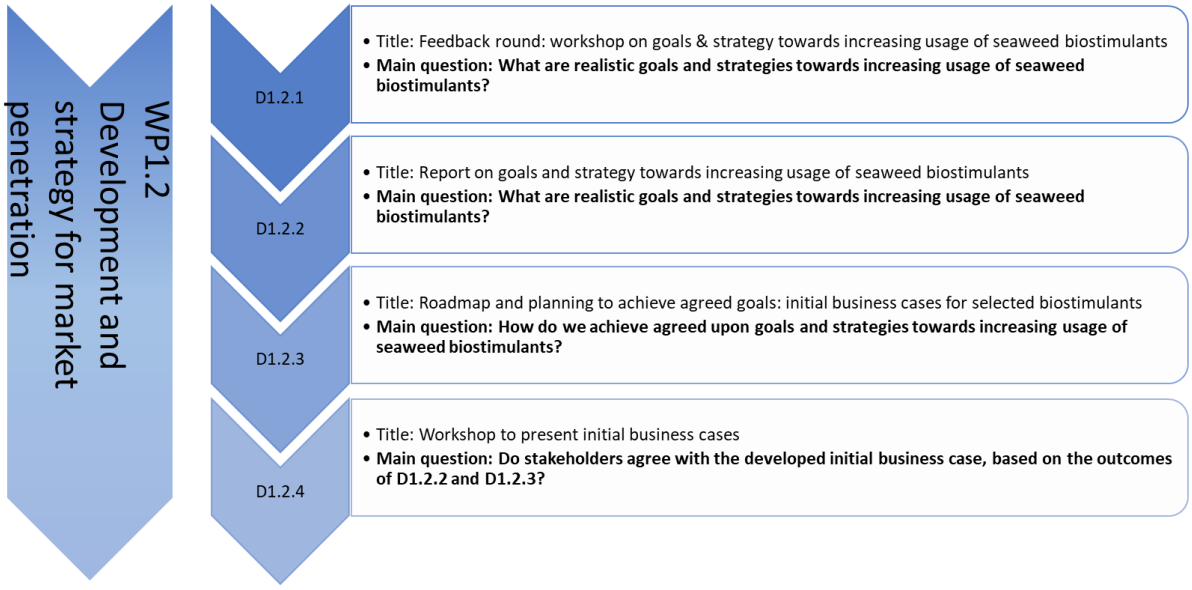

Figure 2: Setup of Activity 2

Objectives for Deliverable 1.2.2

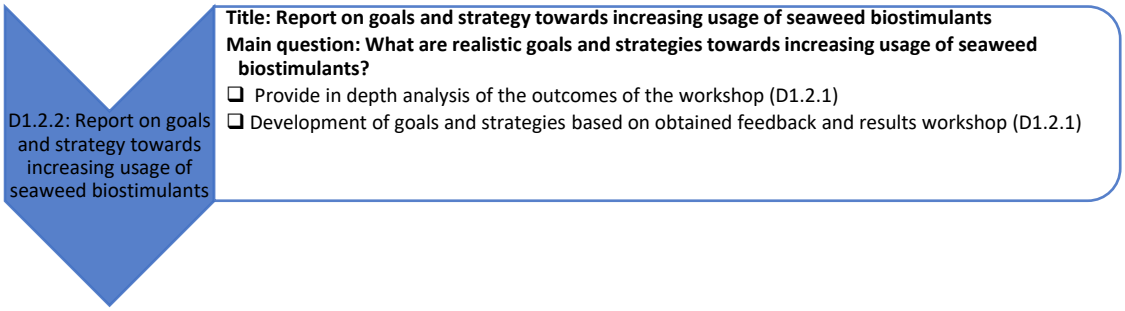

Figure 3: Objective of Deliverable 1.2.2 (this report)

1.1 Recap of preceding deliverables in A1.1.

In deliverable 1.1.1, North Sea Farm Foundation (NSF) has gathered publicly available information by means of online research and acquired market information with all partners and observer partners, including several interviews/meetings with for example Zwaagdijk, PCS, ISA Lille, Olmix, local stakeholders and others. The initial data was provided for the different regions by making use of the network of partners mainly in The Netherlands, Belgium and France which resulted in a community of more than 80 possible relevant stakeholders (this was also the starting point of stakeholder selection).

Deliverable 1.1.2 provides an overview of drivers and barriers of the seaweed biostimulant market making use of a SWOT analysis. In this phase of the project NSF worked in close collaboration with Ghent University in conducting interviews.

Looking from the seaweed farmers' perspective 1.1.3 provides insights in local (2seas region) seaweed species and potential of the species for biostimulants. All data in the deliverables is supported by interviews with stakeholders, observer partners, partners and biostimulant producers.

For deliverable 1.1.4 information from the desk study, stakeholder interviews, the interactive partner meeting and stakeholder skype sessions were gathered to elaborate on the SWOT analysis made in D.1.1.2. and to update this analysis where required. The updated SWOT analysis will then be used to build towards a strategy (guidelines) on how to engage relevant stakeholders and further develop seaweed biostimulant market (roadmap).

Deliverable 1.2.1 provides feedback from all active partners and observing partners on the proposed goals and strategy. All data in the deliverable is obtained in a workshop setting, where feedback was obtained on the updated SWOT analysis from D.1.1.2. and on various statements.

For this deliverable 1.2.2 information from activity A 1.1, data from the determination of the existing biostimulant market as well as the stakeholder workshop are used.

1.2 Description from the approved project application

As part of activity A1.2 as part of work package 1 (WP1), deliverable 1.2.2 (D1.2.2) is included with the aim of obtaining feedback to amend the initial goals and strategy towards increasing usage of seaweed biostimulants, so that a roadmap can be made for the development of business cases for various existing seaweed biostimulants.

The exact description of D1.2.2 is as follows:
All of the obtained feedback will be used to amend the initial goals and strategy towards a final version of a report on goals and strategy towards increasing usage of seaweed biostimulants.
All active partners will be involved in this deliverable and all observer partners will be invited for the workshop and interviews.

1.3 Content of this report

This report, the "goals and strategy report as part of the Bio4safe project" will therefore include:

- Overview of learnings and recommendations from previous reports, interviews and stakeholder sessions
- Resulting goals and strategies with elaboration
- General conclusions and next steps

2 Methodology

2.1 Introduction

In this project one of the objectives of North Sea Farm Foundation is to work towards stakeholder engagement in order to push market developments. To do so, we needed to acquire elaborate information about the biostimulant market and the drivers and barriers which stakeholders experience. This has been done with the help of partner and stakeholder interviews. Additionally, we have presented and evaluated results from earlier work with stakeholders. In both the previous and current deliverable, we have engaged the relevant stakeholders by actively sharing reports, acquiring feedback and organizing interactive stakeholders workshops. This is an ongoing process, as (new) stakeholders will be kept involved thoroughly in future work. These stakeholders are the *real* owners of the biostimulant value chain. They need to feel ownership of the problems, solutions and way forward. This (stakeholder) work will set the basis for developing and executing a roadmap to develop the seaweed based biostimulant market.

2.2 Methodology

In order help stakeholders to make the biostimulant sector more successful, a roadmap will be developed in which the majority of the current drivers, barriers and opportunities within the sector will be addressed. For this purpose, the learnings and recommendations, which were obtained from a.o. interviews, stakeholder sessions, and market research as part of WP1 of the Bio4safe project, were collected and translated into a list of practical goals. These were then grouped into 7 main categories, so called thematic goals, and presented to stakeholder groups in an interactive session, where they were discussed and ranked by measure of importance and urgency.
This ranking will provide the foundation from which the roadmap will be constructed.
You can find the collected learnings and recommendations from previous reports of WP1 below.

2.3 D 1.1.1. Identification of the seaweed biostimulant market

- Biostimulants stimulate resilience of agri- or horticulture production systems.
- Biostimulant market is significant and small, covering 2.5% of the total European fertilizer market and approximately one third of the biostimulant market.
- Limited available data sources with few reliable sources call for direct stakeholder interviews.
- As a new market, it requires positive scientific proof, product availability, application manuals, standardization and a regulatory framework.

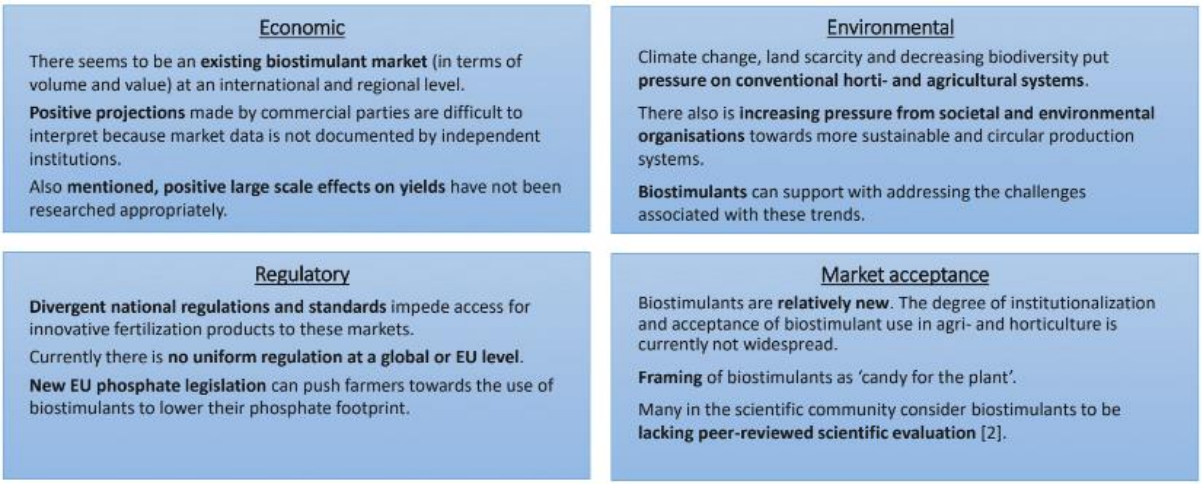

Figure 4: Main drives for biostimulant market

2.4 D 1.1.2. Identification of the market potential of various seaweed biostimulants

Currently it is interesting to invest in the seaweed based biostimulant market as the supply chain is stable and the market is growing. For further growth, investors should also invest in developing the knowledge base, lobby for unified legislation, education of their end-users and a more diverse and resilient supply of seaweeds for their product.

2.4.1 Drivers

- Increasing societal health-consciousness
- Changing climate, leading to drought stress
- A currently stable European seaweed supply chain

2.4.2 Barriers

- European production is built around a single seaweed species, only obtained through wild harvest
- Ununified legislation per country in relation to biostimulant registration
- A lacking knowledge base and market acceptance of seaweed based biostimulants

2.4.3 Opportunities

- Regulatory aspects such as labelling can help with incorrect product claims
- Education of end-users in accurate use of biostimulants can help improve ROI

2.5 D 1.1.3. Identification of market potential of local seaweeds for application in biostimulants

The current status of the seaweed supply chain in Europe is in order although the supply chain can easily be over-demanded. With current positive estimations on the (seaweed based) biostimulant market growth, this status is very inconvenient. Local cultivable seaweed supply chains could form a solution but more research and information is needed as a basis to work from.

2.5.1 Drivers

- Sustainability of a cultivated seaweed supply chain
- Scalability and quality assurance of such a supply chain

2.5.2 Barriers

- Non-existent cultivated seaweed supply chain, due to a limited number of seaweed farmers
- Economic drivers towards seaweed for food markets
- Limited range of locally cultivable species
- Economic feasibility and technological knowledge

2.5.3 Opportunities

- Knowledge on the composition of various (local) seaweed species and their applicability for biostimulants
- Develop new business case models for seaweed farmers, including the holistic refinery of seaweed for food and other applications.

2.6 D 1.1.4. Stakeholder identification assessment

Many stakeholders were highly positive regarding the initiative to help companies in the biostimulant industry, identify their issues and come up with solutions. This commitment will provide a valuable asset when developing suitably tailored roadmaps and business cases. Deliverable 1.1.4 has been based on input from stakeholders, mainly via conducted interviews.

2.6.1 Learnings

- Work towards more inclusive stakeholder engagement activities
- Increase attention on the first steps of market development
- Develop construction relations between value chain stakeholders
- Develop a roadmap with obtained insights and strategies
- Realize more integral cooperation and knowledge sharing of research projects

2.6.2 Recommendations

- Improve stakeholder connectivity through vertical integration
- Invest in a lobby to develop unified biostimulant legislated
- Monetize the ecosystem services of seaweed application
- Increase resilience levels of the (local) supply chain, to handle the ongoing sector growth
- Acquire more scientific evidence and knowledge on functionalities and modes of action of seaweed biostimulants
- Governments should work towards clear regulations to enhance sustainable growth of the (seaweed) biostimulant market in the 2 Seas Region and Europe.

2.7 D 1.2.1. Feedback round: workshop on goals & strategy towards increasing usage of seaweed biostimulants

Due to the large number of enthusiastic stakeholders, the interactive workshop produced a lot of valuable information to construct an accurate roadmap. Additionally, it provided the North Sea Farm and other Bio4safe project partners with a clear perspective on the experiences and needs of existing and potential stakeholders in this market.

2.7.1 Learnings

The following learnings were obtained for future activities of the North Sea Farm and partners:

- Highly levels of interaction were well received by stakeholders and provided the Bio4safe project with a lot of useful information.
- Stakeholder group formation per category allowed for specific knowledge sharing as well as clear and often unanimous feedback.
- Stakeholder division per category can also give an insight into which subjects are still being discussed within sections of the value-chain.
- More information should be provided concerning the Bio4safe project through timely informing of interested groups on the content of the project results and plans.
- A broad array of stakeholders is essential in tailoring a successful working strategy. For practical purposes, large numbers of stakeholders should, if possible, be divided into groups by category.

2.7.2 Recommendations

Based on the above conclusions, we have come to the following recommendations for future work towards achieving and expanding a scalable, sustainable and resilient seaweed biostimulant market in the 2 Seas Region:

- Demonstration trials should be set up to convince farmers of the viability of a product.
- There should be more outward communication, alongside current stakeholder workshops and the sharing of reports on the subjects of both (seaweed) biostimulants and on progress within the Bio4safe project as a whole. The North Sea Farm can share market analyses as well as assist in connecting stakeholders within the same category.
- Projects such as Bio4safe could look into other improvements which seaweed biostimulants could provide, such as pesticide replacement/reduction or as a nitrogen source.
- Clear application manuals should be composed, as called for by scientists, biostimulant producers and end-users.
- Due to the limited experience with seaweed biostimulants in Europe, long-term experience should be obtained from countries like Brazil and Argentina, which have a lengthy history with seaweed in agriculture.

2.7.3 Input for ranking of 'building blocks for success' and subsequent comprehensive stakeholder roadmap

Each stakeholder group placed provided statements on an axis graph, ranking importance on the x-axis and urgency on the y-axis. For each building block, its average graph location between stakeholders was determined. If the spread for a building block was small, all opinions were subsequently averaged to a single position on an axis graph. If, however, opinions were more spread out, multiple positions were indicated, as seen in the figure below (figure. 5). Each of these building blocks are discussed in order, starting from most urgent and important, to gain an understanding of the implicated roadmap.

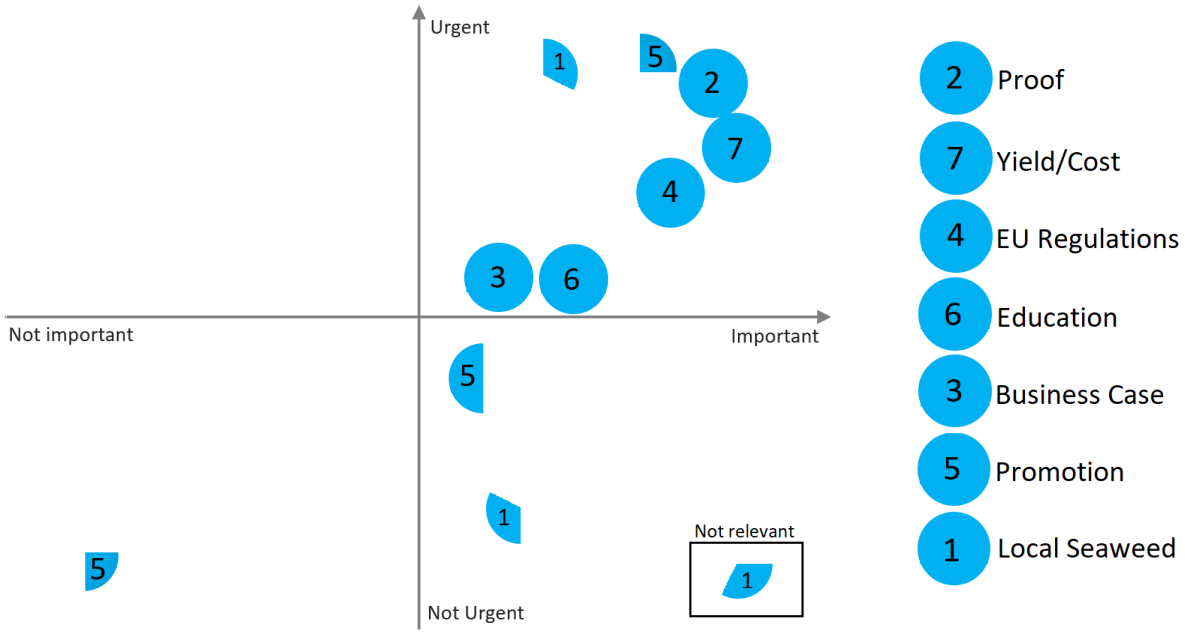

Figure 5: Final building block graph from averaged building block assessments.

Additional suggested building blocks:
The main suggested additions to the roadmap were the acquisition and distribution of more information, separate from trial proof, on the precise way in which biostimulants work. This could then be used to provide clear guidelines for end-users on how to apply these biostimulants to their crops. These additions were deemed highly important and urgent by biostimulant producers, scientists as well as end-users and were therefore recommended as being the first steps to take.

3 Results

3.1 Goals and context

As a next step, and also in preparation for the development of the roadmap in D1.2.3, all of the learnings and recommendations the reports and stakeholder interactions (also see attachment 1), as described above, have been merged into practical goals. These goals have subsequently been grouped into 7 main categories to be able to put the various goals in the correct context. All of this has been depicted in the diagram (Figure 6) below where the main categories can be identified as green blocks and the goals as yellow blocks. The goals (yellow blocks) will be elaborated on in chapter 3.1.1.

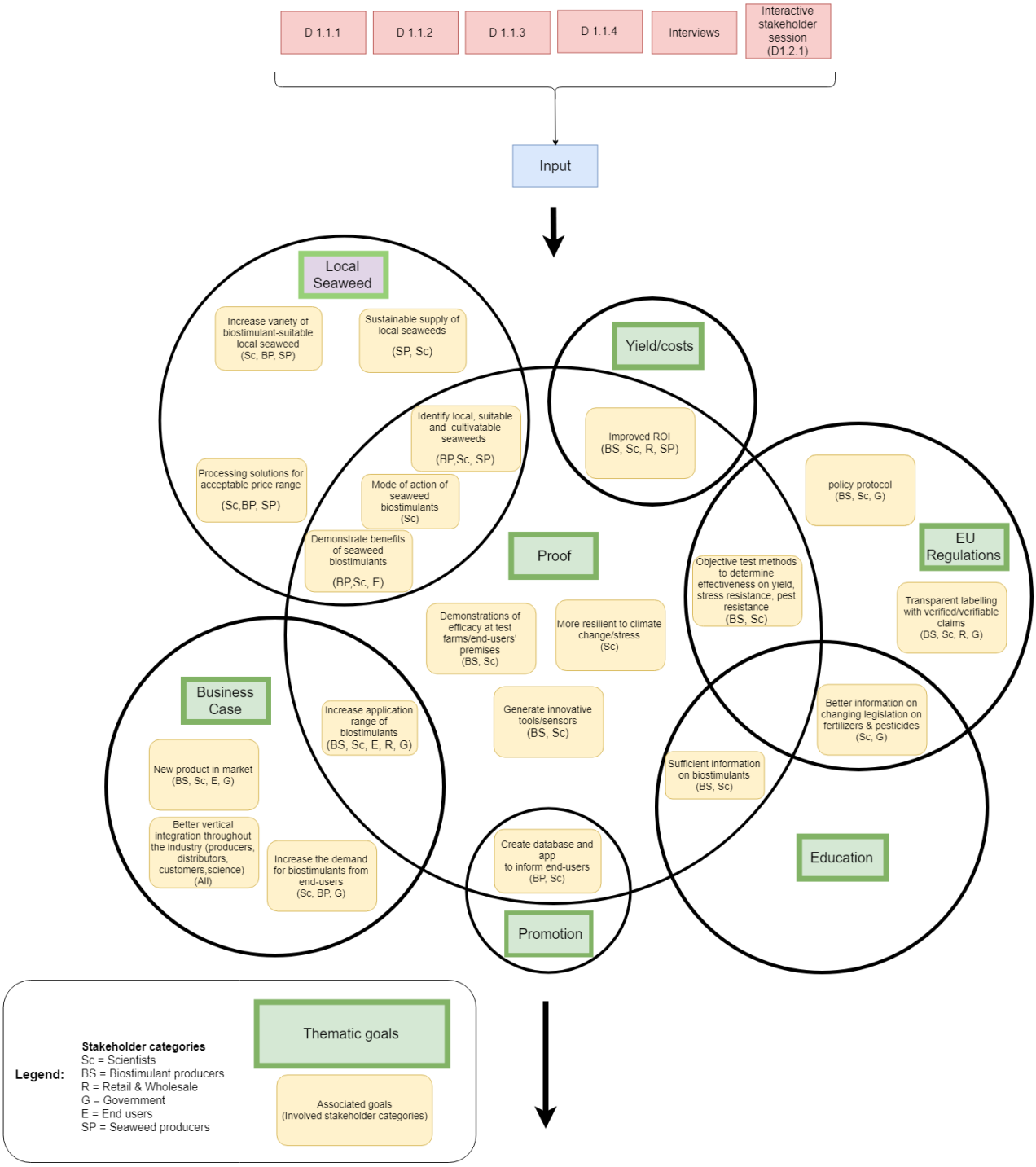

Figure 6: Suggested goals and associated goals for the roadmap, based on the previous deliverables and interviews

3.2 Goals explained

In this section, we will explain the goals (yellow blocks), grouped by their thematic goals (green blocks).

3.2.1 Proof that (seaweed) biostimulants are effective in stress resistance and yield increase

- - Demonstration of efficacy at test farms/end-users' premises -
  The most essential step in persuading farmers that the benefits of using (seaweed) biostimulants is worth the costs, is providing them with practical evidence from field trials. Trials will also help determine which biostimulant products work best as well as approach their most effective application method.
  Proof is however not restricted to trial proof but should also illustrate the precise mechanism in which biostimulants work, which is essential in establishing health legislation as well as finding other sources, extraction methods and applications for biostimulants.

- - More resilient to climate change/stress -
  As climate change is increasing the prevalence and longevity of droughts, providing agricultural and horticultural crops with resilience to abiotic stress to reduce losses for farmers will become increasingly necessary.

- - Generate innovative tools/sensors -
  By identifying and developing more sensitive tools and sensors to measure biostimulant effectiveness, their specific composition and application method can be optimized, whilst also providing policy makers with better data with which to establish regulations.

3.2.2 Yield increase should outweigh the costs of using (seaweed) biostimulants

- - Improved ROI -
  Improving the return on investment (ROI) of using biostimulants is essential in the adoption of the method by end-users. This improved ROI should be demonstrated with specific trial proof.

3.2.3 Clear and unified EU Regulations closely linked to practical application

- - Policy protocol -
  False advertisements of biostimulant effects should be strongly discouraged through setting up a protocol which dictates what proof must be provided before claims can be made. This will both increase trust in the biostimulant market as well as reduce unfair competition within this market.

- - Transparent labelling with verified/verifiable claims -
  Providing transparent labels on biostimulant products, which have demonstrated their efficacy and/or viability as per protocol, can be a valuable asset in the biostimulant market, as it weeds out underperforming or false claim- products and instils more trust in the industry. Here, again, clear and uniform regulation is essential for end-users to gain awareness on trusted labels.

- - Objective test methods to determine effectiveness on yield, stress and pest resistance -
  Scientific protocols should be established which objectively determine if a (seaweed) biostimulant product is effective and if it can live up to its claims.
  These testing methods should be included in EU-wide regulations, so as to discourage false

advertisement.

3.2.4 Education of end-users on the correct use of (seaweed) biostimulants

- - Better information on changing legislation on fertilizers & pesticides -
  As EU legislation on fertilizers and pesticides make it very difficult to enter a new product into the market, more information should be shared within the value chain on this subject, as well as on how to adjust legislation to assist the introduction of (seaweed) biostimulant products with fertilizing or pesticidal properties into the market.

- - Sufficient information on biostimulants -
  Adequate education of end-users on both the correct application of biostimulants and the legislation around fertilizers and pesticides is a valuable supporting step in increasing biostimulant adoption.

3.2.5 A business case showing the viability seaweed biostimulants

The goals, as part of this thematic goal, are applicable to biostimulants in a general sense, i.e. biostimulants made from any type of raw materials. However, as this project aims to support both the biostimulant and seaweed industries in the 2-seas region, these goals will be specifically tailored to seaweed based biostimulants:

- - Better vertical integration throughout the seaweed biostimulant supply chain (scientists, producers, distributors, customers) -
  The seaweed biostimulant industry will benefit strongly from more integral cooperation and knowledge sharing on research subjects that are part of the bio4safe program as well as clear communication on developments and needs in the (seaweed) biostimulant market and in legislation.

- - Increase the demand for seaweed biostimulants from end-users -
  By increasing demand for seaweed biostimulants, either through demonstration of their effectiveness, price or sustainability benefits, demand for suitable and preferably locally cultivated seaweeds will increase.

- - Increase application range of seaweed biostimulants -
  By expanding the application range of seaweed biostimulants in agriculture or horticulture, the demand for seaweed biostimulants and therefore the identification and production of suitable and preferably locally cultivated seaweeds will increase.

- - New seaweed biostimulant products in the market -
  By assisting stakeholders in developing new seaweed based biostimulants, based on locally cultivatable seaweeds, as well as integrating them in the market, the seaweed biostimulant industry will expand, again increasing the demand for locally and sustainably cultivated seaweeds will increase.

3.2.6 Promotion of (seaweed) biostimulant products as well as their applications and effects

- - Create database and app to inform end-users -
  An online database can provide end-users with an overview of biostimulant products, effects and application ranges and methods will improve accessibility of using (seaweed)

biostimulants, which is expected to increase the adoption rate of these products by end-users.

3.2.7 The development of a local, sustainable supply of cultivated seaweeds for biostimulants

- - Mode of action of seaweed biostimulants -
  Whilst thoroughly testing the effectiveness of seaweed biostimulants, gaining an insight into their mode of action would provide significant benefits towards achieving many other goals within the theme of local seaweeds.

- - Increase variety of biostimulant-suitable local seaweed -
  Currently the European biostimulant market is based on a single species of seaweed, *Ascophyllum nodosum*, which will become unsustainable once significant upscaling takes place since it is difficult to cultivate and is therefore only obtained through wild harvest. Increasing the variety of local seaweed, which are preferably also cultivable, is essential.

- - Sustainable supply of local seaweeds -
  For seaweed to become a viable source of biostimulants, seaweed producers must provide biostimulant producers with a steady supply of high quality seaweeds. Species identification as well as cultivation and harvesting technologies must be developed prior to or in parallel with biostimulant production and must therefore be scalable, whilst keeping the North Sea ecosystem intact.

- - Identify local, suitable and cultivable seaweeds -
  This is closely linked to the goal of increasing the variety of biostimulant-suitable local seaweeds. However, the focus here lies specifically on the identification of seaweed species which are suitable for cultivation in the 2-Seas region.

- - Processing solutions for acceptable price range -
  As seaweed produced in Asia and shipped to Europe is currently cheaper than local seaweed, various processing solutions must first be developed for seaweed farmers to be able to offer biostimulant producers local, suitable and affordable seaweed. This includes automated seeding, harvesting and post-harvest processing as well as efficient transport and storage of seaweed and should therefore be developed in collaboration with the scientific community.

- - Demonstrate benefits of seaweed biostimulant -
  Using biostimulants derived from seaweeds specifically, achieves additional benefits, including ecosystem services and ecological impact.
  By improving the health and biodiversity of the North Sea, through habitat development as well as by counteracting both ocean acidification and eutrophication, the use of seaweed biostimulants will indirectly benefit other sectors which rely on a healthy ocean, such as the fishing industry.
  Additionally, carbon sequestration and reduced ecological transport costs are climate-beneficial developments which can potentially be turned into profit.

3.3 Strategy

To formulate the main thematic (seaweed) biostimulant goals into a strategy, a successive order was determined (Figure 7). This was done using the stakeholder input obtained during the D1.2.1. interactive workshop, where these goals were ranked in order of urgency and importance.
This strategy, and the subsequent stakeholder feedback, will be the foundation from which the roadmap will be constructed.

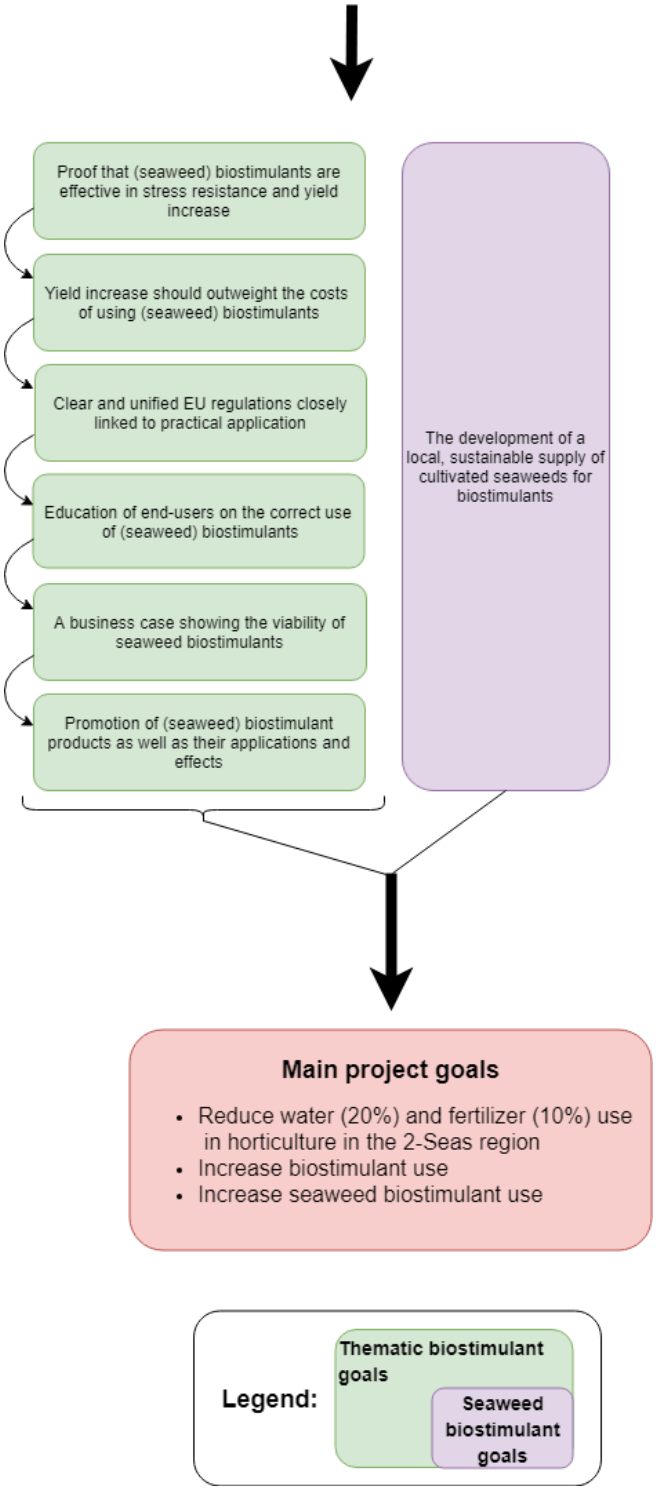

Figure 7: Thematic goals ranked by importance and urgency, determined from stakeholder feedback in the interactive stakeholder session D 1.2.1.

3.3.1 Strategy discussion

Proof of (seaweed) biostimulant effectiveness is an essential first step in working toward a successful biostimulant industry. It is inextricably linked to all other main building blocks. This is not restricted to only proof from trials but should also illustrate the precise mechanism in which biostimulants work. From trial proof, ROI can be determined and ideally improved as it is the return on investment is essential in the adoption of the product by end-users. Once sufficient scientific and practical information is acquired, stakeholders should work towards clear and unified to avoid EU regulations from becoming a barrier in the future. Combined with a standardized testing protocol, unified regulations can significantly diminish competition and/or negative press by false claim (seaweed) biostimulant products. Once a product is developed, education aimed at informing end users on how to effectively apply the product is essential to achieve product adoption in the market. Subsequently, the demand for local, sustainable and cultivable seaweed will increase, making the production of seaweeds for biostimulants more attractive to producers. To motivate seaweed producers towards this goal, a business case can be constructed which assists them in achieving the full business potential of seaweed biostimulants. Finally, promotion should persuade end-users of the viability and benefits of (seaweed) biostimulants, leading to increased demand and subsequent promotion and proof of effectiveness through end-user experience.

Since the goals of the North Sea Farm within the Bio4safe project, as determined in the application form, are built around increasing the use of seaweed biostimulants, the goal of cultivating local seaweed in a sustainable and cost-effective manner is set alongside the general biostimulant goals, creating opportunities for the seaweed industry in the 2 Seas Region. For the biostimulant industry to produce biostimulants from seaweed however, seaweed biostimulants must match or outperform other non-seaweed related biostimulants in the market. This requires processing solutions towards the developments of a sustainable supply of locally cultivated seaweeds, as well as demonstration trials proving the benefits of specifically using seaweed-based biostimulants. However, once the production of seaweed as a resources in biostimulants becomes viable, through proof and positive ROI, the subsequent goals are highly similar to those of the general biostimulant industry.

4 Conclusions & next steps

4.1 Introduction

The main objective for this report was to answer the following question: What are the possible goals and strategies towards increased use of seaweed biostimulants? (see also figure 8 below). As part of this activity we have engaged with many stakeholders via interviews and by means of a plenary and interactive stakeholder session. This has resulted in an updated version of the earlier SWOT analysis of the seaweed biostimulant market that was used to define the goals and strategy in this document. In addition, many stakeholders have indicated that they welcomed the initiatives and efforts of Bio4safe project and its objective of improving developments in the seaweed biostimulant market.

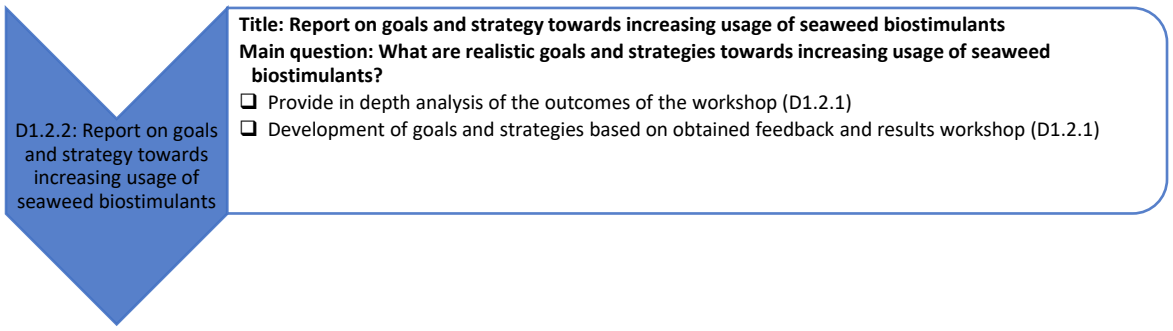

Figure 8: Objective of Deliverable 1.2.2

4.2 Conclusion

In presenting the conclusions we aim to answer the central question of this report: **What are realistic goals and strategies towards increasing usage of seaweed biostimulants?**
This conclusion comprises of three elements:

- Supporting the biostimulant market is supporting the seaweed biostimulant market
- The objectives of the Bio4safe project are relevant for the biostimulant market
- For stimulating the seaweed industry, specific additional goals are required

4.2.1 Supporting the biostimulant market is supporting the seaweed biostimulant market

One of the main learnings in preparing this report was the observations that for some stakeholders, the type of biostimulant is not relevant. Especially towards the end of the supply chain, i.e. distributors, retail and end-users. They are more focused on biostimulant products that work and which are cost effective. For them, it does not necessarily have to be a seaweed based biostimulant. Towards the beginning of the supply chain this is different. That has to do primarily with our focus on seaweed suppliers and seaweed biostimulant producers. Obviously, these stakeholders are very much in favour of seaweed biostimulants. Interestingly, the research stakeholders also seem to favour seaweed biostimulants due to its additional benefits for local economies and as a corner stone for future circular production systems.
It is considered important that all stakeholders of the biostimulant value chain feel included our anticipated efforts to stimulate the seaweed biostimulant market. And this is possible, as many of the associated goals are applicable to both seaweed and any other type of biostimulant. Therefore, our strategy moving forward will be framed in such a way that it is relevant and compelling to both “regular” biostimulant stakeholder and specific seaweed biostimulant stakeholders. That is also what figure 9 below intends to depict: the green blocks are goals that are applicable to all types of biostimulants, the purple blocks are seaweed specific/seaweed biostimulant specific goals.

4.2.2 The objectives of the Bio4safe project are relevant for the biostimulant market

As indicated above, the goals of figure 6 were derived from market and stakeholder research. We observed that these goals were very similar to activities of the Bio4safe project. Therefore, we decided to depict these goals alongside the activities (in terms of Work Packages) of the project in figure 9 below. As you can see, these match up quite nicely. Here are some detailed observations related to this diagram:

- Development of business models will provide insights in the opportunities for seaweed in biostimulants. WP1 of the Bio4safe project aims to identify these business cases, specifically for seaweed based biostimulants. Together with WP4, the EU regulation framework, this should support the further adoption of seaweed biostimulants and therefore also the increase of biostimulant use in general.
- Stakeholders indicated proper and reliable proof of the efficacy of biostimulants in various applications is paramount. In the coming year of the project, WP2 (trials with advanced sensors) and WP3 (disclosing reliable information to end-users) will provide further results of determining this efficacy with a novel (sensor) approach.
- Clear regulations and unified EU legislation. In WP4 the policy protocol addresses this and will aim to include the novel sensor performance measurement protocol as input for the biostimulant standardization process on European level.

4.2.3 For stimulating the seaweed industry, specific additional goals are required

As explained in chapter 4.2.1, certain stakeholder groups do not specifically care about the raw materials used for the production of biostimulant. Thus, by stimulating the biostimulant market you do not automatically support the seaweed market. Even more so, the seaweed market needs specific goals to support development of seaweed based biostimulants and these goals are thus not relevant for the biostimulant market. It should be stressed at this stage that it is the goal of this work package 1 as part of the bio4safe project to also develop the seaweed market in the 2-seas region. Therefore the business cases going forward will include specific goals for the seaweed market that do not contribute directly to the biostimulant market. These specific goals can be found under the thematic goal “local seaweed” in figure 7 above.

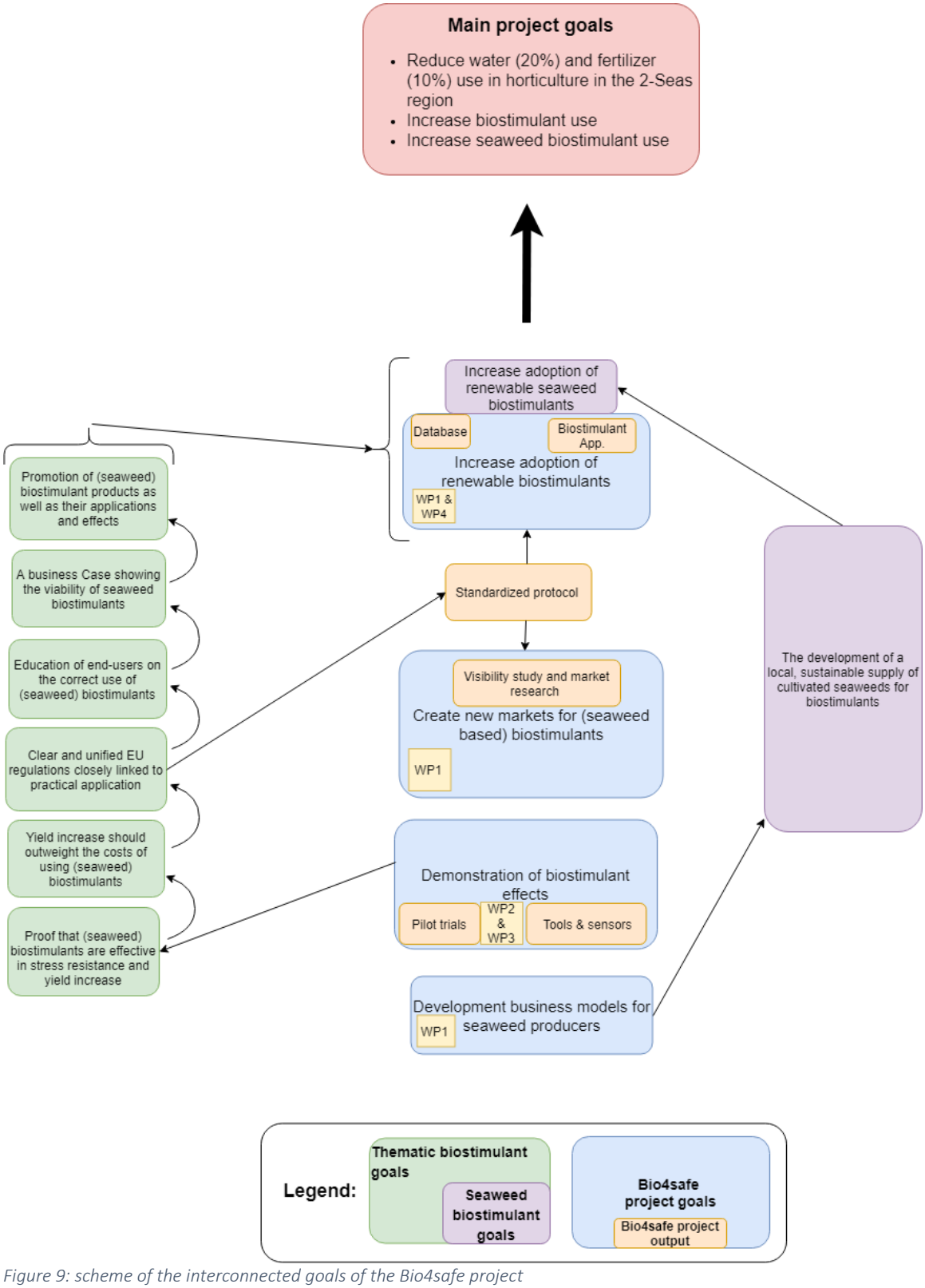

Figure 9: scheme of the interconnected goals of the Bio4safe project

In sum, bio4safe goals and goals op WP1:

- 20% reduction in water use
- 10% reduction in fertilizer use
- Increase biostimulant use
- Increase seaweed biostimulant use

These conclusive main goals of the project are illustrated and described in the scheme below (Figure 10)

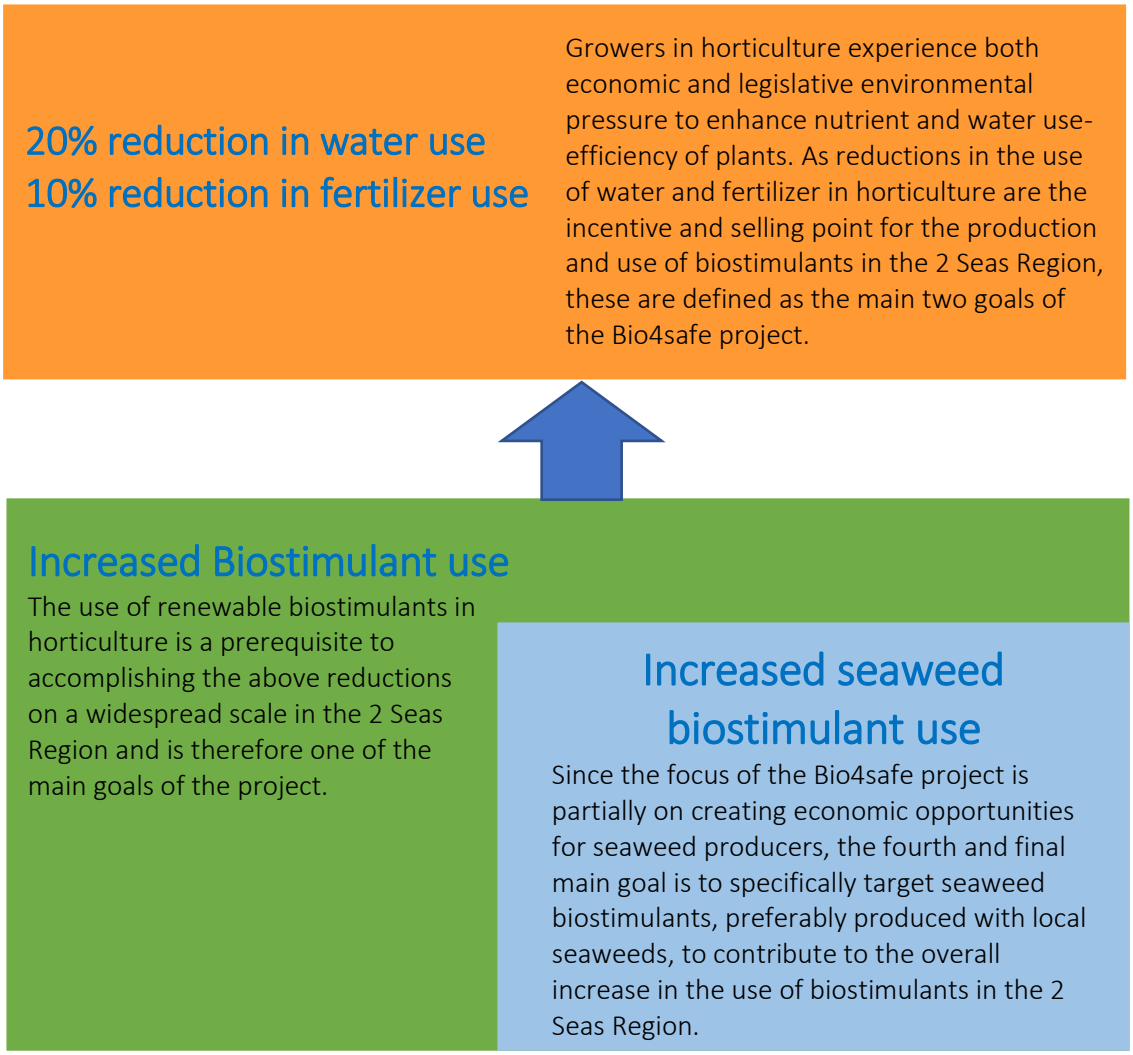

Figure 10: scheme of the main goals of the Bio4safe project

4.2.4 Next steps

Interaction with the is stakeholders is very valuable for the proposed strategy. In the follow up of this report, the NSF will ask stakeholders if the goals fit their expectations and (if needed) sharpen the goals and order of the goals and strategy.

WP1.2: Development and strategy for market penetration, Deliverable 1.2.2 Report on goals and strategy is hereby completed (figure 11). The start of the next phase is an assessment report (D1.2.3) in January 2020.

Figure 11: Next phase of WP 1.2

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Attachment 1: Interactive stakeholder session

Interactive stakeholder session

As part of the Bio4safe observer partner meeting in February 2019, the North Sea Farm Foundation, ISA Lille, PCS, & Pôle Légumes organized an interactive discussion with observer partners as well as other stakeholders attending this session. This attachment provides a short summary of the objectives of the session, applied method, results and is concluded with some brief conclusions.

Objectives stakeholder session

The stakeholder session had the following objectives:

1. To have a discussion with the stakeholders active in the (seaweed) biostimulant value chain in general,
2. To understand participants' level of knowledge on (seaweed) biostimulants, their properties and the market,
3. To exchange knowledge about the market, the price, the technical aspects, and any other relevant information,
4. To get a better understanding of the general sentiment on biostimulants, its market as well as their general potential for the future,
5. To get a better understanding of any differences between stakeholder groups in perception of the relevance of biostimulants, its markets as well as their general potential for the future,
6. To obtain suggestions and feedback on the current SWOT analysis and on the proposed key elements ("building blocks") to be used in the roadmap.

Stakeholder categories

The stakeholder session was attended by the following stakeholders:

- Proefcentrum voor Sierteelt;
- Stichting Noordzeeboerderij
- Ghent University;
- NIAB EMR;
- Yncréa Hauts de France, établissement ISA Lille;
- Pôle Légumes Région Nord;
- Proeftuin Zwaagdijk;
- Seaweed Harvest Holland
- BioAtlantis
- Icl-Group
- NLG Holland
- Plantosys
- Qlabel
- Neuryon (Akzo Nobel)
- Zeewaar
- Vlaco
- Rainbow Colors
- LTO glaskracht
- Cebeco agrochemie
- ECN-TNO
- Van Iperen

- Tomato masters
- Hortipro
- Koppert
- ISA Nanotech
- Louis Bolk Instituut
- Adama
- BSI-products
- Chrysal
- Greenyard Horticulture;
- Tradecorp

Several categories of stakeholders have been identified, based on desk research on the value chain of biostimulants. This has been executed and reported in D1.1.2. & D1.1.3. The different types of commercially active stakeholders in the biostimulant value chain have been described below in table 1. Some stakeholder categories have shown to be active in multiple segments of the value chain. Next to the commercially active stakeholders in the biostimulant value chain, there are other types of stakeholders that are involved in the topic of biostimulants. These stakeholder categories include: science institutes, governments and branch organisations.

This means that in total there were 11 stakeholder categories:

1. Seaweed producer (seaweed farmer, harvester)
2. Seaweed processor
3. Biostimulant producer
4. Biostimulant trader (trader, repackaging, rebranding)
5. Biostimulant agent
6. Retail & wholesale
7. End-user (farmers, gardening professionals, household consumers)
8. Science & Research
9. Branch organization
10. Government
11. Other

For the interactive stakeholder workshop, these categories were grouped into 5 overarching categories. This way all groups would be sufficiently represented to allow for meaningful discussion and results (table 1).

1. Seaweed producer (seaweed farmer, harvester)
2. Biostimulant producer
3. Science & Research
4. Retail & Wholesale
5. End-Users (farmers)

Table 1: Overview stakeholder categories and corresponding biostimulant value chain segments (D1.1.2. & D1.1.3.)

Overarching categories (Stakeholder session0029	Stakeholders categories	Description	Active within value chain segments
Seaweed Producer	Seaweed producer (seaweed farmer, harvester)	Cultivate or harvest seaweeds.	• Seaweed cultivation/ Wild harvest
Biostimulant producer	Seaweed processor	Processes raw material seaweeds into extracts. To be used by biostimulant producers.	• Logistics, processing & biostimulant production
	Biostimulant producer	Buying seaweed extracts or semi-final biostimulant products. Also (re)package and (re)brand to sell directly to end-users (farmers/consumers), sometimes via traders or agents.	• Logistics, processing & biostimulant production • Distribution & trading • Sales to end-users
Retail & Wholesale	Biostimulant trader (trader, repackaging, rebranding)	Buying biostimulant end-products in large quantities. Also repackage and rebrand for agents or end-users. Note: they do NOT modify the product composition itself.	• Distribution & trading • Sales to end-users
	Biostimulant agent	Can be used by biostimulant producers and biostimulant traders, as a middle man, to bring their product to retail & wholesale or directly to end-users.	• Distribution & trading • Sales to end-users • End-users
	Retail & wholesale	Sell biostimulant end-products to end-users e.g. Gamma, Home depot and Hornbach.	• Sales to end-users
End-Users	End-user (farmers, gardening professionals,		• End- users

	household consumers)		
Science & research	Science & research		
Branch organization (End User group)			
Government (Not represented at stakeholder session)			
Other (Not represented at stakeholder session)			

Methodology during session

The methodology was specifically aimed at activating the participants during this session. The aim was to identify any differences of opinion between the various stakeholder groups. For this a positive setup was employed, in which both statements, SWOT analysis and a building block exercise were used to trigger useful discussions on biostimulants. This was done as follows:

Sentiments on biostimulants as a whole

Participants were asked to raise their hands if they

Opinions on the need for biostimulants & on the Bio4safe project approach.

- **Materiality board:** A board was introduced that would allow the participants to rank or rate each statement on two main axes
  - **Horizontal:** for example from “not true” to “true”
  - **Vertical:** for example from “No Change” to “Full transition”
- **Group formation:** All stakeholders were divided into groups corresponding to their stakeholder category as presented in chapter 2.

After the group formation, the individual statements were presented:

- **Explain:** Each statement was projected on the projector.
- **Group consultation:** After presenting the statement each (stakeholder) group would discuss it for 2 minutes to determine its position regarding the statement.
- **Statement on the board:** Then, each group would position its answer, regarding the statement, on the materiality board with a post-it. As each group had its own color any differences in position would be easily identifiable. Then the group member would clarify its position on the materiality board to the participants.
- **Plenary discussion:** After all groups had put their position towards the statement on the board, the differences (if any) were discussed in a short plenary discussion.

SWOT Analysis of the seaweed biostimulant market

The SWOT analysis from deliverable 1.1.2, including input from D1.1.4, was presented to stakeholders, after which each categorical group (as presented in chapter 2) was asked to decide in a few minutes on one statement which they thought was ‘untrue’ and one which was ‘missing’. After determining these statements, groups were give a brief moment to clarify their decisions.
Finally, a few minutes were reserved for discussion of provided input by all stakeholders.

Building blocks for success: roadmap

- **Materiality board:** A board was introduced for each (stakeholder) group that would allow the participants to rank or rate each statement on two main axes
    - **Horizontal:** for example from "not important" to "important"
    - **Vertical:** for example from "Not urgent" to "Urgent"
- **Group formation:** All stakeholders were divided into groups corresponding to their stakeholder category as presented in chapter 2.

After the group formation, the individual statements or 'building blocks' were presented:

- **Explain:** Each statement was briefly exemplified.
- **Group consultation:** After presenting all statements, (stakeholder) groups received ten minutes to determine the position of each 'building block' on the axis graph.
- **Statement on the board:** Then, each group would position its answer, regarding the statement, on a private materiality board with a post-it. Then the group member would clarify these position on their materiality board to the participants.
- **Plenary discussion:** After each group had briefly clarified their output, other participants could ask some questions before moving to a subsequent group.

Stakeholder categories

As explained above, the participants were divided into 6 groups (table 2) . One group per stakeholder group and two groups for the biostimulant producer stakeholders since this group would otherwise be too crowded:

Table 2: Stakeholder groups as used during observer meeting

Biostimulant producers A
Biostimulant producers B
Science & Research
End-Users (farmers)
Seaweed producers
Retail & Wholesale

Results interactive stakeholder session

1. Sentiments on biostimulants as a whole

In figure 12 an overview of the discussed statements and positioning of the stakeholder categories is presented for the first five statements. The interpretation of these graphs is briefly discussed.

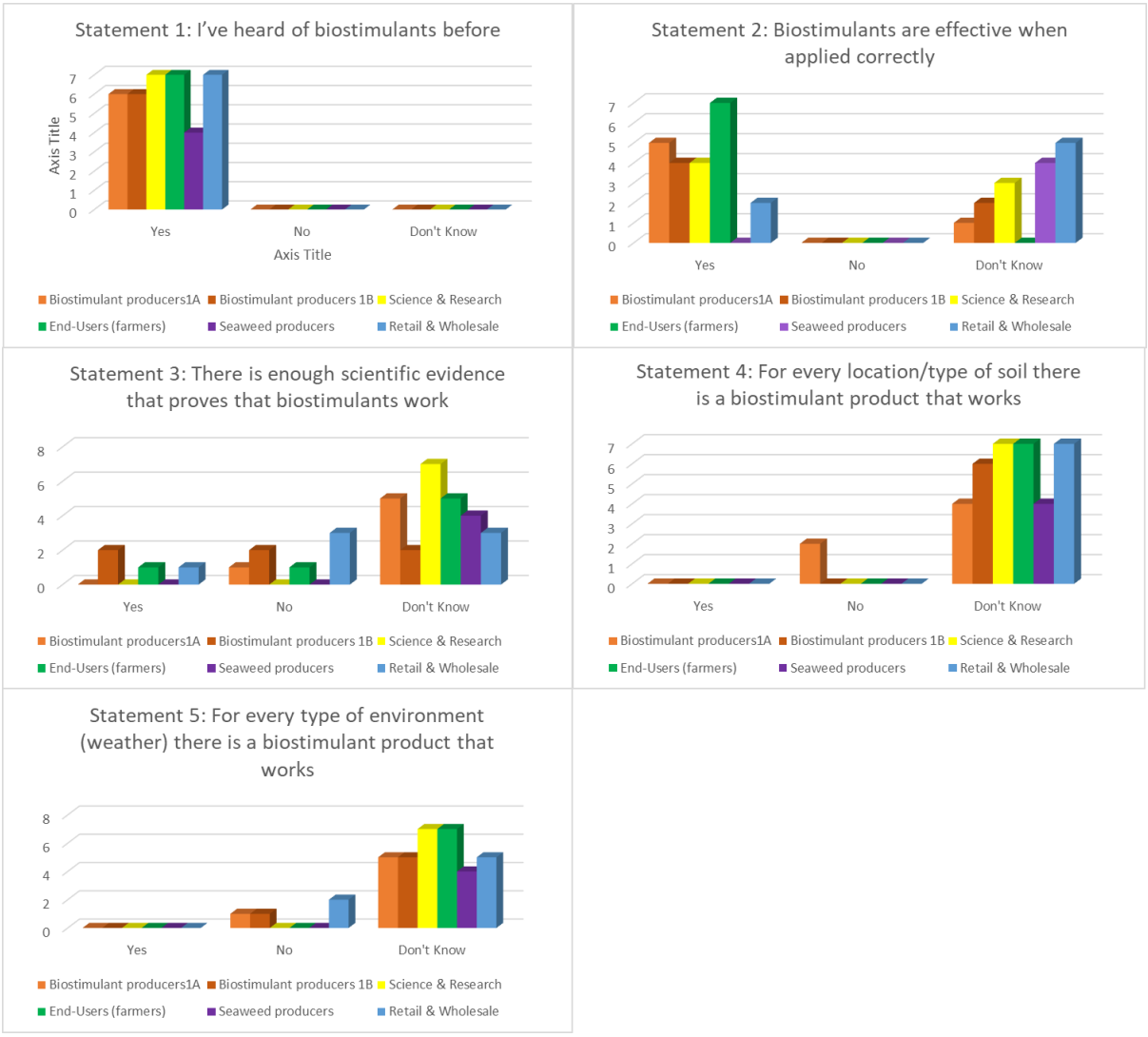

Figure 12: Overview of opinions for first 5 statements in overall biostimulant category

Statement 1: I have heard about biostimulants before.

All participants had previously heard of biostimulants.

Statement 2: Biostimulants are effective when applied correctly.

It is clear that no stakeholders are ready to write off biostimulants as of yet. However, all groups, except for the end-users, have at least partial doubts and feel like more information and proof is needed before such a claim can be made. This is significant since effectiveness is key to persuading end users to use biostimulants.

Statement 3: There is enough scientific evidence that proves that biostimulants work.

More scientific evidence is definitely required in the field of biostimulants before definitive proof of their effect can be agreed upon. Only some stakeholders from the biostimulant producer, end-user and retail & wholesaler groups have outspoken opinions and, within this collection, a majority agrees that there is not enough evidence yet.

Statement 4: For every location or type of soil, there is a biostimulant product that works.

Clearly everyone agrees that no such claim can be made at this moment. However, very few think for certain that the statement is false.

Statement 5: For every type of (weather) environment, there is a biostimulant product that works.

Similar to the response to statement 4, most stakeholders don't think there is enough evidence to make such a definitive claim. However, compared to the previous one, there are more stakeholders that are sure of the falsehood of this statement.

2. Opinions on the need for biostimulants

For subsequent statements, stakeholder groups had two minutes to come to a consensus before placing their stances on a graph. Groups with interesting positions were asked to clarify their positioning, opening a brief discussion before moving on to the next statement. The resulting graphs are depicted below.

Figure 13: This region of Europe (2seas) has perfect conditions, meaning you don't need any fancy products to increase yield

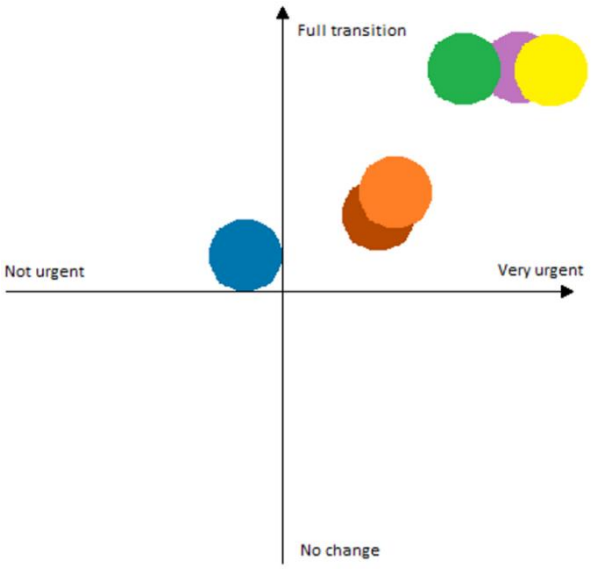

Figure 14: Today's fertilizer use is not sustainable and needs to change in the future

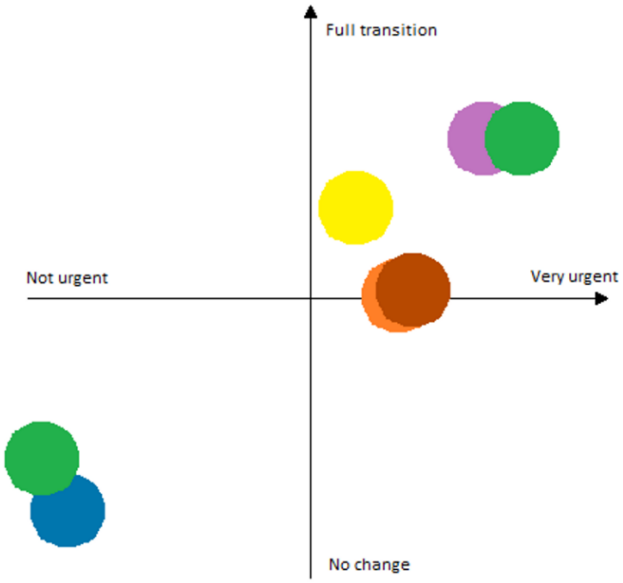

Figure 15: : Stakeholder assessment of statements on biostimulants

Figure 16: Stakeholder categories colour-coding

Statement 6: This region of Europe (2seas) has perfect conditions, meaning you don't need any fancy products to increase yield.

End-Users (farmers): Some claim that we have some really degraded soil and lack of evidence to support the claim that biostimulants are unnecessary.
Seaweed producers: Are in doubt since some areas of the 2seas region, such as Zeeland, have perfect conditions whilst others don't.
Retail & Wholesale: In the field proof by farmers shows that the statement isn't true and that we do indeed need products to keep steady or increase yields. We need solutions to this issue.

Statement 7: Today's fertilizer use is not sustainable and needs to change in the future.

End-Users (farmers): We need a transition because we use too much energy to produce fertilisers. However, the end users have no idea of how much energy seaweed biostimulant production would or what its subsequent impacts would be. This should be picked up by biostimulant producers as a sales argument.
Seaweed producers: Since phosphorus reserves are finite and there is no sustainable production of chemical fertilisers, this statement is a "no-brainer".
Retail & Wholesale: We need a change but we don't see biostimulants leading to a full transition on short notice. You will always need fertilisers for growers in the foreseeable future so it's not that pressing. An important factor that could lead us away from fertilizers will be politics. Although retailers and wholesalers want to develop faster, they have to keep a pace which their clients can follow. Currently however, biostimulants are less accessible than 'quick fix' known products for growers.
Biostimulant producers: There is a big difference between scientific and commercial evidence. We currently have scientific evidence that certain compounds have a biostimulant effect but this is very hard to translate into the field.
However, since regulations are constantly tightening, many fertiliser producers see they are losing access to more and more products, leaving farmers unsure which of these they can use in the future. "This means change is mostly driven by regulation which in turn, is driven by sustainability."

Statement 8: Today's water usage is not sustainable and needs to change in the future.

End-Users (farmers): A distinction must be made between horticulture in closed systems (where water re-use is possible) and agriculture in open fields, which do need improvement. Additionally, industry uses far more (process) water than agriculture, which is a much larger problem.
Seaweed producers: In the province of Zeeland, fresh water has to be pumped up or imported, which is not sustainable. Additionally, a lot of water isn't absorbed by crops and is lost.
Retail & Wholesale: This is a difficult questions since horticulture in the Netherlands for example has the lowest water use in the world by collecting all of their drainage water and re-using it.
The issue is not relevant here, since countries in the 2-seas region use little to no irrigation, whereas warmer areas such as the south of France have to add considerable amounts of water on a regular basis. Of course we need to improve total water usage but considering current local irrigation in agriculture water use, it's not really necessary.

3. Opinions on the Bio4safe project approach

Statements 9-12 focus on the Bio4safe approach and seaweed stimulants specifically. The protocol for these statements remain the same.

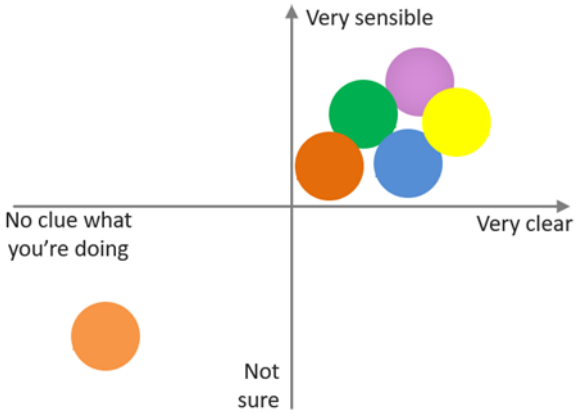

Figure 17: The approach of Bio4safe is logical and sensible

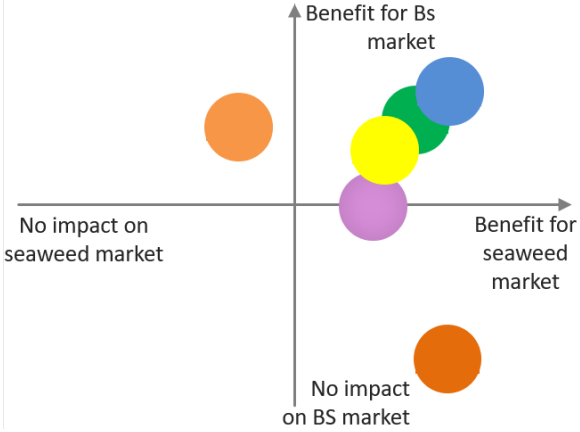

Figure 18: By focusing on seaweed BS, the bio4safe project will create a win-win for the seaweed and biostimulant market

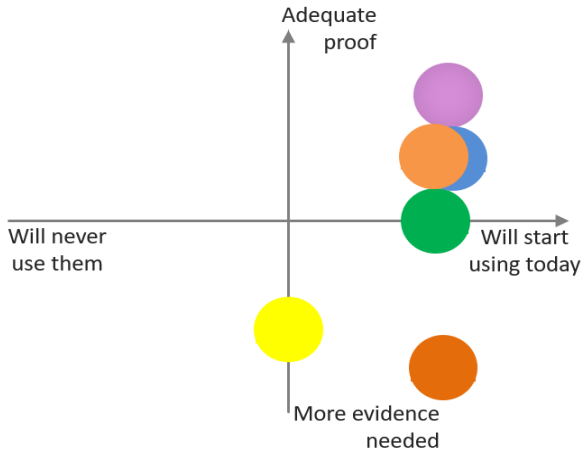

Figure 19: The future Bio4safe trial results can persuade me to start using BS

Figure 20: Stakeholder categories colour-coding

Statement 9: The approach of Bio4safe is logical and sensible.

Biostimulant producers: It might also be beneficial to consider other, non-commercially available, biostimulant products such as pure (seaweed) components. We need more details on what exactly is being done. Is this project known in the field, among farmers or other companies?
Science/R&D: A part is lacking for the approach to be sensible. The last step should be making sure that farmers get truly convinced of using seaweed biostimulants by demonstrating there is something financially in it for them. The best way to convince farmers is to perform demonstration trials at their farm or that of their neighbours.
Seaweed producers: Companies are evolving quickly due to regulations. End-users move at a slower pace and need more persuasion, since the use of biostimulants requires more knowledge than the use of fertilisers.
Retail & Wholesale: The method is clear but information which is already available is constantly being re-discovered. The sensors-component of the project however is quite interesting due to its novelty.

Statement 10: By focusing on seaweed BS, the bio4safe project will create a win-win for the seaweed and biostimulant market.

Biostimulant producers: Half of the group (B) states that this depends on the outcome of the trials and is thus specific for seaweed. This does not perform away the possible effects of biostimulants but could have a negative effect on receptivity to biostimulants from other sources. They are hopeful this project will open up the market, in which it is currently difficult to introduce new products.
End-Users (farmers): It is not so clear what the definition of biostimulants are for many end-users.
Seaweed producers: It is unsure if the demand for seaweed will grow if the biostimulant demand grows as an result of this project. Is there sufficient engagement with companies, Since companies are currently more into food, maybe it is difficult to establish sufficient engagement.
However, due to the currently very small market size, almost any attention is favourable to none.
Retail & Wholesale: The key to improvement in the market is communication.
However, they question if having local seaweed improves this market.

Statement 11: The future Bio4safe trial results can persuade me to start using BS.

Biostimulant producers: Half the group (B) want to use biostimulants, presuming they work. Due to the many different kinds of soil and environmental pressures, there is a considerable demand for more evidence, from a legislative perspective. The outcome of the trials can be used for other trial setups but for the market, more information is needed.
Science/R&D: We are unsure what farmers need to be convinced, since farmers are less “curious” than scientists and don’t feel the need to investigate everything.
Seaweed producers: Local seaweed species (*Ulva lactuca* and *Saccharina latissima*) are currently not used as biostimulants and the extraction process needs to be improved. This project is a first step but even after its completion, we don’t expect any immediate market effects. An important condition is that the trials are similar to the final system of seaweed biostimulant production and use.
Retail & Wholesale: Perhaps there is the need for slightly more evidence but a lot of valuable evidence is already available. These trials could still be worthwhile but the formulation of the experiments is essential in determining if the results will be used or not.

4. Statement conclusions interactive stakeholder session

Similar to the previous stakeholder meeting, the interactive session was an enjoyable and informative way for participants to provide feedback. This format of interactive session with stakeholders and observer partners will therefore be continued in future workshops.

Participant feedback clearly voices agreement on the following:

- The need for biostimulant products as a (partial) replacement of chemical fertilizers.
- The regulation-driven nature of this change, which is in turn driven by sustainability.
- Need for more proof on the cost-effectiveness of seaweed biostimulants and the clear communication of this trial-based proof.

On other points, participants indicated issues and offered some insights into how they think these should be addressed. These issues revolved around:

- Which areas require the use of biostimulants.
- How insufficient communication concerning (specificity of) trial results and what exactly constitutes a biostimulant might negatively affect the entire biostimulant market.

These points are valid and will be considered in the subsequent roadmap activity.

SWOT analysis of the seaweed based biostimulant market

In the earlier deliverable D1.1.2 the SWOT analysis for the seaweed based biostimulant market was introduced. This provided an overview based on the desk research as well as several stakeholder interviews that had been performed at that stage (mid 2018). The SWOT analysis made a distinction between the general/global market and the EU/2-seas region as the latter is the focus of the Bio4safe project.

Since then more stakeholders have been approach by means of

- In depth interviews (see D1.1.4)
- Online stakeholder session (see D1.1.4)
- Interactive stakeholder sessions (see D1.1.4 and 3.5 and onwards)

Based on this new input this SWOT analysis will now be reviewed and updated. To this end chapter 3.6.1 presents the SWOT analysis from D1.1.4., SWOT 2. Chapters 3.6.1.1 to 3.6.1.4 describe the new stakeholder feedback in terms of strengths, weaknesses, opportunities and threats.

SWOT 2 – based on desk research & stakeholder interviews and interactive stakeholder sessions

As indicated above, in the report D1.1.4: Seaweed Biostimulant Market, the SWOT overview as seen below was included. This SWOT analysis was presented to the stakeholders in which each group had to single out one statement which they completely disagreed with and provide a statement which they thought was clearly missing, after which they were asked to briefly clarify their decisions.

Table 3: SWOT analysis of seaweed biostimulant market (General & Global and European and 2 Seas Region level), based on interviews and interactive stakeholder sessions (D1.1.4)

Strenghts	**Weakness**
S1. Availability of high quality & sustainable seaweeds S2. Well informed market players	W1. Limited knowledge when and how to use biostimulants properly W2. Very few and non-cultivatable seaweeds are being used for biostimulants
Opportunities	**Threats**
O1. Market demand for biostimulants is growing O2. Growing momentum to change to more sustainable production methods O3. Local cultivatable seaweed species may also suitable as biostimulants	T1. Inconsistent legislation for biostimulants in the EU T2. False claims on benefits and effectiveness of biostimulants

*Review of the **Strengths** compared to stakeholder feedback*

Table 4: Stakeholder assessment of strengths

Strengths
S1. Availability of high quality & sustainable seaweeds – – – – S2. Well informed market players – –

Biostimulant producers: The market does not contain players which are well informed.
Science/R&D: S1 is not a strength, it is also a weakness since harvesting is currently not sustainable.
End-Users (farmers): Feel both not sufficiently informed and that the current method of wild seaweed harvesting is not sustainable.
Seaweed producers: There is not a sufficient abundance of seaweed to render wild seaweed farming sustainable. They compare the current state of seaweed cultivation with a “Gas station without gas”.
Retail & Wholesale: Think that there is no sustainable harvest of seaweeds without production through cultivation.

Stakeholders clearly state that there is currently insufficient availability of high quality and sustainable seaweeds. (See 1.1.4. nodosum). However, in collaboration with seaweed producers, the North Sea Farm is rapidly moving towards the production of sustainable seaweed in the North Sea. Once the demand increases, growers will naturally expand their business. Additionally, we see there is a large amount of wild seaweed (such as *Asparagopsis nodosum*), which can be harvested sustainably through quinquennial harvesting.
Seaweed biostimulant producers do not agree that the market players are well informed and end-users indicate that they feel under-informed themselves. By improving reporting and knowledge distribution towards stakeholders, we hope to achieve better transparency of the project and keep the community informed and engaged. This will also help to avoid mis-interpretation of results, which could otherwise negatively impact unrelated parts of the biostimulant or seaweed industry simply by proxy.

*Review of the **Weaknesses** compared to stakeholder feedback*

Table 5: Stakeholder assessment of weaknesses

Weakness
W1. Limited knowledge when and how to use biostimulants properly
W2 Very few and non-cultivatable seaweeds are being used for biostimulants
+ Complexity of biostimulant use
+ Lack of knowledge on seaweed active components
+ No clear view on cost-effectiveness

Biostimulant producers: The complexity of using biostimulants is a significant weakness. There is a strong call for clear application manuals for every biostimulant.
Science/R&D: There is a lack of knowledge of the effect and active components of seaweed. This knowledge would help screen for useful seaweeds.
End-Users (farmers): It is still unclear whether seaweed biostimulants are cost effective.

Both biostimulant producers and researchers indicate the complexity of understanding and using biostimulants. However, whereas scientists call to understand the underlying mechanisms and bioactive compounds, producers take a more practical approach and require clear application manuals for every biostimulant. Both of these points can fall under W1, stating that there is limited knowledge on proper biostimulant use. Through a combination of practical trials and innovative sensors, the optimal effectiveness, and therefore cost-effectiveness, of various commercially available seaweed biostimulants is researched from a practical perspective. This does however not address the need for an improved understanding of the bioactive compounds and mechanisms leading to these observed effects.
The few species of seaweeds which are currently being used as biostimulants, combined with limited number of commercially cultivatable seaweed species severely restricts possibilities of cost-effective and sustainable upscaling. This weakness is exactly why local cultivation of seaweed is essential for the widespread and long-term use of seaweed biostimulants in European agriculture.

*Review of the **Opportunities** compared to stakeholder feedback*

Table 6: Stakeholder assessment of opportunities

Opportunities
O1. Market demand for biostimulants is growing
O2. Growing momentum to change to more sustainable production methods
O3. Local cultivatable seaweed species may also be suitable as biostimulants
+ New opportunities to gather and share information across partners

Biostimulant producers: There is an opportunity to gather information across partners and make it available, in which case biostimulant producers are willing to cooperate.

The proposed opportunities, which are the main drivers of the project itself, are mostly agreed upon by stakeholders. The biostimulant market growth can be attributed to the ever increasing need for sustainable solutions to current agricultural issues such as drought, overuse of chemical fertilizers and other forms of abiotic stress. The challenge of finding suitable local cultivatable seaweed species is both an opportunity and a weakness, since failing to achieve this will severely hinder the cost-effectiveness and upscaling possibilities of seaweed biostimulants in the 2seas region.

As mentioned, biostimulant producers do not feel that market players are well informed and instead label this as an opportunity within the project. Precise research and clear communication of the results is necessary before the full potential of seaweed biostimulants can be achieved. The North Sea Farm and other Bio4safe partners must therefore find a way to improve outward communication of these results, alongside the current stakeholder workshops and sharing of reports.
An additional opportunity, proposed by biostimulant producers, is the possibility of EU legislation to improve transparency of the biostimulant industry, whilst removing false claims through regulation.

*Review of the **Threats** compared to stakeholder feedback*

Table 7: Stakeholder assessment of threats

Threats
T1. Inconsistent legislation for biostimulants in the EU ⊖
T2. False claims on benefits and effectiveness of biostimulants
⊕ Difficulty for new players and new products entering market
⊕ Insufficient amount of seaweed
⊕ Bad influence on entire biostimulant market if seaweed underperforms

Biostimulant producers:
Group A: It is difficult for new players to enter this new market with their products. They don't have a clear view where to position these products compared to fertilisers, pesticides, etc.
Group B: Think T1 isn't a threat but an opportunity since legislation might make biostimulants more transparent, regulated and remove false claims.
Seaweed producers: There is not enough seaweed to start using them as biostimulants.
Retail & Wholesale: If trial results show products are not effective or otherwise underperform, this will have a bad impact on the market.

From the previous market analyses and stakeholder session, regulations/legislations were often mentioned by almost all stakeholders as a major issue. Predominantly (seaweed) biostimulant producers perceived this as an issue since they need to get products admitted to the market. The absence of distinct regulations or inconsistencies between various markets and countries makes this particularly difficult.
One group of biostimulant producers echo this point by stating that new players have difficulty entering new products in the market as a lack of clear legislation makes it unclear where biostimulants stand compared to fertilizers, pesticides, etc. However, other biostimulants would characterize the current lack of legislation as an opportunity instead of a threat, as improved transparency through legislation can remove false claims from the market.

Another threat, this time brought up by seaweed producers, is the upcoming shortage of sustainably harvestable seaweed. As long as suitable cultivatable species are not determined and produced on a large scale, the market cannot reach its full potential.

Finally, retailers and wholesalers warn that underwhelming or even negative results from the Bio4safe trials could have detrimental effect on the entire biostimulant market. This ties back to the need for clear communication from the Bio4safe project partners towards the stakeholders and the industry as a whole. If the project scope and methods are clearly defined and communicated, this threat can be diminished.

5. Building blocks for success: Roadmap

Roadmap per stakeholder group

Each stakeholder group was given 7 sticky notes, each represent a statement on potential key elements (designated as "building blocks") in the roadmap determined by Bio4safe. Each group placed these statements, as well as one optional "missing building block" as identified by themselves, on an axis graph ranking importance on the x-axis and urgency on the y-axis. The results will be represented in the final report as seen in the example below.

The following were the provided statements:

1:**Local seaweed**: availability of local, cost-effective & sustainable seaweed supply chain.
2: **Proof**: that certain seaweeds are suitable as biostimulants.
3: **BuCa SW-biostimulants**: business case that shows that seaweed biostimulants is a viable market with growth potential.
4: **EU regulation**: for a level playing field for biostimulants in Europe.
5: **BS promotion**: of the benefits of (seaweed) biostimulants.
6: **BS education**: Better information towards end-users on how to use biostimulants successfully.
7**: BS Yield/Cost**: Higher yields with biostimulants and/or lower cost, i.e. better return ratio.
+: Optional additional statement

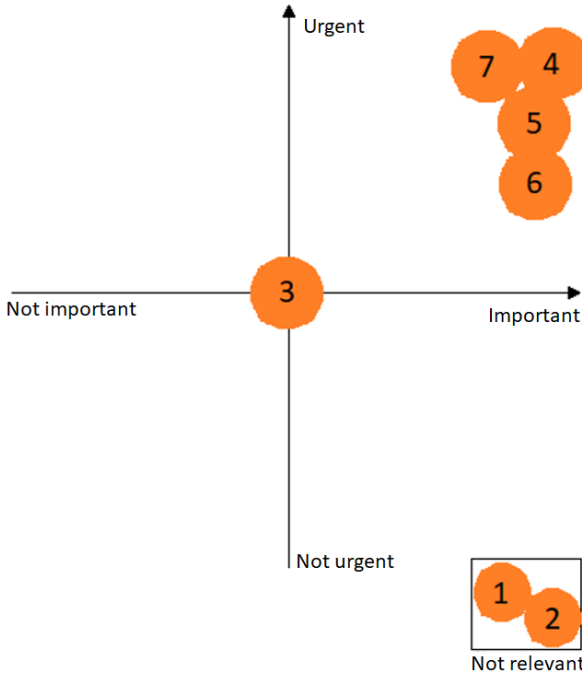

Figure 21: Building block assessment by biostimulant producers (group A)

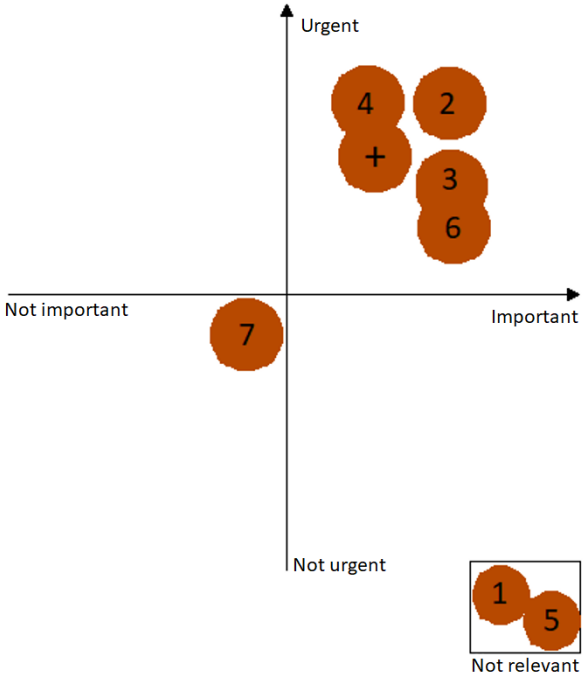

Figure 22: Building block assessment by biostimulant producers (group B)

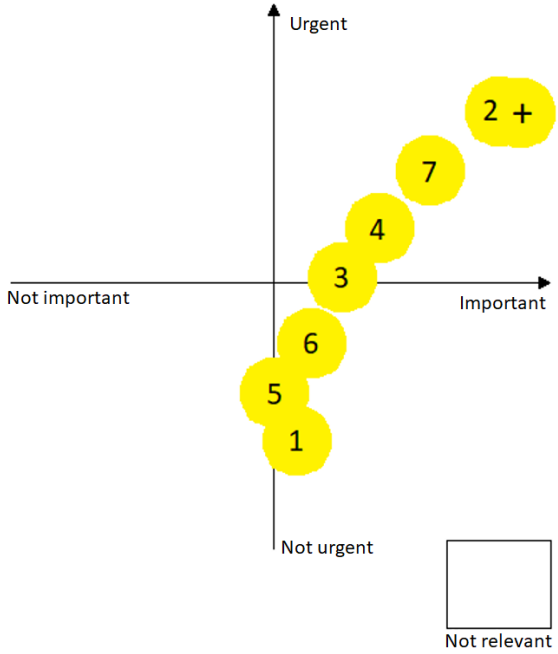

Figure 23: Building block assessment by scientists

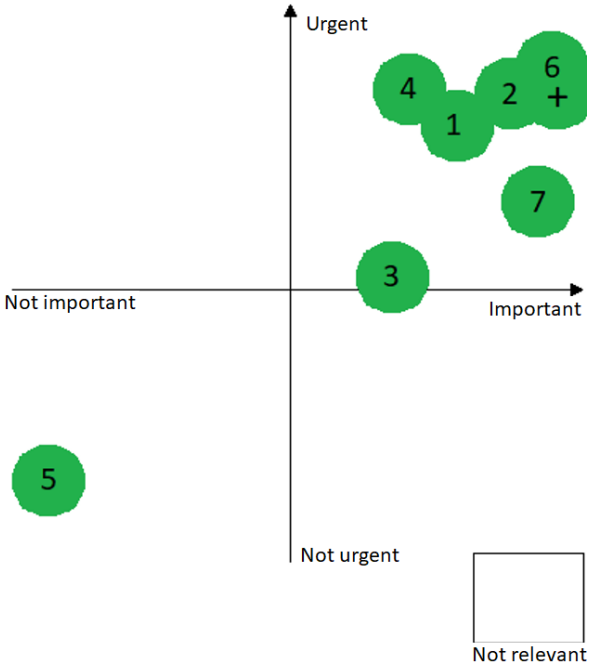

Figure 24: Building block assessment by end-users

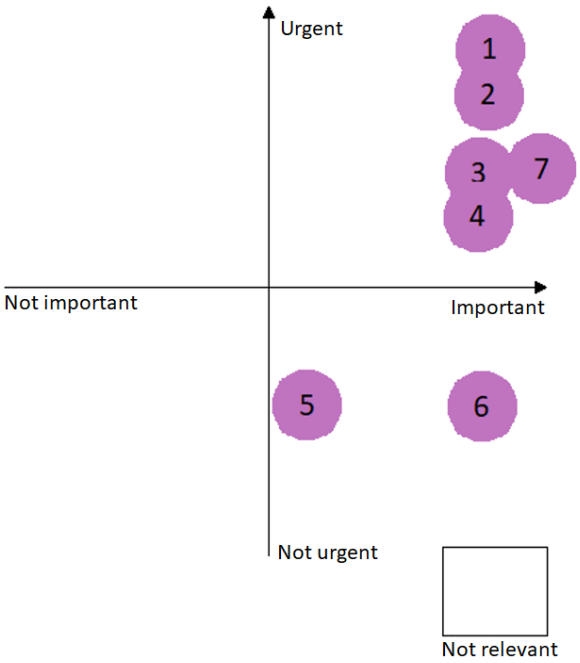

Figure 25: Building block assessment by seaweed producers

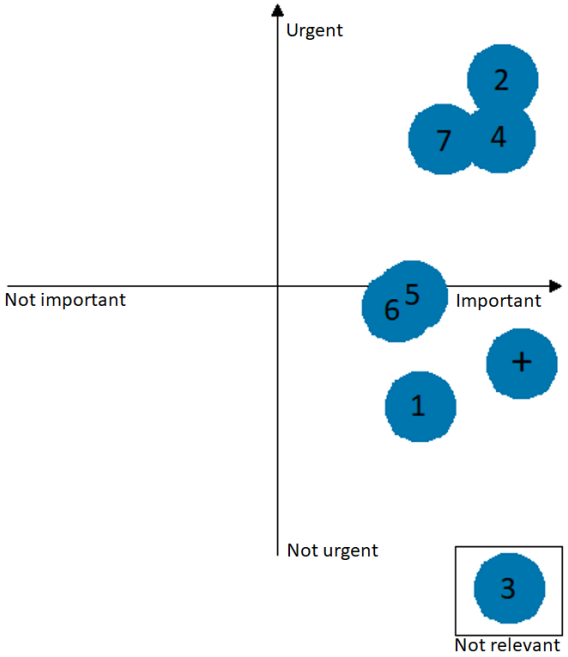

Figure 26: Building block assessment by retailers & wholesalers

Figure 26: Stakeholder categories colour-coding

Stakeholder group roadmap discussion

Biostimulant producers A:
By first creating a market through EU regulation and by demonstrating a higher cost effectiveness compared to other products, the other steps will gradually follow.
What is currently not relevant is that the seaweed is locally produced. Naturally harvested seaweed can also be sustainable and considerably easier to obtain.

Biostimulant producers B:
Missing step: There is a strong need for more information on the subject of seaweed biostimulants, not just proof.
Proof is important but the origin of the seaweed is less relevant. What is important is that it works in a competitive market setting. This is then followed by constructing a business case and through education, which are also quite important yet less urgent.

Science/R&D:
Missing step: The identification of active ingredients.
The science & research group see the building blocks as a logical sequence. Since it is best to start with proof and look into the mode of action and identification of the active ingredients, experimental research is essential to determine if seaweeds work effectively and consistently as biostimulants. This can open up opportunities to look at local seaweeds for biostimulant production. First however, economics must be considered. This includes the viability for biostimulant producers as well as what's in it for the farmer. With sufficient proof, the ROI should be efficiently calculated, after which EU regulations should be made to allow you to enter the market and work on a business case. Finally, education and promotion, which are currently less urgent, become important once proof and yield benefits are determined. These are essential to getting the product to sell. Of all building blocks, the origin of seaweed is the least important.

End-Users (farmers):
Missing step: The practical experience of end users is both an urgent and important focus to have. This is only surpassed in importance and urgency by education.
Promotion is much less important than proof the concept works in practice so the initial targets should be proof and education.

Seaweed producers:
Although education and promotion are very important, the focus should first be shifted towards proving that local seaweed works effectively, after which the viability should be confirmed by making both a business case and ROI, which are highly interconnected.

Retail & Wholesale:
Missing step: There needs to be awareness of the possibilities of seaweed biostimulants amongst end-consumers, not only amongst producers.
Proof and EU regulations are most important and urgent, as well as calculating a yield/cost or ROI study. The latter is not necessarily important for everyone, since producers will not have the luxury of choice. Since education and promotion are the next logical step after this, they are less urgent.
The business case is not relevant for this group since both retailers and wholesalers already have most of this knowledge and are also already convinced that this is a large and growing market.

Local seaweed can be important, since it reduces transport time and costs. However, aside from agreeing it isn't urgent, there isn't a clear consensus on the issue.
Finally, it could be interesting to make the customer more aware of the many different uses of seaweed biostimulants. This is important but perhaps not so urgent.

Learnings

The following learnings were obtained for future activities of the North Sea Farm and partners:

- Stakeholders were very positive about the frequent interactivity of the workshop, which made them more willing to participate in discussions, providing Bio4safe with a lot of useful information.
- By forming groups per stakeholder category, individuals of each group could share their specific knowledge with similarly interested people. This combination of common knowledge and shared interests often led to fast and relatively unanimous responses to the proposed statements.
- Despite the previous point, splitting up a single stakeholder category into multiple groups can also lead to vastly different responses. This can depend on the heterogeneity of the stakeholder group or simply be due to individuals with strong worded opinions.
- The main critique of stakeholders in all categories was the lack of provided information from the Bio4safe project. If this is anticipated and updates are shared with interested groups adequately beforehand, this will be less of an issue and the focus can lie more on the content of the project results and plans.
- The large number of stakeholders led to an interesting array of opinions which can significantly help the NSF and Bio4safe in successfully tailoring their working strategy. As long as individuals are divided into groups by category, it should remain possible to gather fast and clear answers, even from large amounts of people.

Recommendations

Based on the above conclusions, we have come to the following recommendations for future work towards achieving and expanding a scalable, sustainable and resilient seaweed biostimulant market in the 2 Seas Region:

- Demonstration trials should be set up to convince farmers of the viability of a product.
- There should be more outward communication, alongside current stakeholder workshops and the sharing of reports on the subjects of both (seaweed) biostimulants and on progress within the Bio4safe project as a whole. The North Sea Farm can share market analyses as well as assist in connecting stakeholders within the same category.
- Projects such as Bio4safe could look into other improvements which seaweed biostimulants could provide, such as pesticide replacement/reduction or as a nitrogen source.
- Clear application manuals should be composed, as called for by scientists, biostimulant producers and end-users.
- Due to the limited experience with seaweed biostimulants in Europe, long-term experience should be obtained from countries like Brazil and Argentina, which have a lengthy history with seaweed in agriculture.