

Building a new Norwegian industry for large-scale kelp cultivation, for the market in the food industry:

A case study of innovation and sustainability transition
in agrifood systems



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ABSTRACT

Creating more sustainable food production and changing the agrifood systems are essential to mitigate climate change and provide more food for future needs. Seaweed and species like kelp from cultivation have several advantages in food production, both for health and flavour, and it has become a key factor regarding future food security. In several European countries, like Norway, actors are working on building new aquaculture practices for kelp cultivation and creating value chains and new markets for human consumption.

This thesis explores this Norwegian innovation process and industrial building in aquaculture with kelp for food consumption may be heading towards becoming a sustainability transition in the agrifood system. By looking into this new sector in Norwegian aquaculture and investigating the market they need to scale up production and succeed.

The study shows that this sector has been growing in numbers and production volume and shows incumbent niche interaction, and a bigger impact from incumbent actors that may now accelerate a transition is in motion. There seems to be a market in the Norwegian food industry, but there are certain factors that have to be solved on the production side in order to succeed. One big actor is now creating a market and accelerating the need for kelp in the food industry, that others may follow. Consumers' demand push for this food will also create a market for the kelp and for the cultivation businesses.

The impact of sustainability, with SDG and climate targets, will likely be even more important for businesses and change the strategies towards opportunities like kelp. The use of the oceans with sustainable aquaculture is in the spotlight on the national and international agenda, and this will probably lead to change in a more sustainable direction and make new actors come into this business.

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1. Introduction

Creating new and more sustainable food production and changing the agrifood systems is essential to mitigate climate change, loss of nature, and ecosystem problems and provide food for human consumption (FAO, 2021). The need for sustainable and healthy food will be vital when the global population rises to 9 billion by 2050. Ocean space will be essential in increasing human food production when agricultural land is scarce. Humans now use about 40% of land space but only 2% of the oceans (IPBES, 2018). Seaweed and species like kelp from cultivation have several advantages in food production, both for health and flavour, and it has become a key factor regarding future food security (Barbier et al., 2019). It may also be a factor in solving global challenges regarding energy use, health issues, and sustainability.

In several European countries, like Norway, actors are working on building new aquaculture practices for kelp cultivation and creating value chains and new markets for human consumption (Araujo et al., 2021). We now have the most significant number of actors in this new industry in Europe (Araujo et al., 2021), but this new business is still small, and production needs to be scaled up (Broch et al., 2019). Having the second-longest coastline in the world gives Norway an enormous potential for kelp cultivation at sea (Edvardsen et al., 2017). Finding or creating markets and providing kelp food consumption is one of the bottlenecks facing this new industry.

This thesis explores if this innovation process and industrial building in aquaculture with kelp for food consumption may be heading towards becoming a sustainability transition in the agrifood system. By looking into who these Norwegian aquaculture actors are and investigating the market, they need to scale up production and succeed the Norwegian food industry. How this industry responds to the prospects of using this raw material in production is essential. Because the large actors in the food industry may play an essential role in contributing to the demand side push, changing diets in a more healthy and sustainable direction, and creating food innovations that meet new consumer trends (EAT-Lancet, 2019). This study investigates how the concept of sustainability impacts development and the role these actors may have.

1.1 Oceans of opportunities

Sustainable use of the oceans and their role in mitigating climate change are key factors in the Paris Agreement and the UN Sustainability Goals (SDG). SDG no. 14 calls on the world's focus on “*Life below water: Conservation and sustainable use of the oceans, seas and marine resources for sustainable development*”. The importance is underlined with the initiative, UN Decade of Ocean Science for Sustainable Development. A project with a focus on science policy to reverse the decline in ocean health, on sustainable development (Ocean Decade.org, retrieved, 11.06.2022), promoting productive oceans with sustainable food supply and ocean economy through transformative ocean science.

Statistics show that 1 million tons of wild seaweed were commercially harvested in 29 countries, from cold to tropical coastlines in 2016 (Babier et al., 2019). 32% of this biomass was harvested in Latin America, and 26,9% in Europe where Norway is top producer with 15,5% of the global harvest of kelp (Barbier et al., 2019). This is mainly the production of alginate production from harvested wild Curvie (Arujo et al., 2019). In addition, Norwegian small-scale producers are harvesting seaweed and making products for niche markets and the growing interest in this raw material is also due to the adaptation of new food trends like sushi to our diets (Altintzoglou et al., 2016).

There is a need to transition from wild stock seaweed harvesting to aquaculture production to meet the growing demand and avoid the overexploitation of wild resources (Araujo et al., 2021). Kelp cultivation does not compete with space for food production for human consumption, with cultivation at sea in salt water. The production is without the need for freshwater and pesticides, so it has the potential to become a sustainable food source if handled right (Torrissen et al., 2018). Seaweed, like kelp, is loaded with vitamins and contains the fifth “umami flavour” used by culinary professionals to enhance flavours in dishes and can be used as a substitution for salt with its natural saltiness. Kelp may also be an essential source of biofuel, food for livestock, bioplastic, well-being, ecosystem management, or can be used in medicine (Barbier et al., 2020). Seaweed and kelp play an essential ecological role in coastal systems as one of the most productive habitats on the planet and are vital to maintaining (Barbier et al., 2020).

The Norwegian Government has highlighted the ocean as an area with enormous potential for innovation and growth in sustainable food production. As a significant actor in fisheries and aquaculture and the world's second-largest seafood exporter, with a solid maritime sector, research, technology, and management of our ocean space (Blue Opportunities, 2019), they seek to promote this development. Once salmon farming was a small business but today, it has become one of our largest export industries and something we now find on most Norwegians' dinner plates but not without problems concerning sustainability and production volumes (Aarset et al., 2020; Hersoung, 2021). Maby the future will show a new significant Norwegian aquaculture sector in kelp cultivation with a new sustainable trajectory.

This new field in aquaculture now has a Seaweed Manifesto that outlines a sustainable path for this new sector on a global scale. Initiated by Lloyd's Register Foundation, and UN Global Compact, with contributions from academia, business, non-governmental organisations and UN agencies that outline a vision for this new industry. *“Upscaled, responsible and restorative practice. Playing a globally significant role in food security, climate change mitigation, and support to the marine ecosystem, as well as contributing to job creation and poverty alleviation.”* (Seaweed Manifesto, 2020). This may lead to a different trajectory for this new sector if the actors follow this vision.

Today about 32Mt macroalgae were cultivated globally in 2016, according to the UN Organization for Nutrition and Agriculture, and 99% of this production takes place in Asia (Barbier et al., 2019). Sugar kelp (*Saccharina latissima*) is, by 2021, the most produced species by aquaculture in Europe and also the one that has been mostly grown by the sector in Norway (Araujo et al., 2021). Building a new Norwegian sector for aquaculture involves several challenges related to controlling of nutrients of kelp and technical challenges related both to growing, harvesting and post-harvesting processes (Almås et al., 2019). But nevertheless, the kelp industry in Norway is lifted having a high potential to become a leading producer of macroalgae if they succeed with this process started.

1.2 The aim of the study

A successful development of a kelp cultivation industry for human consumption is dependent on a domestic market in the food industry. The study aims to provide more knowledge about the actors in this new Norwegian industry and what factors driving this new trajectory are needed in order to create sustainable products and maybe provide changing agrifood systems. How leading actors in the food industry are working towards their future market in regard to using kelp to create new healthy products is a question this study seeks to answer.

Research shows that sustainability drives innovation in the food industry (Grimsby, 2021). To what extent can we find this among the leading actors in the conventional food industry, and can kelp be an ingredient that may enhance this process is in question. If new consumer trends and preferences for sustainable food like kelp contribute to an acceleration of innovation in the food sector, thereby creating a domestic market in the Norwegian food industry.

When upscaling production volumes and use of kelp, it has the possibility to become more than a niche and small scale commodity for Norwegian food consumption. So far, mostly used by consumers with particular interest in healthy food or in the seafood, vegan or vegetarian segment. By looking into the conventional domestic food industry, kelp may also reach a larger part of Norwegian consumers through both the products the industry already is making more healthy or in new products, meeting new food trends. The big actors in the Norwegian food industry may need larger quantities and can act as a driving force for development.

What is the scenario for the development in the future - how will it be in ten years? Will it be possible to create a sustainable industry with a Norwegian value chain? How and to what extent is sustainability integrated in their business strategies, is a question to be answered in this thesis. The thesis also analyses if this new trajectory can be a sustainability transition in agrifood systems using the theoretical framework Multi-Level Perspective (MLP) (Geels, 2019). This development may require changes in socio-technical systems, meaning production methods, market, and changing user practices, which will be looked at in this exploratory study of this sector.

These transformations in the socio-technical systems, in this context, agrifood systems, includes primary agricultural production of food and non-food products from crops,

livestock, fisheries, forestry, and aquaculture (FAO, 2021). The UN provides definitions on a sustainable agrifood system as a system that deliver food security and nutrition for all, maintaining the livelihoods of the agrifood actors without the risk of destroying the economic, social and environmental base for the future generations in concern with food security and nutrition. A sustainable agrifood system needs to both be profitable and beneficial to society and have a positive or neutral impact on the natural environment (FAO, 2021).

Creating new value chains of production, work in coastal areas, in kelp cultivation and use may have an impact on health and food security, ecosystems and CO₂ emissions. In the case of kelp, successful development and upscaling of the industry volume and use incorporates multiple dimensions and actors in aquaculture - the food industry, - policies and regulations, changing user practices and regulations, industry structure, technology, and market.

Applying the innovation theory MLP, will efficiently explain mechanisms in play in developing new trajectories. The MLP framework is now paying more attention to the role of incumbent actors in these transition processes, and a majority of the informants represent this type of actor. The aim will also be to explore the role of these actors in the process of developing a new aquaculture sector. In the food industry, demand-driven innovation may explain to what extent changing consumer trends/preferences serve as a potential driver for innovation towards the incorporation of kelp in their products. Demand-side solutions may play an essential role in sustainable shifts and transitions.

“Diet shifts, as another demand-side strategy, are even more impactful in the food sector. Estimated annual GHG emission reduction by 2050 associated with dietary shifts to low meat, vegetarian or vegan diets” (Creutzig et al., 2022).

This thesis also explores how the actors regard sustainability and how it may impact future development. Because changing our food systems is lifted as one of the crucial factors in providing more and healthy food (Eat-Lancet, 2019); in combating climate change and nature degradation (FAO;2021), a study of possible trajectories in the Norwegian kelp aquaculture sector and their needed market in the food industry will contribute to understanding how sustainability transitions may come about in the case of cultivation,

production for food. The following research questions below will be used to answer the scope of this thesis:

Research questions:

How will Norwegian kelp cultivation actors use the potential for kelp farming on the coast of Norway and create sustainable food for the future? Who are these new actors?

How will Norway's food industry use kelp in their production to create healthy and more sustainable food and meet new consumer trends?

How is sustainability, and the UN Sustainability Goals SDG, impacting business development in the food industry and kelp sector?

The answers from two levels of actors will answer the fourth research question:

Will this new sector development and creation of value chain, production, and potential market, become a future sustainability transition in the agri-food system?

1.3 Delimitation

In order to understand the objective of this study, a delimitation is important. The diverse and complex world of seaweed and kelp consists of many levels and practices for both harvesting, cultivation and use. This study does not explore actors harvesting kelp or the production of small-scale food products from this business. The thesis is limited to Norwegian actors cultivating kelp meant for human consumption and use of conventional actors in the Norwegian food industry, and it seeks to answer the overarching question of this case as an example of a process heading towards being a sustainability transition with changes in the socio-technical system and changing agrifood system.

Using a case study allows in-depth focus on a case; here, kelp cultivation sectors and actors in the food industry. Using a case study as an empirical method that investigates a phenomenon (the case) in a real-life context which has been done in this thesis (Yin, 2018), with the study of actual stakeholders in these cases studied. Where the objective is to describe experiences, thoughts, meanings, and insight from experts in companies in the kelp field and

from main actors in the Norwegian food industry, building a new sector and value chain for kelp production and use for food consumption in Norway will require changes in the socio-technical system. When the industrial development in the kelp sector in Norway is ranked to be the most advanced by 2021 (Araujo et al., 2021). It is believed to be a good case to show what mechanisms have been vital for the development so far and what it will take to advance and scale up productions, and create a market for sale and use in the food industry. This research and outcome may be a contribution to innovation and transitions studies on similar processes in this sector or similar in the agri-food systems.

1.4 Structure of the study

Preceding the introduction part, outlining the topic, context, problem statement, research questions and delimitations, it will proceed with the following content. A presentation was placing the study on kelp for food in a framing of the academic literature and policy. An interesting point will be the biology and use of seaweed and kelp for numerous use. How humans have used this historically and how we, especially in Europe and Norway, make use of seaweed today is essential in understanding how the market and consumers may embrace this food. Outlining how the two business sectors are studied, kelp cultivation and the food industry is important in understanding how this trajectory may evolve. Research on the field and politics with ocean policy supporting future sustainable solutions is also essential factors in understanding future development of the case.

Using a theoretical framework in the study is important in order to understand and frame the case that can be applied in other academic studies explaining sustainability transitions and changes in the sociotechnical systems presented in chapter three. In research on sustainability transitions, the theoretical framework created by Frank Geels, The Multi-layer Perspective (MLP) (Geels, 2019) provides the relevant theory for the analysis of a new industry and value chains for kelp for food consumption. The MLP describes patterns in socio-technical transitions, using innovation and the interactions of different levels with processes, pathways and actors. The more prominent role of incumbent actors and demand-side solutions will be studied. The study will also apply the concepts of sustainability and outline the historical context and impact, and use the UN Sustainability Goals (SDG), a framework for sustainability, to explore how this impacts business trajectories. This will provide an important context to the development of the case being studied. In chapter four, the research

methodology is presented. Methods used, how the data collection process was conducted, scientific standpoint and reflections and challenges concerning the methods used.

Chapter five outlines the finding collected mainly with experts interview and in addition to multiple sources of evidence. Findings in the sectors of actors is divided into sections that have been coded and are analysed thematically in order to create a good and clear basis for the analysis part. Here, the analysis will be done thematically, and the two-sector of actors are merged, and answers analysed together in order to answer the research questions and ... In the last part, the conclusion will summarise the finding of the study and suggestions for further research. This outline for the case study aims to provide a description of a phenomenon that may be used to analyse similar processes within research on sustainability transitions.

2. Situating the thesis in its policy and academic literature

This chapter reviews available literature on the kelp field, biology, research, history, and how people have used this for food and other applications, use literature and reports on the different sectors discussed in this thesis, the Norwegian food industry, aquaculture, and the role of policy. It will be useful in understanding, analysing, and exploring possible trajectories concerning Norwegian kelp cultivation and using this raw material in the food industry.

2.1 Seaweed biology and use

Seaweed is found in all coastal areas on the planet and all climate zones. Like plants, they carry out photosynthesis using sunlight to produce carbohydrates and energy (Mouritsen, 2013). The word seaweed is a popular term that is applied to the larger group of marine algae, macroalgae. Algae are divided into two groups, macroalgae and microalgae. The last are tiny microscopic unicellular organisms divided into various groups, often floating (Mouritsen, 2013).

Macroalgae are fastened to the seabed or the surface of other organisms such as mussels, and there are about 10 000 different species of marine macroalgae. They are classified into three major groups, brown algae (*Phaeophyceae*), red algae (*Rhodophyta*), and green algae (*Chlorophyta*). Mouritsen, in his definition (2013), uses both seaweed and macroalgae interchangeably, which is also being used in this thesis. Kelp is an umbrella term for large brown algae according to Mouritsen's definition, and the species is mainly used in the cultivation practices in Norway. On the Norwegian shores and sea, we find 400 species of brown, red and green seaweeds (Stevant et al., 2017), a perfect place for aquaculture with cold water temperatures. Brown algae species like winglet kelp and sugar kelp are primarily grown in the new cultivation sector in Norway (Stevant et al., 2017).

Macroalgae and kelp may not only be a good source for food and flavour, which is mainly looked into in this thesis. A long list of possible areas can use these marine resources, due to

macroalgae being a good source of vitamins, minerals, proteins, and lipids, it is a good choice as a component for skincare. Seaweed is also used as a texturing stabiliser or colouring agent in cosmetics. The antioxidant compounds can be used in medicine, such as in the treatment of neurodegenerative diseases like Alzheimer's and Parkinson's (Barbier et al., 2019).

The use of algae in anti-cancer or anti-inflammatory activities is being explored by researchers when it comes to the excellent effect of seaweed. In addition, seaweed is used as fertiliser for crops in many countries, traditionally also in Norway. The use of seaweed for this purpose claims to promote higher seed germination and the ability to increase yield and make crops resist some diseases (Barbier et al., 2019. p. 25). Seaweed used in bioplastic will give us an alternative to petroleum-based plastic that now contributes to a high level of waste in the oceans and takes decades to desegregate (Wayman & Niemann, 2021). In addition, seaweed has an important function in coastal ecosystems, supporting complex food webs, serving as food for marine organisms, and protecting from light and predators. These plants also serve as a coastal defence against sea-level rise and erosion (Barbier et al., 2019).

Estimates show that marine algae and plants may be responsible for more than 70% of the world's carbon storage, even when they only cover 2% of the sea surface (Barbier et al., 2019). In this context, large-scale seaweed cultivation fields may potentially be used in both mitigations of acidification and to reduce CO₂ excess in the atmosphere. Uptake and removal of nutrients is another factor that seaweed contributes to. By cultivation of kelp, for example, kelp can be used for the uptake of nutrients from salmon farming. Since kelp cultivation does not compete with space for food production for human consumption, cultivation in salt water without the need for freshwater and no pesticides used with may be a sustainable process (Torrissen et al., 2018).

2.2 Consumption of seaweed and kelp

For food consumption, the nutritional values in macroalgae, fibres, minerals, proteins, low fat, and low lipid level may contribute to balanced diets both for humans and animals (Barbier et al., 2019). Kelp contains Omega 3 and 6, different vitamins, protein, fibre, calcium, iron, and magnesium, and substances like iodine and heavy metals cadmium and arsenic (Blikra et al., 2020). Making the raw material ready for use in the food industry by removing iodine and other potentially toxic components and delivering a safe product, ready

to use as an ingredient in the food products, is a task in research projects. Iodine reduction has been tested through different sequences, and heat treatment alone shows a clear decrease in iodine (Løvdal & Skipnes, 2022). The same treatment may be best for the removal of toxic components like heavy metals in some kelp species to secure food safety.

Traditionally, seaweed is widely used in diets in Asia, in countries such as Japan, China, Korea, and the Philippines. Both are due to their rich flavour and nutritional value (Stevant et al., 2017). In Asia, many cultivated macroalgae are also used for food consumption. In China, more than 70 edible species are reported in the Chinese diet, but only a few of these are approved in the EU. In Europe, we do not have the same tradition of consuming kelp in our food diets. In European countries, seaweed consumption has been limited to the coastal communities historically, and only a few regions have their own culture using seaweed in diets. But in the latest years, we have seen a growing interest from consumers, and it has been made available in stores and restaurants (Torrissen, 2018).

Traces of humans eating algae also goes back to the earliest time in the North European countries when people settled after the last glacial period between 12,000 and 8900 BCE (Mouritsen, 2013). Using seaweed for food both for people and animals. Later we found use in Norway, consumption of dulce was widespread in coastal areas, and something that has also been used as a trading commodity in Iceland since the 700s. Islanders, and most likely the Norwegians too, according to Mouritsen (2013), ate fresh dulce baked in bread to make the flour last longer and dried dulce as a sort of snack.

Seaweed was mixed with butter and served with dried fish or cooked potatoes. The Norwegian Vikings brought dried seaweed along to their long journeys as provision. Dulce was brought on these journeys to protect them against the medical condition of scurvy, and due to its high contents of vitamins could prevent this, according to Mouritsen (2013).

The use and consumption of seaweed were for centuries linked to times of hardship. In Iceland, when the times were hard, they had to eat other types like winglet kelp. Winglet kelp was also used for feeding animals. On the Faroe Island, there is a saying about a person that dies in poverty; “He was laid in his grave with a piece of seaweed in his mouth.” (Mouritsen, 2013).

In Norway, seaweed was widely used for animal feed in coastal areas. When the grass grew poorly, seaweed was a considerable nutritional value for animals. Seaweed has traditionally

also been used for the production of salt, both from the ashes of burned seaweed and from drying seaweed. Seaweed is also used for medical purposes. Sugar kelp (*Saccharina latissima*) was for example used for alleviation of plugged ears, and extract from marine algae was also used as a cure for sea sickness and hangovers (Mouritsen, 2013). Large amounts of kelp was burned and used to extract iodine to provide protection against diseases and lack of nutrition. After 1930-thies the iodine factories was closed, and we found other sources for this mineral (SNL, retrieved 12.05.2022).

In the latest years, small-scale producers have started harvesting and using kelp for mostly high-end niche products such as salt flavoured with kelp and in various products like pasta and spices creating the fifth taste of “umami”. With new food trends like sushi, vegan diets, and a focus on health, this ingredient is getting more attention among consumers. Kelp can be used as a substitute for salt in food products and is well known for enhancing flavour with the so-called “umami” taste (Mouritsen, 2012).

2.3 Food trends and consumer preferences

New food trends with sushi have brought some types of seaweed to European plates. In Scandinavia, the renewal of the Nordic cuisine with high-end restaurants like we have seen lately with the underwater restaurant “Under” at Lista, based on local natural ingredients. This has triggered the interest in seaweed in the world of gastronomy, according to Mouritsen (2012). It's the so-called umami flavour the new nordic cuisine is using to create new culinary experiences. They were described as the fifth basic taste in 1908 by the Japanese chemist Kikunae Ikeda, along with the classical four: sour, sweet, salty and bitter. Umami is the chemical compound glutamate, which we find in the Japanese seaweed konbu, and thereby widely used in Japan (Mouritsen et al. 2012).

Seaweed used for innovative flavouring or as a salt substitute now seems appealing to European consumers. We find that 37% of seaweed-flavoured food and drink products launched in Europe between 2011-2015 were in the snack category, according to Mintel's Global New Products Database (Babieri et al., 2021). Other top product categories with seaweed were sauces and seasoning, bakery products and soups. Food and drink products that contain seaweed ingredients increased by 147% in the same period on the European market. This leaves the European market as one of the most innovative regions globally using seaweed flavouring in drinks and food and thereby outrunning both North America and Latin America (Barbieri, 2019).

Exploration into Italian consumers' attitudes and perceptions towards seaweed with a group sample of consumers. 76% of the sample expressed a positive view toward eating seaweed. Palmieri & Forleo (2020) explain this may be due to tradition in Italy using seaweed in some traditional dishes in some of the regions or impact from the Asian kitchen with sushi. One explanation for this willingness is consumers' increasing interest in healthy food and more sustainable alternatives. In Australia, a study of the future seaweed consumer in western countries conveys that consumers with higher education and who are concerned with symbolic values for food consumption and health doubled the likelihood of eating products made with seaweed (Birch et al. 2018). Recently, Norwegian consumers' preferences also have been investigated and showed that Norwegians are positive towards kelp, especially in the group with young, highly educated and environmentally conscious persons with knowledge of sushi (Goavaerts et al., 2022).

In a study, Norwegians reported higher food innovativeness than the Japanese in a study looking at these two groups' preferences on sushi (Altinzoglou et al., 2016), which Norwegian consumers have adopted widely the lastest year. Recent research show the challenges on the market providing seaweed and kelp for food consumption to the European market including potential consumer skepticism due to unfamiliarity, and barriers concerning food safety and quality preservation quality (Blikra et al, 2021), all bottleneck that is under study in different research projects in the sector.

2.4 Aquaculture - the cultivation of kelp

Cultivation of kelp is a new practice in Norway, and the first license was given in 2014. According to statistics from the Directorate of Fisheries, it has risen from 54 licenses in 2014 to 520 licenses in 2021. The county of Nordland and Vestland is where most are given, with a total of 457 licenses of the 520 licenses in hand. The most used macroalgae species in production by 2021 were sugar kelp, oarweed and winglet kelp. Twenty-seven companies are involved in cultivation, up from 10 companies in 2015 (Directorate of Fisheries, 2022).

This development is also shown in production volume in the sector, from 60 metric tons in 2015, to 338 metric in 2020 (Directorate of Fisheries, 2022). With this, Norway is the country with the highest number of kelp aquaculture companies due to the strategic work in the sector by research institutions industries and public authorities to develop the cultivation of seaweed (Araujo et al., 2021). When we look at the worldwide production of macroalgae, it has increased by 6,8% every year over the last ten years, to a total production of. Thirty million

Mtons globally in 2016, according to FAO (2019). Most of this production is still dominated by Asian countries, which account for 99,4% of the quantity produced (Barbier et al., 2019).



Fig. 1 Seeding on rope on the production site of Arctic Seaweed. Photo. Solfrid Sande

The current status of these new aquaculture practices in Norway (Stevant et al., 2017) emphasises the need for upscaling the industrial production, implementing new farming strategies, new technology, and handling biomass when harvested and processed logistics. As well as an automated seeding process, monitoring biomass, and improvement in economic sustainability (Araujo et al., 2021). Estimates show the potential by 2050; the Norwegian market can produce and distribute products based on kelp and seaweed for 40 billion NOK annually (Almås et al., 2019). The report underlines the huge possibilities to develop new markets both in Norway and for the global export of kelp (Almås et al., 2019) and is something that will be a possibility for some of the Norwegian actors.

The negative effects of fish farming on the environment with waste utilising nutrients requires new solutions where kelp provides a possible solution. An integrated multi-trophic aquaculture system (IMTA) with seaweed function as an extractive component for these nutrients and help reduce the environmental impact of intensive fish farming (Stevant et al., 2017). When the salmon and trout production is predicted to rise annually by 3-5% over the

coming decades, measures to reduce nutrients and environmental impacts such as eutrophication and the ecological degradation of this production are needed (Stevant et al., 2017). These ecosystem services may be partly provided by the new kelp aquaculture industry.

The status of macroalgae production in Europe shows that the main production is still from harvesting, 68% (Araujo et al., 2021). Upscaling production volumes, technological challenges and market development are highlighted as key drivers for development. The macroalgae and microalgae producers are now 225 in number, whereas macroalgae producers dominate (Araujo et al., 2021). Most of the seaweed companies we find in Europe direct their production toward food, and several species are being sold for direct consumption or being used as condiments as dressing, sauces, canned seafood, pasta or bread by European food producers (Araujo et al., 2021).

2.5 Food industry in Norway

The other sector investigated in this thesis is the Norwegian Food industry. This industry is dominated by large companies when it comes to the scale of production, finance and workforce. On the list of the largest Norwegian actors in the food industry, we find both actors in seafood, dairy and meat production, beverages, and other food brands in the market. Four of these largest actors in the industry are also the same informants in this thesis.

Kårstad & Pettersen (2021) defines the food industry as the production of processed products/goods from agriculture and aquaculture for food, feed, and beverages for both humans and animals. This definition is based on the “Standard for næringsgruppering (SN 2007) in the statistics used by SSB. (Kårstad & Pettersen, 2021). The food industry has a growing share in an industrial sector that has been declining, with considerable growth for the last eight years, mainly due to the success of Norwegian seafood (Kårstad & Pettersen, 2021).

Grimsby et al. (2021) describe an increasing interest in plant-based food products due to new consumer preferences when they looked at sales in this food segment for the last five years. They show how innovation in the production of plant-based food products has increased sales from 2016 to 2020. The UN Sustainability Goals (SDG) have highlighted the importance of sustainable food production, and the Eat Lancet report the same on a healthy diet that is more plant-based. Sustainability can be seen as an important driver of innovation in the food industry over the last five years (Grimsby et al., 2021). But in this segment, Norwegian-made, plant-based products have a poor representation, with few of these

innovations still on top sales after four years, dominated by foreign manufacturing and soy-based products (Grimsby et al., 2021). This shows the innovation potential in this segment.

For the food industry, these value chains are developing and changing, with future scenarios that show consumers' views on the industry-made food will likely change (Kårstad & Pettersen, 2021). Consumers will be more critical of a long and often complex list of ingredients that may be difficult to understand and use too much sugar or salt for better taste. The report emphasises the industry's technology and knowledge to change towards meeting these changing consumer preferences with products that apply to health, dietary advice and sustainability challenges (Kårstad & Pettersen, 2021).

2.6 Research development on kelp

The research field in seaweed and kelp is emerging internationally when we look at the number of publications on the field. A search for scientific articles on Google Scholar shows that articles on sugar kelp (*Saccharina latissima*), the species most produced in the new aquaculture sector, show 3080 publications on this topic published between 2018-2022. In comparison, the number on the same topic was 2900 publications in almost twenty years, from 2000-to 2018, which confirms this rising interest in seaweed.

In Norway, several research projects involving research institutions in ocean science and food science have been involved projects on kelp. R&D, transectactoral, from aquaculture producers, researchers, actors in the business, and policymakers, are involved in exploring and investigating the opportunities for upscaling and commercialising kelp production with different research projects with the aim to help develop this new industry. SINTEF Ocean has looked at the possibilities and terms for cultivating kelp and points out that to get things going, technological expertise from the offshore sector and aquaculture industry should be used, and also to develop co-production of kelp and offshore wind using the same area. Using open sea will bring about production on a larger scale, with estimates of 20 000-ton per km² in wet weight. This opens for larger scales than will be feasible in the fjords and near the coastline (Sintef, 2019).

Blikra et al. (2021) provide an overview of the challenges in providing seaweed to the European market and present solutions to both technical challenges, microbiological hazards, and consumer scepticism. In a new study on environmental life cycle assessment (LCA) of

kelp from Sweden showed that more carbon was captured by photosynthesis than emitted when being cultivated and preservation methods, where the ensiling process was found to have the lowest impact by using less energy (Thomas et al., 2021). This is to shed the light potential carbon sequestration potential of kelp and its role in the nutrient loop. Thomas et al. (2021) point to the need for further research into downstream processing of kelp into market-ready products, and draw a comparison to raw material kelp may try to replace. This is to ensure that seaweed production is environmentally friendly, and optimising the use of LCA will be important for development (Thomas et al., 2021).

The new SusKelpFood - Sustainably cultivated kelp for the food industry project is a three year research R&D project funded by The Research Council of Norway starting in December 2021. Supervised by Møreforskning and The Marine Research institute, with attendance from the kelp cultivation sector and food industry. This is a transsectoral project with a goal to test and develop new methods for sustainable production of cultivated kelp for the Norwegian and European food industries. Production and creation of new sustainable value chains in the aquaculture and food industry. Value chain analysis, sustainability, technical development, and post-harvesting processes. Bottlenecks for development like food safety, nutrients, and the product's sensory properties, iodine, and process technology are under research by attendance at the Marine Research Institute and The Norwegian food research institute, Nofima (Moreforsk.no, retrieved, 11.06.2022).

2.7 Politics - sustainability and ocean policy

To develop a new field and the role of politics play a part. The Solberg Government's ocean strategy "Blue Opportunities" (2019) points at kelp farming as one focus area. With the SDG and commitments in the Paris Agreement in focus, storage of carbon and sustainable management of nature and industry development in mind. As a major actor in fisheries and aquaculture and the world's second-largest exporter of seafood, Norway has developed a strong maritime sector, research, technology, and management of the ocean. They seek to promote innovations by supporting research and technology development across the ocean industries. Secure market access and support the promotion of Norwegian ocean industries abroad in this strategy (Blue Opportunities, 2019).

As one of 14 member countries on the high-level panel for a sustainable economy, "The Ocean Panel" takes the sustainability goals as the foundation in their work to preserve and seize these great opportunities that lie in this field. Building alliances and framework for a

sustainable future for the world's ocean (Ocean Panel, 2020). The Norwegian prime minister Jonas Gahr Støre is now in charge of the Ocean Panel. The new government, “Hurdalsplattformen”, outlined a plan to meet goals in the Paris Agreement, Klimaplan for 2021-2030 (Regjeringen, 2019), and points at the food industry as an important factor in contributing to creating more sustainable food systems.

Norwegian policy is highly influenced by The European Union, regulations, and policy framework as The Green Deal, that impact and influence the Norwegian politics. European Commission's Green Deal, aims for Europe to become climate neutral by 2050 (European Commission, 2019), and targets the algae production sector as a contributor to this, where aquaculture production may contribute to global food security and sustainability (European Commission, Green Deal, 2019).

National laws and regulations in aquaculture are needed; make seaweed be branded as seafood will make a big impact on the future market and export opportunities for this sector and product. Low-trophic species (Barbier, 2019) In the seafood regulations, seaweed is not regulated as seafood in Norway (NRK, retrieved, 14.06.2022). Now on a seafood conference the ministry of fisheries gave the signal of a possible change in the seafood law, defining kelp as seafood.

3. Theoretical framework and perspectives

In research on sustainability transitions, the theoretical framework created by Frank Geels, The Multi-layer Perspective (MLP) (Geels, 2004) provides the relevant theory for the analysis of a new industry and value chains for help for food consumption. One definition of sustainability transition is “radical transformation towards a sustainable society, as a response to several persistent problems confronting contemporary modern societies” (Grin et al. 2010). The MLP describes patterns in sociotechnical transitions, using innovation and the interactions of different levels with processes, pathways and actors. Together with the backdrop of classical innovation theory on innovation, the Multi-Layer perspective now shows a new understanding of how sustainability transition may become a reality.

This study will also apply the concepts of sustainability and outline the historical context and impact. And use the UN Sustainability Goals (SDG), a framework for sustainability, to explore how this impacts business trajectories. This will provide an important context to the development of the case being studied. Together this will provide a good framework for answering the research questions and analysing the findings in this thesis.

3.1 Multi-layer Perspective - transition framework

The Multi-Level Perspective framework (MLP) offers a multi-level view of innovation and transitions as processes happening through the interactions and on three levels. The niche level, regime, and landscape, with emphasis on struggles between new niche innovations and the exiting regimes, protect the enduring sociotechnical system. On the niche level, radical innovations are built by new actors who build momentum started by changes on the landscape level that might put pressure on the regime, like the Paris Accord that changed the landscape (Geels, 2002). Then destabilisation of the regime offers a window of opportunities for the niche level as one pathway for changes in the socio-technical landscape with their radical innovations. The MLP model was first used to explain historical energy transitions, like the transition from sailboats to steam engines, which took many decades, and later applied to new energy transitions like electric vehicles.

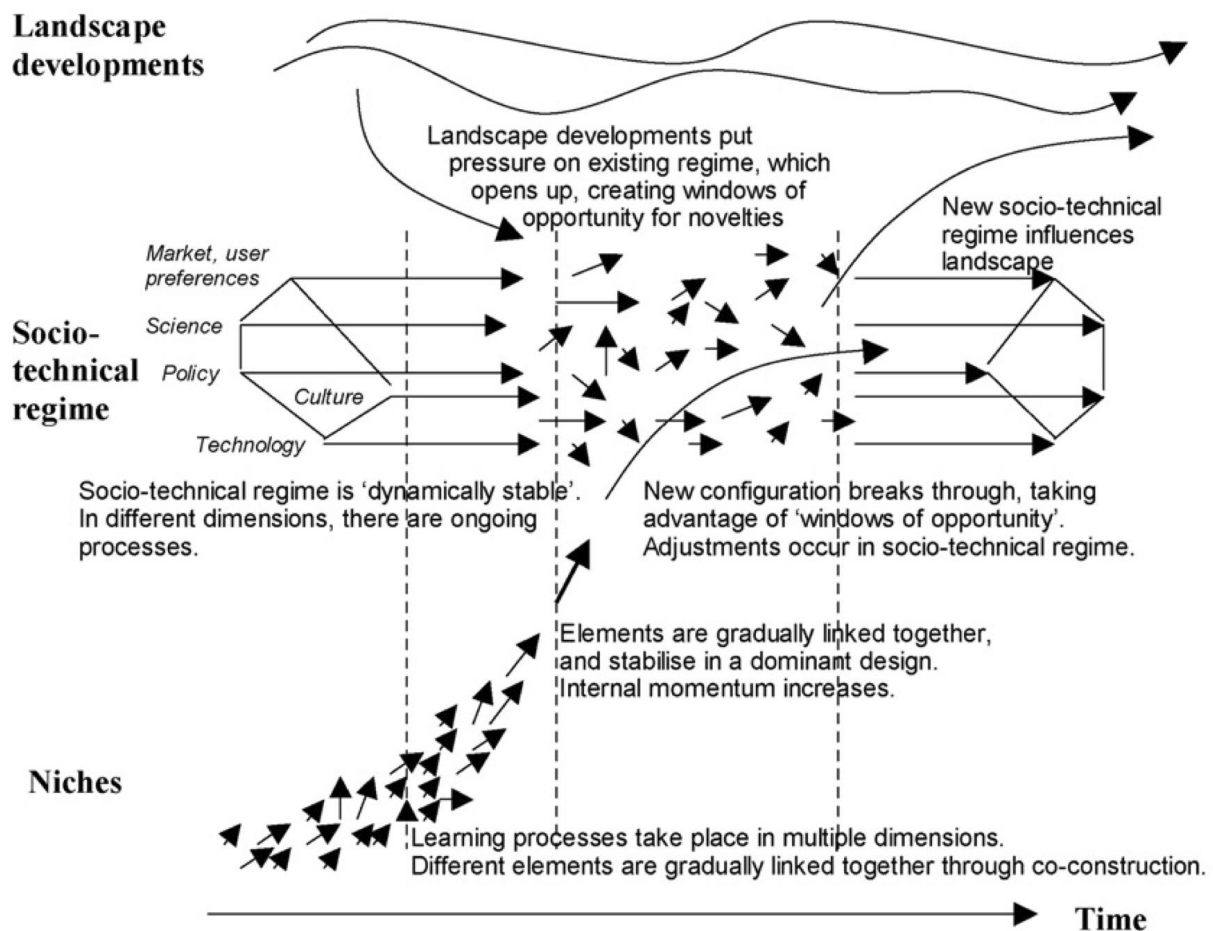


Figure.2 The Multi-Level Perspective, Frank Geels (2004).

The MLP model was first used to explain historical energy transitions, like the transition from sailboats to steam engines, which took many decades, and later applied to new energy transitions like electric vehicles. Time framing and the lack of agency, and impact of politics, and the emphasis on radical innovation from niche actors, have been criticised, and the models have been modified with new aspects (Geels, 2011), and lately, the new framing on sustainability transitions. And more emphasis on cooperation between niche and regime to change the socio technical systems. The MLP framework has now become a more holistic framework (Geels, 2018) in order to explain innovative solutions or transitions that may tackle environmental problems and climate change or loss of biodiversity. These problems need shifts to new kinds of energy and housing solutions or change the agro-food systems called socio-technical transitions (Geels, 2018). In this transition, it is not necessarily

understood as something that shall replace an old system like the historical transitions, but not create new and more sustainable solutions within regimes that may change them and create new into more sustainable ones. This new shift to a new system involves more than changes in technology but also changes in consumer practices, policies, infrastructure, cultural meanings, and business models, as the case is explored in this study.

3.2 Role of incumbents in sustainability transition

The MLP framework talks about incumbent actors as being locked in existing regimes, is now instead of talking more of incumbent actors who can play a more productive role in sustainability transition (Geels, 2019). By this, Geels is moving beyond the Schumpeter theory that radical innovation only comes with new entrants and not the incumbent actors that now do incremental innovations and points at these actors in the case of electric vehicles. The incumbent actors may be pushed by financial incentives, forced legislation, or pushed by new public opinions, which leads these actors into reorientation that may accelerate sustainability transitions (Geels, 2019).

This more broad view started out with the pathways (Geels&Scout, 2007), understanding that these socio-technical transitions do not always come from niche innovations that put pressure on the regime. With the transition pathways, they lay out four types of pathways that use the MLP to understand that transitions come about from alignment between development at multiple levels. MLP emphasises the impact and importance of radical innovations, but understanding change in socio-technical systems requires that we look at this as a multi-actor process and interactions between the new actors and incumbents. The MLP model was first presented as a global model, providing a big-picture understanding of these socio-technical transition processes (Geels & Scout, 2007). Now the micro-foundations on a more local level view in socio-technical transitions are applied (Geels, 2020).

In the case of kelp, both incumbent actors and new innovators try to seize the opportunities that lie in this field. In the pathway framework, one of them is described as *“As pressure continues to build in a certain direction, landscape change gradually becomes more disruptive. This characteristic may lead to a particular sequence of transition path”* (Geels and Scout, 2007). Regime actors will then address these problems by using their resources and changing directions of activities, and this can be seen when we look at the industry building for kelp production. Niche-regime interactions on the macro-level now is something

that is more emphasised in this theory, and the Importance of cooperation between industry, research, and government (Geels, 2018.)

In the socio-technical transitions to sustainability, Geels (2019) explains and adding new perspectives to social science because these changes are multi-actor processes, long-term, goal-oriented, disruptive, and processes that are nonlinear. A demand-side solution that may accelerate transitions, such as consumer changes, is also lifted to have a potentially big impact (Greutzig et al., 2022).

All these factors are helpful to look at in explaining the findings in this thesis. The case of kelp also has multiple dimensions and actors in the aquaculture and food industry, the need for new technology and regulations and policies, industry structure, market, and changing user practices. Turnheim&Sovacool (2019) see Incumbencies as a provided position over the established systems and may take a direction that may influence and shape a transition. Sovacool et al., Investigates the role of incumbents and: incumbent-oriented intermediaries may both facilitate, through a more reformist and reconfigurational role, that revolutionary or incumbents may also enable certain transformative system changes. (Sovacool et al. 2020). Incumbencies are a provided position over the established systems and may take a direction that may influence and shape a transition. They highlight the need for more information on how different incumbents play in socio-technical transition dynamics and study the condition they may contribute (positive and negative) in transformative pathways (Turnheim&Sovacool,2019).

3.2 Sustainability and SDG as a perspective

Focus and impact of sustainability on the society and the business world, starting out with the Brundtland report “Our common future” in 1978. The UN Brundtland Commission made a definition of sustainability as; *“meeting the needs of the present without compromising the ability of the future generations to meet their own needs.”* (UN.org). The concept on sustainability has been evolving and been more incorporated societies and businesses during these years, through summits from Rio in 1992, to the Sustainable Development Summit in 2015, and agreement like the Paris Accord that impact the sustainability trajectories (UN.org). Sustainable Development as a concept *“have been central to the evolution of the environmental policy domain in recent decades”* (Meadowcroft, Langhelle & Ruud, 2012, P.1), with its three pillars: Social, economic and environmental.

This political decided framework will be used as a perspective on sustainability due to its impact on businesses today and in future directions. The SDG now provides a framework with specific goals for businesses, and since 2015 it has become a more important and strategic force for development (Schönher et al., 2019). The 2030 Agenda for Sustainable Development was adopted by all the United Nations Members States in 2015, and the 17 Sustainability Development Goals (SDG) call for action by all countries. With the measurement of the implementation progress with reports that now show real progress in the areas. The SDG, The Sustainable Development Goals, is intended to form a framework for improving lives and mitigating climate change (UN.org .)

The SDGs are now universally applicable, broken into specific targets directly relevant to the business. A standard set of goals for multiple stakeholders, including companies, government, and civil society organisations may lead to new partnerships turning goals into action beyond the control and influence of individual companies (Schönher et al., 2019). SDG is also seen opening up new business opportunities for sustainable investments like the one we see in kelp. Estimates show that this will be at least US\$12 trillion across the four economic systems investigated by the Business and Sustainable Development Commission (BSDC, 2017) where food and agriculture is one. Awareness of the SDG in the business world is high, and the KPMG report, Survey of Sustainability Reporting 2020 (KPMG, 2020), show that a significant majority of companies are connecting business activities to the SDGs in their corporate reporting. The financial risk of climate change is also making an

increasing impact on the 250 largest companies in the world (KPMG, 2020), and this may change the directions of the business world and investment.

In a group including the biggest global companies (G250) report on sustainability ESG (Environmental Social and Governance), 90% do sustainability reporting, up from 35% 20 years ago. Also, connecting their activity directly to the SDGs is rising among these global companies showing the increasing corporate impact since the SDGs came in 2015. But the same report also emphasises that SDG's focus is mainly focused on the positive contributions the companies are making in this regard and finds a lack of transparency on the negative impacts (KPMG, 2020), and this shows the need for companies to set clear SDG goals on performance, and factors being investigated in this study.



Figure. 3 UN Sustainable Development Goals, SDG

The UN Sustainable Development Goals provide specific goals in seventeen targets on no poverty and hunger, good health and well-being. Education quality, gender equality, clean water and sanitation for all. Affordable clean energy, reliable, sustainable and modern energy for all. Decent Work and Economic Growth. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all (Global Goals, 2022). The remaining targets below are the ones that are most relevant in relation with the case in this study.

SDG 9 - Industries, Innovation and Infrastructure. Build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation.

SDG 10 - Reduced Inequalities. Reduce inequality within and among countries. leads to financial and social discrimination.

SDG 11 - Sustainable Cities and Communities. Make cities and human settlements inclusive, safe, resilient and sustainable.

SDG 12 - Responsible Consumption and Production. Ensure sustainable consumption and production patterns.

SDG 13 - Climate Action. Take urgent action to combat climate change and its impacts. Climate change is a real and undeniable threat to our entire civilization.

SDG 14 - Life Below Water. Conserve and sustainably use the oceans, seas and marine resources for sustainable development.

SDG 15 - Life on Land. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.

SDG 16 - Peace, Justice and Strong Institutions. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.

SDG 17 - Partnerships for the goals. Strengthen the means of implementation and revitalize the global partnership for sustainable development.

(Global Goals, 2022)

4.0 Methods

The main goal of this thesis is to explore how sustainability transition may come about with the innovation and structural processes needed to succeed. This research and outcome may be a contribution to innovation and transitions studies on similar processes in this sector or other the agrifood systems.

4.1 Selection of research design

Research was made by using qualitative research methods, with multiple sources of evidence, such as interviews, literature, documentation, and observation on field trips. This I believe provides a good basis for answering the research questions. Using the exploratory research approach is a method that attempts to develop a description or understanding of a social phenomenon that can answer questions of what might be happening, the people involved, and in what way will provide answers (Blaikie&Priest, 2019).

The thesis is a case study embedded with multiple units of analysis that were used in investigating these sectors and actors, both in kelp cultivation and in the food industry. A thematical analysis was a sufficient way of coding the finding from the informants before applying them to the analysis. Since this new field in aquaculture and the use of kelp in food production is under development, the exploratory purpose of the research was a good way to get an understanding of where the actors are and where they and this industry are going. This also provided a flexible method that can be alternated and adapted as the research goes along. The abductive method of logic was useful for the exploratory approach used toward the actors involved. This is to describe and understand certain concepts, meanings, and motives and develop a theory as an end product (Blaikie&Priest, 2019), through the data collected from the companies and the expert informants.

When the industrial development in the kelp sector in Norway is ranked to be the most advanced, I believe it will be a good case in order to show what mechanisms have been vital for the development so far and what it will take to advance and scale up productions, create a market for sale and use in the food industry. In addition, the abductive inference is described as something that discovers or shows something that might be (Danermark et al., 2005) and it is a suitable method of studying processes that have formed but where the outcome is unclear. One main objective of this study is to analyse possible trajectories and what measures it takes

to get there by using theoretical perspectives on transition. Since I have made similar research questions for the two groups of actors in the study, I will use the abductive inference for both looking at the cultivation actors and the actors in the food industry.

This study will also apply concepts of ontology assumptions connected with the subtle idealist assumptions in order to explain the possible trajectory for kelp as a new raw material. By using this type of reasoning, the objective is to discover concepts, meaning, motives, and by this be able to produce a technical account (Blaikie&Priest, 2019) for this through, the data collection and interviews with the experts from stakeholder companies in the selected business sectors concerning the scope of the thesis.

4.1 Data collection

The study follows the case study approach for collecting evidence from multiple sources, such as documentation, interviews, and direct observations, and where each source presents evidence for the case study (Yin, 2018). Data for this case study, *“Building a new Norwegian industry for large scale kelp cultivation, for the market in the food industry: a case study of innovation and sustainable transition in agri-food systems”*, is mainly based on expert interviews, in person and online on Teams. Fieldwork, use of literature, company website, and observation on site of two of the kelp companies.

By using case study it allows me to focus in-depth on the case, and here the organisation and development/processes of a kelp cultivation industry and on the major actors in the domestic food industry. Yin (2018) defines a case study as an empirical method that investigates a phenomenon (the case) in-depth within a real-life context which has been done in this thesis. It provides a real-world view of the actions, plans, and future prospects of these companies. There are several actors who work with harvesting wild kelp and seaweed, making products for a niche food market in Norway. This study is limited to actors cultivating kelp with a desire for use and sale in the market for human consumption. The main objective is to describe experiences, thoughts, meanings, and insight from experts in companies in the kelp field and from main actors in the Norwegian food industry.

The thesis is done as a part of the research project “SusKelpFood - Sustainable ingredients from cultivated kelp to the food industry” at The Norwegian Food Research Institute, Nofima, and some of the companies and expert informants involved are part of the project,

but in other working packages of the R&D project. In my role as a journalist I wrote an article about methods for making kelp ready for use in the food industry, where I interviewed researcher Dagbjørn Skipnes at Nofima on his work on this. I found the world of kelp so interesting that this became a topic for my master thesis three years later. I then contacted him for some information, and he let me do this explorative study for the master thesis as a part of this new research program stating out.

From the kelp cultivation industry, three different actors was chosen for expert interviews. I selected three actors for in-depth interviews with different sizes, prospects, and philosophies. In addition, the new organisation in this field, The Norwegian Seaweed Association, provides insight and views on the sector as a whole. Niche actor (anonymised), has no ambition of becoming near large scale, or the so-called industrial scale, but is nevertheless a significant actor in the industry development with their participation in developing good practices, technical solutions, and research, and their business philosophy. This is to get different perspectives on what's important for the actors.

From the food industry, I have selected companies that have the potential to use kelp as an ingredient in their existing products or create new products with the ingredient and are the largest companies in the industry. Semi-structured interviews online on Teams were the solution here because of the location and possible time frame available. One informant from Orkla Ocean was the only informant from this level I met in person. The selection of actors, and use for data in the thesis, are all leading and major actors in the industry, with a large production of products. Companies are at the forefront of innovation and adopting new consumer trends. They are the conventional and big actors serving both the Horeca and the grocery/consumer market in Norway.

Open sources were preferable, but since this study involves innovation and business strategy, some informants preferred to maintain anonymised. Names of all the expert informants are taken out, and I will use the company name and titles of the informants in the data section and for the discussion. I argue that open sources with both company names and titles of informants are important because the specific actors and scale of the company's ability to drive trajectories are important in understanding how this may develop.

The expert informants provide a perspective of the industry objectives and the direction of further development. Together with other documentation on innovation, an investigation into their new products and business strategies will provide this. These are all experts on a high level with insight both on production, innovation, and business strategy. Through this, I will get a clear perspective on where the domestic conventional food industry is heading in regard to innovation, the use of a new ingredient as kelp, and to what extent sustainability is implemented in many aspects of the business. Several informants from the same company would provide the thesis with a broader view and perspectives from persons in different roles in the company. I argue that with the informants I use, I also get a good insight into the major players in the sector that gives a direction for the future.

Expert Informants from actors in kelp cultivation

Company	Position
The Norwegian Seaweed Association	Project manager
Lerøy, Ocean Forest	Product manager
Arctic Seaweed	Managing Director
Niche actor , anonymised	Managing Director
Niche actor , anonymised	Sales manager

Expert Informants in the food industry

Company	Position
Holmens as	Technical manager
Kavli	Director products development O. Kavli as
Mills AS	Senior Product Developer
Large supplier in the grocery market	Director, innovation, production and quality, anonymised
Nortura SA	Research Director
Orkla Foods/Orkla Ocean	Sr. Product Developer
Orkla Foods/Orkla Ocean	CEO Orkla Ocean

The research project was reported and approved by the Norwegian Agency for Shared Services in Education and Research, NSD. The participants were all sent the document: “Participating in a master thesis research project on kelp cultivation and use in the food industry” introducing and explaining the project to all experts, along with the interview guide for the two sections, after agreeing on the phone to participate. This was done in the Norwegian language due to the respondents being experts working in Norwegian companies. All the experts and their respected companies, besides three, will remain open sources with the name of the company and the name of the position in the thesis. Data from the interviews done in Norwegian were later translated into English for the data analysis and coding.

For the interview with the kelp sector, questions on actors, organisations, on how they collaborate and the importance of innovation cluster, research, and regulations. Where the major bottlenecks for development lie, market challenges, and the impact of sustainability on this profile. For the actors on the second level, the food industry questions concerning demand or use of kelp today or in the future. How new consumer trends impact innovations. Is a Norwegian-made raw material something they will prefer? How sustainability is a more integrated part of the business strategies and how this impact these companies. In the analysis part, topics will be merged together, in the analysis part of the thesis.

Two field trips were conducted during the project to collect data. On-site I can go deeper into societal conditions outside the company regarding prospects for jobs and what expectations lie in the local community on different levels. In Bergen, I visited the Toro Arna factory and was provided with a tour around the facilities before I interviewed the two informants from Orkla Ocean. Norwegian Seaweed Association with informant was also conducted on-site at the organisation's office in Bergen.

The day after, I went to Øygarden, one hour outside Bergen city centre, to visit the Arctic Seaweed headquarter and product facility, and did the interview with the CEO. I was shown how they grow kelp and storage and some of the technical solutions like the harvesting machine they use on deck and meeting employees. I also had a field trip to Vestland county, where I visited a research institution and one of the informants in kelp cultivation. I was shown the drying facilities, storage, and offices. I had an interview with two informants from this company. I have participated in some SusKelpFood online meetings and seen how the

food researchers in the project at Nofima conduct their practical testing of kelp in heating and freezing processes in the laboratory. The rest of the interview was conducted online on Teams due to geographical distance, time frame and obstacles concerning availability.

4.3 Research quality

With the eight “Big tent” criteria for qualitative research that Tracy (2010) provides a model on how to conduct quantitative research used, is the criteria that will give a good review of how this study was done, and the end goal and quality of it. Worthy topic: Doing studies into sustainable solutions and the possible transition is highly relevant today. The need for new sustainable systems for food production is essential, and that makes kelp a worthy topic for research. When the sector in Norway is one of the most advanced, a study of how this process has been and its status is highly relevant.

The thesis has been analyzed thematically as a qualitative study that has the ability to transmit knowledge - be able to tell something about other similar transition processes. In this study I have explored the possible market in the Norwegian food industry, that is essential for further development. By choosing the largest actors it gives a good picture of this, when they may need large quantities and help accelerate the market using relevant transition literature I believe will be sufficient in projecting future scenarios.

Reliability: Understanding, and describing the actor's motive and meanings, will give a basis for outlining possible scenarios for future development, using abductive inference to understand this business development and food production. The experts are all representing their firms, and that by providing me with a positive view, and this is something I have reflected on. A lot in this process is uncertain, and mainly one expert from each firm may not provide a full picture. But when analysing this data, multiple sources of evidence collected and using available literature on the field, it has been sufficient to say and project something on a case that is the objective of this study.

I have tried to be objective, and use multiple sources of evidence to produce descriptions of how it is today and how this may develop in the future. There are no definite answers, only a description of what may be happening, and the use of literature to support the study and possible scenarios. With my background in journalism, I am used to meeting a variety of

people and asking them questions on topics that are used to produce a story on different fields that require knowledge in order to understand. How to ask questions, and interpret them. Doing a literature review and study on this field provided me with a good starting point before doing the interviews. The interview guide as a basis made it a good process. Since I am used to writing down by hand I did not use the recording. All the data have been processed according to the guidelines from the NSD. This fieldwork and research process has been done in a structured manner, where I have been especially thorough in the communication with the informants, explaining and providing them with information on the study procedure. They have all received the data provided for approval. This is to secure that the information provided in the interviews was not misinterpreted when doing this study on behalf of Nofima I believed it is necessary to do this right to avoid any errors concerning data and contact with the informants.

5. FINDINGS

This chapter outline findings based on expert interviews, websites, and documentation. Observation and in-person meetings on field trips have provided the thesis. This part is structured after topics that will be the basis of the analysis part of the thesis when the two sectors of actors are analysed together.

5.1 The Norwegian kelp cultivation sector

After almost ten years of development, we can see a more clear path regarding actors and tighter cooperation in this new field. The new sector organisation, The Norwegian Seaweed Association, is a result of the merging of Algae Nettverk Nor and Norsk Tare dyrkerforening. By May 2022, the organisation will have 29 members, mostly from growers, companies providing technical solutions, R&D, and public actors. Of the growers who are members of the association, around ten have started cultivating by 2022. Two of the new actors involved in driving the kelp farming trajectory are new companies like Arctic Seaweed and Niche Actor. Both take an active part in the development of the sector.

“For the time being, the small actors drive the industry forward, except for Lerøy. I don't have a clear answer as to why there are no more big actors coming in.”

Informant, The Norwegian Seaweed Association

Lerøy, one of our biggest actors in salmon farming, joined forces with the environmental organisation Bellona in 2013 to develop sustainable cultivation of low-tropic fish species such as macroalgae, and is today one of the largest producers in Europe - close to industrial scale. An investigation into the actor shows that besides Lerøy, we find only one other big actor from the conventional fish farming industry. Last year Ocean Forest made 177 tonnes of sugar kelp in the pilot project; this year, increasing to 300 tonnes, but 1000Mt will be needed to make the business profitable, according to the informant. Ocean Forest is the R&D company, while Ocean Harvest is the commercial, and the informant explains the main objective of this big fish farming company to invest in this new industry:

"Lerøy wanted to limit the footprint of the aquaculture industry by recycling nutrients from production in fish farms and creating a more sustainable biomass for feed and food."

Informant Ocean Forest

Main focus for this kelp production in recent years has been on animal feed because the market for human consumption is currently too tough, but the intention is to create raw material for food. The informants say Lerøy wants an open sharing culture around their experiences and underlines the importance of collaboration in the industry and participating in research projects. The informant also believes that when a major player like Lerøy goes in, it can give others a sense of security to enter. As a big incumbent actor, Lerøy may help drive the industry forward using their knowledge and economic mussels.

Arctic Seaweed, with the main production of winglet kelp and sugar kelp on the coast of Vestland, uses a new self-made technical system. As for Lerøy, large-scale production is a long-term goal for this company, with a production of fifty thousand tonnes yearly in the future. Last year's production, which was expected to be 120 tonnes, turned out to be only 20 tonnes, and for next year the informant is hoping for 500 tonnes. The company that started out in 2016 got Orkla Ocean on board as a minority investor in 2020, which gives them a new direction and a customer for their raw material.

Niche actor has a production of winglet and sugar kelp as the main species on a location on the coast of Vestland. This company works with a concept of circularity – Cradle to Cradle design, where the goal is to go beyond sustainability and work with a positive impact through what they do with regard to economic (business model), societal and environmental aspects. Production this year is around 20 tonnes. The two niche actors have some things in common but also a different business approach that is beneficial to the development of the industry.

5.1. COLLABORATION - CLUSTER - R&D

As an organisation, The Norwegian Seaweed Association is working to solve bottlenecks for successful development of the sector, such as sustainability, product development /quality, production technology, market, and food safety. New governmental funding has now secured the cluster organisation in the “Norwegian Seaweed Cluster”, and thereby changing the organisation from being a corporate network, to expanding and now including R&D - academia, public actors, and investors, and now have around 70 partners, funded by Innovation Norway and member fees.

“We are dependent on cluster collaboration and that we move forward. And that the companies are setting aside time for this new industry to get off the ground.”

Informant Norwegian Seaweed Association

Cluster collaborations have become important for the sector and may explain how the Norwegian sector, by now the largest in Europe (Barbier et al., 2019). The informant from the Norwegian Seaweed Association also highlights the importance of collaboration in research like we now see in new big R&D projects. Cluster members, the participation of both Lerøy and Arctic Seaweed, and Niche Actor in research and development in the sector and in programs like the SusKelpFood R&D project show this. Niche actor is involved in both research and development projects in the industry, is concerned with knowledge sharing to promote development in the sector, and believes their company triggers the progress of other companies by being in front of the development and a catalyst for sustainable solutions.

Arctic Seaweed is also an active partner in collaboration in sector development and has a special interest in academia and educational measures. They need trained and educated people in this business, and motivation towards youth is vital for future trajectory in this sector. When some previous industries in aquaculture started out, cultivating new species, such as halibut, mussels, and cod, there was a lack of cooperation among the actors and insufficiency when it came to knowledge. The kelp companies have taken knowledge and expertise very seriously and come from varied backgrounds, the informant from the seaweed organisation says.

Norwegian Seaweed Cluster

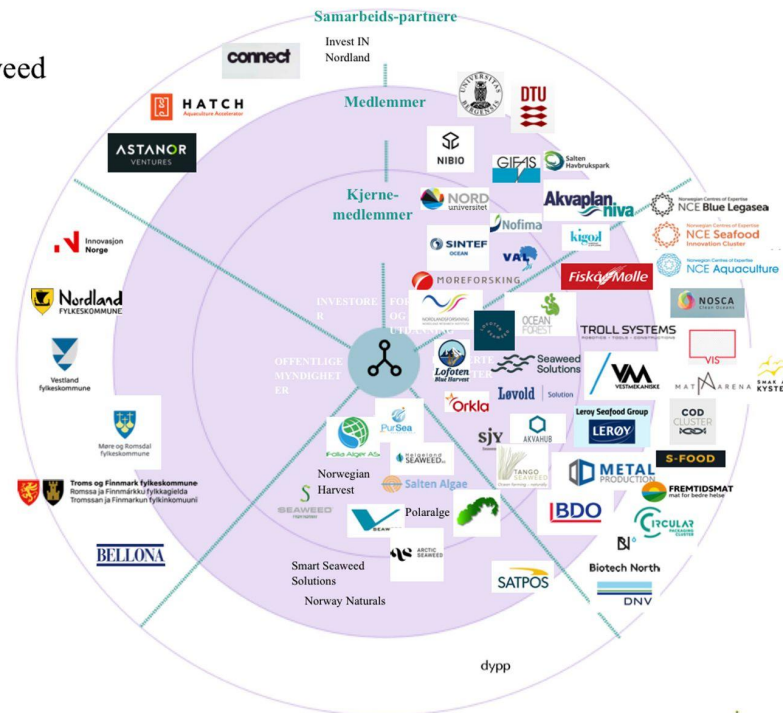


Figure. 4 Cluster map, Norwegian Seaweed Cluster, from The Norwegian Seaweed Association.

We can also find one of the big actors in the food industry on the cluster map. Orkla Foods has taken an active approach to use kelp, with the establishment of Orkla Ocean in 2020, a B2B company that works exclusively with kelp. After participating in a research project, they were allowed to make kelp a business strategy with this new company. Other companies and Orkla brands will include kelp in their production, but the main objective is also to provide kelp for production to other companies in the food industry, primarily in the Scandinavian market, eventually in the European. In 2020 Orkla Ocean became a minority shareholder in Arctic Seaweed, where the main objective is to secure raw materials for production and help the new sector with the market creation needed to succeed.

“We usually do not have ownership interests in the first link of the value chain. But we saw that it is an immature value chain, and we realised that if the kelp industry is to succeed, it must be scaled up.” CEO Orkla Ocean

By this Orkla Ocean help secure funding for further development and a market for the raw material. The informant from Arctic Seaweed believes that when others see that Orkla enters the early phase, it will change and increase the attractiveness of investing in kelp companies. “With Orkla Ocean as a customer, gives a positive signal to the entire industry. They give us confidence that we can get sales on the volumes we make. It gives us a clearer direction of our business”. This informant also sees more willingness to invest in the industry now, but the development is expensive, so he hopes the large capital will come in in the future. If the industry shall be able to produce on a large scale, capital will be needed. The Norwegian Seaweed Association sees that many small growing companies have problems getting investors, but some say money is not an issue, and the informant does not see any calling for more public funding.



Figure. 5 Kelp on rope for testing growth outside Arctic Seaweed locations in Øygarden. Photo. Solfrid Sande

Regulations not being adapted to low-tropic farming is also a challenge that kelp producers face. All the informants enhance the need for new rules that today mainly are adapted to salmon production. Another challenge concerning requirements is that many actors with

licenses for kelp production are sitting on the fence, not using them so far. The Norwegian Seaweed Association wants it to be easier to withdraw licenses that are not used, to prevent blocking the development. This indicates that kelp cultivation is seen as interesting by many actors, but they are maybe awaiting technological developments and market possibilities in order to start. And project the sector will come a lot further in ten years' time, and by then solved the major bottlenecks, and have best practices in hand. Market is one of the important points, and here the Norwegian food industry is important according to all the informants from cultivation.

5.1.2 For a market for human consumption

Most Norwegian kelp farmers seek a market in the human food segment. When kelp and seaweed so far have been a small-scale niche from harvesting, now also from cultivation, a market in the food sector will be vital for these companies. Building new business practices and supply-driven innovation toward the specific market in the food industry is the main goal for Arctic Seaweed. It will, according to the informant, be vital for upscaling and growth. Niche actor is working with a different food segment, both national and international in the LOHAS segment - Lifestyles of Health and Sustainability, where smaller actors play a role in promoting this lifestyle segment. They view the change they now see in the conventional food industry, and the work Orkla now is doing in the kelp field, hopefully, shows a new direction. One is also a prospect for a whole domestic value chain for kelp and hope for a diversity of companies in the future kelp sector.

“I am excited about the development in the food industry in Norway with a focus on quality and sustainability. I hope there will be a complete value chain here in Norway.” Informant 2, Niche Actor 2

For this informant, with a focus on high quality and a more niche customer segment, found the increasing impact of sustainability in the food sector described in research(Nofima). For Lerøy, building a market at the same time, as solving technical challenges in this sector, is important. Food security, and managing the contents of iodine and toxic substances are vital for them to reach the market in the Norwegian food industry. Something both the actors and research projects is working on before kelp may be ready for use as an ingredient for the food industry.

“We work actively to ensure that kelp has a place on the Norwegian plate. There is a growing consumer trend with plant-based food, where we see that kelp can take a large place. Seaweed is a good source of iodine and minerals.” Informant, Lerøy, Ocean Forest

The informant think the food industry needs this reassurance around food safety before they may embrace kelp as a new raw material for their food production. Both for the domestic food industry and the one abroad. Norwegian authorities are now also waiting for the EU's risk assessment of food safety in kelp to harmonise their laws and requirements in this field. When this is secured, the consumers are in focus for Lerøy.

6. The Norwegian Food Industry,

A majority of the expert informants, represent large or the largest companies in the Norwegian food industry. Meat products, ready-made dinner segments, or in sauces, spreads, and plant-based products reach a large segment of Norwegian consumers. Orkla Foods, the biggest company in the industry, with its production at the dry goods factory Toro Alna in Bergen, alone produces 120 million bags annually in a robotised process, for a segment of 350 different products well known to most Norwegian consumers. Of the other companies, Mills and Kavli both make well-known brands in their segment. Mills AS, a family-owned food brand, with products in the butter, salads, and mayonnaise segment, and Kavli that provides the market with brands such as Kavli, milk products with Q-Meieriene, Kornli, and Planti - a new plant-based dairy alternative.

Nortura SA, as one of Norway's biggest food producers, provides the market with meat brands like Gilde and Prior, with a market share of around 44 per cent. Informant company Holmens a Stavanger based owned by the Grilstad Group. Produces ready meals, "honest food" from local raw material suppliers, ready meals, steaks, dinner pots, and oven-baked dishes such as lasagna, cold cuts, and sausages for the groceries. The last informant, “Major player in the food industry” (anonymised), also provides ready-to-eat dinner dishes to a large market segment. Four of these actors are on the top list of the major companies in the industry and can possibly make a big impact when it comes to market function for kelp.

5.1 DEMAND FOR KELP

To discover whether the big actors in the industry are using or are planning to use kelp, questions around this was asked to the expert informants representing these companies from the Norwegian food industry. As the biggest company in the food sector, Orkla Foods is a provider of a large part of what Norwegian families are eating. With the new company Orkla Ocean, Orkla Foods is taking the lead in both involvements to develop and scale up a new kelp cultivation industry and create a domestic market for sale in the food industry.

"When a company as large as Orkla goes in with so many products, it hopes that consumers and others will also open their eyes to kelp" Product developer, Orkla Ocean.

With a big share of the domestic market, their possible impact from strategic new sustainability directions may be considerable. For the other informants interviewed the questions on the use or future use of kelp vary. For Nortura as a strong incumbent force in the domestic food sector, kelp is a two-part question. Until now, this company has worked mostly with kelp for fodder for livestock, and the informant says that they now have knowledge of kelp. Research shows that kelp in animal feed can reduce emissions of methane gas from ruminants, is vital question for Nortura to mitigate.

"The use of kelp for us is part of the sustainability strategy, utilisation of the resources we have in Norway. Seaweed was used before, so it is not new, but we just have forgotten about it." Informant Nortura,

The informant, points to our historical use as fertiliser, and for feeding animals, but also our use as food, as a substance in bread (Mouritsen, 2013)). This is a confirmation that sustainability now is an active strategy for the company, as the new sustainability report launched may also underline the informant states. When it comes to using kelp in Nortura's food products, the informant states they need more information on the content of iodine and heavy metals. And discover where kelp may provide a beneficial effect, such as salt replacement. The informant says Nortura is concerned with the content of iodine, both for use

in a product for human consumption and for feed, and works on projects to get more research on this.

Neither Large Supplier, Kavli, Mills, or Holmens use kelp in their production today. Large Suppliers are unfamiliar with this raw material but state the company will come down the road when it is ready for the food industry, available, and commercialised. Holmens state they will consider kelp for production again when it is ready to use, labelled for the industry. For Kavli, there is also still a lack of detailed knowledge about kelp, but the company pays attention to ingredients that may be relevant to the expert informant states. The healthy nutritional levels in kelp are important, but they are concerned with food safety and needs more information on iodine level. This provides uncertainty for Kavli today. But the informant states that kelp may become interesting because the company is largely consumer-driven.

“We are concerned with nutritional content and are part of the collaboration that will reduce salt, sugar, and saturated fat. And we take this with us when we develop new products.”
Informant Kavli

For Mills food security is important regarding their attitude to the raw material kelp. The informant says that they have kelp in mind and tested it, but that there is also significant uncertainty for the company regarding the standardisation of the product. This shows the importance of food security, nutrient, and health aspects for these companies, as we find in the industry salt reduction program. Orkla and their Toro brand have worked with a salt reduction in food since the 80s, by ensuring that the foods are healthier. Here, kelp can contribute to salt reduction and the same time to new and good flavours in the food, according to informants. So far, Orkla has not used kelp as a salt substitute but as a flavouring component in vegan products to learn about the sensory properties by doing many tests. Orkla launched 8 new products this winter, and then came four products from Orkla Ocean.

“We do not talk so loudly about the fact that we have kelp. It is a fact that consumers are not so familiar with the product yet. But we are good at that and will use our knowledge to reach consumers.” *CEO Orkla Ocean*

Even with changing consumer preferences, kelp is still a raw material unknown in use both for industry and consumers. Kelp was used as salt substitution historically, and this is something Nortura has tested in some settings and has noticed the desire out there for natural additives in the food, the informant states. Their product developers have kelp high on their list. *“Use of kelp as a salt substitute?” “Definitely, where it can give us such an effect.”* The informant states and tells that Nortura has already had a salt reduction of 60-70% reduction in recent years. The company is concerned with having a short list of ingredients in its products due to health-conscious consumers. Although Nortura is a company working with meat products, they also see the possibility of these new consumer trends.

5.2.2 Changing consumer trends innovation

The companies in the food industry have, in different ways, answered to new consumer trends such as vegan and vegetarian diets with product development in recent years. Even the large actors like Nortura, which mainly have a production of meat from animals, have looked into this market segment. The informant from Nortura tells about experiments on vegetarian products, which did not go so well. But the company is waiting for new opportunities to hit the market with products in the vegetarian segment.

“We keep an eye on the new food trends, and it is not quite natural for a meat company like Nortura to make vegetarian food. It has been a big discussion.”

Informant Nortura,

The informant, states that he sees Nortura's meat factories as natural places for production in this segment for products like vegetarian/vegan “lab meat” because they already have the machinery and the expertise needed for such products. For Orkla, on the Toro pots products, serving tips are now also given with meat-free alternatives to make it greener or vegetarian and with consideration of allergens. One reason for this labelling practise is the growing amount of consumers in these segments Orkla Foods would like to reach, the informant CEO at Orkla Ocean states.

“ The Toro factory has always been the one that has shown the way to new food trends in Norwegian homes. But some things we have also been out too early with. But we want to be

one that introduces new and slightly healthier trends. Seaweed is the vegetable of the sea and has a huge range.” CEO Orkla Ocean

Now kelp is on the agenda for Orkla, a new raw material that many consumers are not familiar with, it will now help through making new products. The informant, CEO Orkla Ocean says they are seeing a consumer change, especially among young urban consumers who are thinking about sustainability and want authentic flavours in food. So with this, the informant believes it's a good position for kelp to become.

*“The new thing, after solving the bottlenecks concerning kelp such as iodine level. When more products containing kelp are on the market, it will become mainstream,”
CEO Orkla Ocean*

This indicates how Orkla Foods, with Orkla Ocean, wants to be at the forefront of innovations and comply with consumer preferences today, but also in the future. For the company Major Player, in the readymade dinner segment, the informant state this company is not the one who is at the forefront of innovation, but they can not be behind either. A goal is to be relevant and up to date with consumers. They focus on a wide segment of consumers but also want to reach new groups like younger customers with vegetarian dishes, but this is not a large segment of products today. For the family-owned company Mills, the vegan or vegetarian segment is important and has created a number of new and plant-based products that meet the growing consumer demand. Products like Plantago, on hummus based, one spread with tomato, as well as Plantago - salads. The desire is also to provide consumers with products that follow the dietary advice from the authorities, reducing salt and fat, and according to what is considered sustainable, the informant states.

Questions if a consumer preference study, like the study Nofima on positive consumer preferences attitudes towards kelp (Govaerts, 2022), may affect how actors like Mills and Kavli will consider kelp as a raw material. The informant Mills believes that more documentation on this content is needed before they will consider again, using kelp in production. For Kavli, the informant says consumer preferences may affect the use of this raw material.

“It is important for us to be part of trends, and when consumers want new flavours, we must follow. We like to look at what's up and coming in the field of taste in Europe. Plant products for a vegan diet are also something we work with and are important to us. ”

Informant Kavli

Answers concerning how these companies in the Norwegian food industry apply to new trends and consumer preferences show a high level of innovation to adapt among most the actors in the study. Concerning directions for the vegan or vegetarian segment, it is in line with research on this that the food industry applies to this (NOFIMA, 2022).

5.3.0 Norwegian value chain

For the kelp cultivation actors and The Norwegian Seaweed Association, the possibility of a year-round industry creating more jobs in coastal communities is an important future prospect. And finding new ways to process the raw material later, to delay the growing and harvesting season. The creation of a whole domestic value chain will also be important for production scale, creating jobs, and creating a ripple effect for other potential stakeholders such as suppliers or the process industry. Arctic Seaweed believes that with the short technical timeframe available, local processing will be natural. Then the need for the local workforce in facilities directly in production, processing, and in the supplier industry may be viable. Arctic Seaweed hopes its company will have facilities along the entire coast and utilize the different temperatures in the water along the coast.

Lerøy and Ocean Forest want to keep the knowledge on production at home and create as much activity along the coast as possible. This company wants further processing here, to create jobs and generate short-distance food for feed and food. Otherwise, it destroys the entire value base of kelp, the informant states. And believe kelp can create more jobs along the coast. Lerøy is already employing many people in Norwegian coastal communities and wants to continue to generate more jobs through kelp production. The ambition is to have most of the value chain at home, employ people where the seafood is, and not ship it worldwide for processing.

“We must build a market at the same time as we solve the technical challenges we have. I think we can achieve this with a culture of sharing, and investment from R&D, companies, and the authorities. ” Informant, Ocean Forest, Lerøy

One of the main objectives for the kelp industry is building a market for food production, and actors like Lerøy are targeting the food industry in Norway with a potential domestic-made safe product. The experts from the food industry represent big actors, with the possibility to make impact on directions by choosing a Norwegian-made product. To what extent inland production is important, and of Norwegian grown and made commodities or raw materials vary for companies and informants interviewed. The informant from Kavli highlights the importance of buying Norwegian raw materials but states they are primarily concerned with being as climate-friendly as possible, and the Kavli company aims to be a positive climate standard in 2030.

“We are not concerned with geography because we want to see the whole value chain and transparency of what we buy. But we welcome Norwegian suppliers. ”

Informant Kavli

For an actor like Mills, the informant states that whether the raw materials they use are Norwegian-made is not decisive for them, but at the same time, it is desirable to use as many Norwegian raw materials as possible. Both in relation to the security of supply and climate footprint. Around 85% of the raw materials Mills uses are also plant-based. They do not always view that Norwegian made is the best, neither in terms of the environment nor life cycle. And as a small family-owned company, the informant does not think it is relevant for Mills to look at the raw material side when it comes to ownership, such as Orkla.

On the other hand, Nortura was organized as a corporation owned by 17100 stakeholders, mainly in agriculture; their slogan is: “The more Norwegian, the better.” the expert informant says. They want as many local ingredients as possible, and in this context, kelp may be very good, according to the informant. This company looks at climate footprint in all contexts, so everything that can be related to energy use and sustainability is important to us, and if kelp can be used to enhance this profile, it's interesting. Also, Major Player sees that the CO₂ footprint on their products will be more focused and important in the years to come.

“We want to use Norwegian raw materials as much as possible, especially on meat, fish, and vegetables. From a sustainability perspective, it is important that the raw material does not

have to travel far; and by that, we contribute to Norwegian industrial jobs. We think that is positive.” Informant Major Player

Holmens try as far as possible to have Norwegian ingredients, but if they need Asian flavours, import is necessary. They desire to use the entire raw material and set requirements for suppliers, which has become more important. Everything that triggers the path that is good for Holmens. These answers in hopes of creating a Norwegian value-chain for kelp for the kelp cultivation sector seem to be answered by the food industry in regard to the importance and use of a Norwegian-made raw material.

5.4. Sustainability

Sustainability as a concept has become more and more important in the business world, and among consumers regarding what choices we make. In this section, the impact of sustainability and the UN Sustainability Goals SDG has as a driver for business development are looked at both on kelp cultivation actors and the actors from the food industry.

5.4.1 Impact on innovation In kelp cultivation

Sustainability is a strong driver for everyone who works with kelp, according to the informants from Lerøy. For them, climate change, lack of resources, and sustainability challenges are the backdrop for their project in Ocean Forest together with Bellona. And the fact that Lerøy as a company wanted to reduce its own footprint by reducing nutrient salts in production and bringing the circular economy into operation. One goal and ambition is also to secure their own feed for fish production from low-trophic species like kelp.

“The UN's sustainability goals are a driver for why we have invested in kelp.”

Informant, Ocean Forest, Lerøy

The kelp industry may also be a tool for slowing down climate change through ecosystem services. This is also one of the goals of the Norwegian Seaweed Association to uncover the positive environmental effects of kelp cultivation, such as ecosystem services.

“Kelp grows on nutrients. Therefore, it would have been interesting to include the salmon industry, but they are not known for wanting to pay. But we are still at an early stage in the

development and must be able to better document better the effects the kelp may have on the ecosystem services. Then we get the large fish farmers involved and clean the fjord systems after fish farming. This will also provide kelp growers with the prospect of selling both food and ecosystem services.” The informant from the Norwegian Seaweed Association says.

Informant 1 from Niche Actor also believes there will be implemented a system with certificates for this (nutrient cycling and recovery). They believe several manufacturers in salmon production are positive about this kind of solution but are “sitting on the fence”. Informant 1 believes, that when new demands or regulations coming that aim to control the problem of nutrients, many will probably get interested. In Denmark, fish farms must show how much nutrients are released, and these emissions must be compensated. So ecosystem services may be one of the positive prospects and possible profitable solutions that can make the kelp cultivation companies grow.

When it comes to sustainability in their own business sector, Informant one from Niche Actor believes the cultivation business is far from a sustainable level today. The sustainability challenges for the company include the use of plastic ropes, but informant 1 believes alternative materials will come. Rope made of kelp, and packaging in the same material will be able to provide a whole concept. Problems often arise where there is a large monoculture. Also, the tendency to separate climate and nature conservation is something that concerns this actor. They believe kelp cultivation for human consumption can be climate positive, not only neutral, but it is a long way to go, informant one says.

Also, Arctic Seaweed believes there are too many big words on how sustainable the kelp cultivation business is now. Everyone has their own business models, but Triple Bottom Line (People, Planet, Profit) is important to Arctic Seaweed, the informant believes many others in cultivation have the same business philosophy. This company now wants to apply a management tool to set specific sustainability goals, such as minimizing energy consumption in production, that can measure if their operation can be called sustainable. In the future they need autonomous vessels, with low emissions, drones, and robots, it will be like agriculture at sea - depending on season variables.

The ocean is affected by weather and wind, and changes in the balance of ecosystems will impact the production levels and growth of kelp. For Niche Actor, its own goal for its

business is to avoid negative impact on the surrounding environment but contribute, creating life or space for other species, and avoiding large monocultures at sea and on land. This company thinks regeneratively - like farming, in the sea, where you have to switch between species. The desire is to co-cultivate.

"I try to avoid the concept of sustainability because it is only about reducing footprints and emissions. It is often a question of going to zero while we want to move towards making a positive impact. We also want to add something. " Niche actor 2, informant one

5.4.2 Sustainability impact in the food industry

Research has shown that sustainability drives innovation in the Norwegian food industry (Grimsby et al., 2021), and by creating products that may be more healthy, have a lower climate print, and be more sustainable according to the ingredients used and production methods. Nortura has now launched its new sustainability plan and wants to appear sustainable, and it's something they wish to tell their consumers. Agreement on 2030 emission targets to solve climate challenges is now incorporated into their business strategy.

And Nortura is taking sustainability in value chains seriously, even though they always have focused on short-distance production. The informant thinks kelp in this regard may be a raw material to make their products more sustainable. And may use kelp in production be used strategically on sustainability for consumers or owners? *"It probably can, according to the informant, but Norturas use of kelp in food will probably be limited. I'm sure kelp will be more important in our feed than in food,"* On questions, if Nortura may copy Orklas practice and involvement in the kelp industry, the informants state that Orkla has an extensive product segment, including kelp, that Nortura does not have. So thereby not as natural for Nortura, but the informant understands well the Orkla strategy.

For Orkla, providing raw material for their own products from kelp is one mission, but also a plan to contribute to building new value chains that can make a positive contribution to reducing climate emissions. The informants from Orkla Ocean say the company has worked with sustainability for the past fifty years, without putting the name on it, and Toro Orkla is now mapping the environmental footprint of the raw materials in its own production. Now both consumers and shareholders demand this effort on sustainability. *"We have seen a clear*

change from the Orkla management in this field. It is top-down to work with sustainability. ” Ceo, Orkla Ocean. The informant underlines the bottlenecks for kelp, such as an energy-efficient drying technique and iodine content, and also understands the market better to make a quality product at the other end.

“When the concept of sustainability came in, I think for a long time it was a concept without meaning, but in the last five years, it has become more concrete through new projects. Orkla Ocean is the idea of sustainability in practice. Kelp is about both climate and environment and about health. ” Orkla Ocean, CEO

For the actor Major Player, the sustainability work is also strengthened and has become a more integrated part of their business strategy with the SDGs. The informant says this is in demand by their board and owners, and then they now see an increasing focus on this. For the other ready-made dinner company, Holmens, sustainability and the environment now are more in the company's way of thinking and will mean something for the further development, the informant says. Mills aimed to become one of Norway's most sustainable companies and make their production climate-neutral by 2021. Concerned about social responsibility and providing consumers with healthy food today and in the future. This new strategy fits with the company strategy Mills has had for a long time, but now sustainability is put more into the system the informant states. *“Sustainability has become more important in our communication of the products we make. But not by using an index finger, but by telling the consumers a good story that creates a good feeling”*. Informant, Mills.

Also, Kavli has set a goal of becoming climate-positive by 2030, and it is clearly communicated to consumers with measures such as recycling aluminium and food-saving days. The sustainability aspect in own production, food waste, cut transport, and energy consumption, we actively use in the strategy both in the group and out to consumers. Kavli will also extract more greenhouse gas from the atmosphere than is used, the informant says on their long-term company strategy. On the question of kelp as a raw material that in the future may contribute to strengthening the sustainability profile of the company the informants say:

“It is not inconceivable that we could have used help to strengthen our sustainability work, but we will probably not buy from a subcontractor. But as part of the climate-positive strategy, it is not inconceivable.” Informant Kavli

Answers from the two sectors on importance and impact of sustainability indicated that this is an important area for both sets of stakeholders. But nevertheless, looking at these connections and maybe conflicting strategies that impact in reality will affect the trajectory.

6.0 ANALYSIS

The main objective has been to do an explorative study into this new sector development, and the possibility for it to become a sustainability transition in the agrifood systems with kelp production for food consumption. Changes that require new cultivation practices, process technology, market, and making new products for consumption. Through interviews with expert informants from selected companies, uncover how different stakeholders view, projections, and meanings in order to develop a description or understanding of the ongoing process by using transition literature and the analytical framework of the Multi-Level Perspective. In the analysis, four topics will provide a basis for the last part on future scenarios presented here.

6.1 Building a new industry - a multi-actor process

The ongoing process with the kelp actors and the cluster collaboration show this interaction of actors the process needed to succeed with sustainability transitions. Changes in the socio-technical systems or food systems in a more sustainable direction to tackle climate change (Geels, 2019) and provide more food using sea space. Such a process is described as being goal-oriented, disruptive, non-linear and a long-term transition. This also requires a multi-actor process, which this study shows with the development so far from the multiple sources of evidence collected in the study.

The 70 members of the cluster show a goal-oriented path, with actors in kelp farming, business actors, R&D projects, public authorities, investors, and first movers making a new sector succeed. Research is highlighted as important, and going into real issues for the industry like reduction of iodine, process technology or life cycle analysis that is vital for successful development. Data show that it's not the fish farming companies that are the main drivers, with the exception of Lerøy, which has taken a special role in this sector. It is mainly new companies from various backgrounds and with people from the research community, food sector, and aquaculture, with a different starting point, philosophy and production goals. Both Arctic Seaweed and Niche Actor take an active part in the R&D projects and are actors interested in developing a sustainable aquaculture practice, but with different production goals concerning the scale and market segment.

The increasing number of actors in cultivation shows this is a promising business, but difficulties starting production, maybe due to the market situation for the time being. The Norwegian Seaweed Association says that this sector has knowledgeable actors that take sustainability in their business foundation and think long-term development. This separates this new industry and the actors from the mussel industry that failed the informant stated due to lack of competence. It will probably lead to more solid companies with knowledge and expertise to grow and survive in the long run in this new industry.

Lerøy as a big actor in the fish farming industry, has been important in the technological development, scaling production, and is at this point near industry scale. Now also looking for a market for food and are waiting for best practices concerning this. Now a large actor in the desired food market, Orkla has created a demand and forming of a market for kelp in the Norwegian food industry with the strategic choice of making kelp a force for the sustainability profile of the company. For Arctic Seaweed, with Orkla Ocean on the owner side of their company, they already have a large customer in the market that will need large quantities of kelp for food production. With this, they secure demand for the time being, and the multi-actor process needed to drive this towards a transition into sustainability solutions is by this in good motion. By also being a B2B provider of raw material, they may Orkla Ocean potentially can provide kelp for the other actors interviewed. The answers show they all may consider using kelp in their own production. With the entrance of Orkla, a market is building and may accelerate due to the need for large quantities.

A market for kelp seems likely when looking at the answers from the informants. Of course, the expert informants may just provide a popular answer in light of being a spokesperson for the company and giving a positive picture. But when looking at these conventional actors in the food industry, there is a high level of innovations and compliance both with governmental health requirements and consumer preferences in a competitive market. With this in mind, may the companies in question, being the largest in their segments, have the power to impact the kelp trajectory.

Taking an exciting marine bioresource into cultivation and succeed comes with challenges, like optimising the growing process and tackling the biomass are bottlenecks the sector still is working on. They have come a long way in the last ten years, but several factors need to be solved in the next ten, to succeed in scaling up to large-scale production. Regulations need to

be changed, and new signals highlighted by the experts are now in the pipeline in the government and political landscape, which will be important in exporting kelp. Labelling kelp as food in the seafood regulations will open new doors for the industry.

6.2 Sustainability transitions - the role of incumbent actors

Transition theory talks about incumbent actors as being locked in existing regimes now emphasising incumbent actors in a more productive role in sustainability transition (Geels, 2019). Regime actors may use their resources to change like we see both Lerøy, Orkla, and Nortura in their segment do with their approach and the possible impact of this on the food industry trajectories when they as big companies may need large quantities. Incumbent actors may be pushed by financial incentives, forced legislation, or pushed by new public opinions, which leads these actors into reorientation that may accelerate sustainability transitions (Geels, 2019). This is to a great extent, what this case shows when we look at the selected companies and the answers from the expert informants in concern with new consumer trends and climate change impacting directions.

Lerøy and their role in development in R&D, has the backdrop of Climate change and SDG are drivers, and with the goal to secure their own feeding. Providing food for the food market and dealing with their problems concerning nutrients by using low-trophic species like kelp. This show how landscape changes have an impact and new policies in this field. As a pioneer in kelp production Lerøy, with their collaboration is doing incumbent niche interactions, playing an important role in the case of this possible sustainability transition.

By Orkla accelerating development into the food market, a domestic market for kelp may be formed, as long as they need kelp for their own production. Nortura is also a regime actor playing a role in using kelp, and also helping development, even though their main use will be for feed, they are now engaging. With the answers from the other actors in the food industry, it may indicate that kelp may be a raw material they wish to use in the future, maybe on-demand from changing customer trends. They are all large companies with big production and with potential to reach many consumers, and can play a more active role influenced by Orkla in the future? Because incumbencies as a provided position over the established systems and may change directions that may influence and shape a transition (Turnheim&Sovacool, 2019), this is what is believed to happen in the case of kelp.

In this sector development, we can also see a multiplicity of incumbent actor types, a variety of actor strategies, and strategic positioning over time as we see with Lerøy, Orkla Foods and Nortura in regard to kelp. Lerøy and one other company are active in new solutions for solving problems with nutrients. Regime actors in the conventional fish farming industry can be seen as incumbent actors slowing the transition with their lack of investment in an industry that is highly beneficial to their production. Money seems to be one issue, according to the Seaweed Association. New regulations may force these actors to go in and then accelerate the transition and scale-up production volumes and market for ecosystem services.

6.3 Demand-side push and consumer impact

Going towards a transition of the food systems, as we see in this case study, is not a linear process, but interactions of various actors and mechanisms in play are needed for successful innovations. The supply-side approach from kelp actors is now being supported by a demand-side push from actors like Orkla. This outcome may also be impacted by a demand-side push from changing consumer trends that may change trajectories. Orkla will use kelp in their products for flavour and salt reduction and as a strategy to make the company more sustainable.

In this regard, consumers' preferences impact Orkla's direction and demand strategies that may have an impact on other companies in this industry, and this will impact future directions and might accelerate the development. This is also dependent on the supplier's ability to promote a stable and safe raw material ready to use for the food industry, as all the informants requested as important. In the study data, we can see both supply-driven innovation, and demand-driven innovation in the two sectors that interact and may create a new trajectory for sustainable agrifood transition for kelp.

Changing customer preferences and demands are creating a window of opportunities for the industry with vegan and vegetarian diets. Impact of sustainability, climate change, and Eat Lancet report show this changes consumer preferences, and this act as innovation drivers in the Norwegian food industry (Grimsby et al., 2021). We can already find a powerful impact of the vegan or vegetarian trends on products some of these actors are making. Orkla, with their Toro brand, now include these groups in producing many of their old products like the

Toro dinner pots, applying a vegetarian/vegan serving alternative. Kavli and Mills regard plant-based products as important and work on new products. They both have good segment, complying with societal development and changing trends. Even in the meat industry, Nortura is thinking of making fake “meat” for this market. What impact can this can show on further development is uncertain, but it is likely that the diets will change further in a more plant-based direction with meat substitutes.

Blikra et al. (2021) have highlighted kelp, as an ingredient that is unfamiliar to most consumers, so the food producers must also deal with neophobia towards seaweed and kelp. But a recent study on Norwegian consumer preferences for eating seaweed also shows a positive view with consumers that are concerned with sustainability questions (Goavaert et al., 2022). We now see that seaweed is an ingredient that has a rapid growth in new products in the European food industry. This is definitely heading in a positive direction in larger product segments. But the implementation of kelp in production is not dependent on a large segment of consumers asking for this ingredient and has to wait for changing preferences of the average consumer. It can be used in the companies existing products, replacing salt and adding new flavours, and possibly contribute to a shorter list of ingredients, like the informant from several companies regarded as important to comply to new consumer preferences.

6.4 Impact of sustainability

SGD now provides a framework with specific goals for businesses has since 2015 it has become a more important and strategic force for development opening new business opportunities for sustainable investments like the one we see in kelp. In the food industry, sustainability, with the implementation of SDG and the 2030 targets, has now become a stronger driver for innovation and business development. The active approach by both Orkla and Nortura concerning kelp, to improve their sustainability profile indicates this. Other experts say kelp may be used to enhance their companies sustainability profile, which shows this raw material a future potential. They all say that sustainability has become more important, from the top down through the organisations. Consumers being more concerned about sustainability and climate, has an impact on all companies, according to the informants.

In the kelp sector they hope for a domestic value chain for their production. On a question if a Norwegian-made raw material is desired in production for the food industry, the answers are mostly yes. These companies want to a large extent to use Norwegian raw materials, but in this consideration CO₂ footprint, lifecycle and other sustainability factors on the raw materials their using i production are vital factors. This may be something that can slow the kelp trajectory if the bottleneck concerning lifecycle and energy in cultivation, harvesting and processing use are not solved.

For the kelp actors, sustainability is at the core of their business. For Lerøy, The UN's sustainability goals are a driver for why they invested in kelp. The kelp industry may be a tool for slowing down climate change through ecosystem services. They work towards solving problems and achieving sustainability throughout their production and supply sustainable kelp for food consumption. All the companies deal with these challenges and need to solve this before the kelp production achieves a sustainable lifecycle, and this might slow down the market process in the future.

Actors like Niche Actor work on a regenerative approach, not separating climate and nature conservation. A goal for its business is to avoid negative impact on the surrounding environment but contribute, creating life or space for other species and avoiding large monocultures at sea and on land. This regenerative approach is in line with the vision in the Seaweed Manifesto and may impact the Norwegian kelp sector, being an actor involved in R&D. It is likely that the future will require a more regenerative approach that is seen more emphasised in both agriculture and now in the seaweed strategy (Seaweed Manifesto, 2020). With the direction towards sustainability, SDG is taking in terms of being more integrated in business it is likely this will have a bigger impact in the future.

6.5 Scenarios for the future

Will this new sector building become a transition in the agrifood systems? The sector development we have seen so far supports the transition literature on the new framing of sustainability literature, with a long-term multi-actor process, with different dynamics of actors. This requires changes in the existing socio-technical system, not replacing an old, one but with new technical innovation, some using existing technology, creating new production system.

With development not being mainly driven by niche disruption challenging the regime, we clearly see the interaction between niche and incumbent actors as a long-term multi-actor process. Kelp cultivation is a new practice in Norway with the species selected for use, it provides something new built on nature's abilities and be used for innovative food and for cleaning the nutrients in salmon farming.

In the reconfiguration pathway (Geels&Schot, 2007), when the new regime grows out of the old, with substantial changes in the regime's basic architecture, is one possible pathway. Implementing a new raw material in the food industry that requires new process technology, product and markets. Because this as a transition not necessarily understood as something that shall replace an old system as the historical transitions, but create new and more sustainable solutions within regimes with a new product and technology that may change and create new more sustainable ones. This likely leads to a sustainability transition in the socio-technical system.

Building aquaculture for kelp is an innovation, a raw material for future use in different applications and in this study, for human consumption. Creating new consumer products and improving existing ones with a potentially sustainable future. Changes in consumer practices, policies, infrastructure, cultural meanings, and business models, as this case show. Understanding and describing the actor's motive and meanings that provide possible scenarios for the future has been one objective for this study.

Working on solving bottleneck, importance on R&D for technology development, regulations, biology, iodine level, market. New process technology, preservation, drying techniques, harvesting and processing technology special for kelp. This new shift to a new

system involves more than changes in technology but also changes in consumer practices, policies, infrastructure, cultural meanings, and business models, as the case is explored in this study. In the socio-technical transitions to sustainability, Geels explains, now are adding new perspectives to social science because these changes are multi-actor processes, long-term, goal-oriented, disruptive, and processes that are nonlinear (Geels, 2018).

Using The Multi-Level Perspective of sustainability transitions and new framing and contribution in the transition literature, the processes with mechanisms and actors involved in line with the type of pathway that's seen as necessary to achieve a sustainability transition in the agrifood system. The transition literature suggests that sustainability transitions are

more

dependent on multi-level corporations and incumbent actors in the regime rather than dependency on radical innovations from new entrance. This study of these new value chains of the kelp sector and food industry is a clear example of this. Incumbent actors enable the future transition from their privileged position and then shape directions. A demand-side solution may accelerate this transition pathway, such as consumer changes. The importance of Norwegian-made raw material among the informants in the food industry can drive demand for kelp. If other big companies follow Orkla or Lerøy, it may accelerate development further.

Understanding and describing the actor's motive and meanings that provide possible scenarios for the future has been one objective for this study. The timeframe is a long-term transformation: ten years now, and how about future scenarios? Development and potential involvement from salmon aquaculture actors that can scale up and provide investments may be one solution or bigger investment from other actors from the food industry following Orkla Ocean? Or will international actors come in? These are questions that I have not found answers to and will need investigation to answer.

7. Conclusion

The main objective of this study has been to perform an explorative study into the new sector of kelp for food consumption, and if this new sector can become a sustainability transition in the agrifood systems. Data in the study show that this sector has been growing in numbers and production volume, and the actors are mostly new, with various backgrounds. The role of the big actors is important, an incumbent niche interaction, and a bigger impact from incumbent actors that may now accelerate a transition is in motion as the transition literature project have a greater impact on these transitions.

How will Norwegian kelp cultivation actors use the potential for kelp farming on the coast of Norway and create sustainable food for the future? Who are these new actors? Both new actors, and large actors from fish farming is working on developing this new sector with an increasing number of companies with different business philosophies and scales. The cluster collaboration with 70 members shows a goal-oriented path. With actors from kelp farming, business, R&D projects, public authorities, investors, and first movers is working to make a new sector succeed. Research is highlighted as important, going into real issues for the industry like reduction of iodine, process technology, or life cycle analysis, and reaching a market. This is vital for successful development, and explored in this study.

How will Norway's food industry use kelp in their production to create healthy and more sustainable food and meet new consumer trends? There seems to be a market in the Norwegian food industry, but there are certain factors that have to be solved on the production side in order to succeed. One big actor is now creating a market and accelerating the need for kelp in the food industry. The other actors in the food industry are all positive; even if they don't use kelp today, future use is likely. Consumers' demand push for this food will likely create a market for the kelp and for the cultivation businesses.

How are sustainability, and the UN Sustainability Goals SDG, impacting business development in the food industry and kelp sector? Sustainability impact both sectors, but the outcome may have a different implication for the success of kelp. If the kelp sector is not able to solve the food security issues, use of plastic ropes, energy use, and with this have high CO2 footprint; it is likely the food industry will regard this raw material as not being up to

meet their standards for sustainability. Using the expert interviews and the other case study evidence, it all together projects a likely picture of future trajectories, which also lies in the scope to explore future scenarios.

Will this new sector development and creation of value chain, production, and potential market, become a sustainability transition in the agri-food system? This Norwegian industry is at a good point in development and by now the most advanced in Europe, mainly due to these actors' devotion and collaboration. Have the industry solved its biggest obstacles in ten years? Marked being one of them, seems to be in formation. With the action of Orkla and the answers from the other informants in the industry, it seems there will be a good domestic market for the large-scale producers. Orkla alone will need large quantities, and as long as the producers overcome their major bottlenecks, it seems likely that the market will be ready for kelp. New signals from the government classifying seaweed as food - will be a gamechanger for the future export market.

It is likely that the development we have seen, with a bigger pressure on the landscape in concern with climate change, it will probably make the SDG and climate targets even more important for businesses. And likely lead to new political changes with new requirements for the traditional fish farming industry, if not from the Norwegian government, then from the EU regulations we comply to. Then the large salmon farmers will probably go into this business, when these challenges are solved. Use of the oceans and sustainable fish harvesting and aquaculture are in the spotlight on the national and international agenda, and this will probably lead to change in a more sustainable direction. The ecosystem services by kelp will provide a good solution.

Due to the limitations of scope and informants, I suggest further research on the Norwegian actors in salmon farming. This will unveil how these actors view the new kelp production industry and how or if they plan to get involved. If they will require kelp to implement in their own facilities, and be used as ecosystem services.

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9. Attachments

Attachment. 1

Intervjuguide bedrifter tare kultivering

1. Når ble virksomheten startet?
2. Når startet virksomheten med produksjon av tare?
3. Kan du beskrive bedriftens rolle i verdikjeden i tare-verdikjeden?
4. Hvor stort er produksjonsmålet, og til hvilke markeder? Eksport eller norsk marked?
5. Hva produserer bedriften?
6. Er bærekraft viktig i forretningsprofil og for valg av produksjon?
7. Har dere en klar strategi i forhold til utslipp og lavt CO2 avtrykk i produksjon? Er energibruk viktig?
8. Hvordan ser bedriften på vekstmuligheter lokalt, med hensyn til arbeidsplasser?
9. Hvor ligger det etter deres syn hindringer for vekst og oppskalering av produksjon?
10. Er lovverket innen aquaculture tilstrekkelig for å møte fremtiden og legge til rette for tare industrien?
11. Opplever dere at støtteordningen for innovasjon virker eller ser dere behov for det?
12. Hvordan opplever dere interessen eller mottakelsen for råvaren hos matindustrien?
13. Er nye forbrukertrender viktige for deres satsning?
14. Er samfunnsansvar viktig, eller en strategi for bedriften?

Attachment. 2

Intervjuguide matindustrien

Hva slags kunnskap har dere om tare? Bruker dere tare i dag, i produksjonen, eller har dere planer om å bruke tare i fremtiden? Hvis nei, hvorfor er det ikke aktuelt?

1. Nye mattrender: er det viktig for dere å være med eller foran i denne utviklingen? Hvordan ser dere på nye mattrender som økt bruk av plante dietter, noe dere satser på?
2. En studie fra Nofima viser at norske forbrukere har positive preferanser til å spise tare både av sunnhet og av bærekraft/miljøhensyn. Betyr slike studier noe for retningen dere tar for nye produkter?
3. Er næringsinnhold og helseaspektet viktig når dere bruker, eller vurderer å bruke tare i produksjon?
4. Er det aktuelt å bruke tare som erstatning for salt i deres produkter?
5. Er produksjonsmetoden eller prosesseringen og energibruk, viktig for råvarene dere velger å bruke?
6. Er det viktig hvor geografisk en råvarene er produsert? Betyr norsk produksjon noe for deres syn på, eller bruk av en råvare?
7. Er en tydelig bærekraftstrategi viktig for utvikling av bedriften, og i kommunikasjonen ut til forbrukere?
8. Hvordan påvirkes retningen i utviklingen og innovasjon i bedriften av FNs Bærekraftsmål (SDG)?
9. Kunne en råvare som tare brukes bevisst for å styrke bærekrafts profilen for bedriften ut mot forbrukerne, eller overfor eiere eller bransje?

10. Har dere gjort det, eller kan det være aktuelt for dere å gå inn i råvare leddet, for å sikre utvikling i leverandørindustrien, og tilgangen til en råvare for egen produksjon?

Attachment.3

Vil du delta i forskningsprosjekt til masteroppgave

“Creating a new industry for large scale cultivation/production of kelp and use in the food industry in Norway. A case study of possibilities and barriers”

Dette er et spørsmål til deg om å delta i et forskningsprosjekt hvor formålet er å undersøke hvordan det kan skapes nye verdikjeder for tare til bruk i den norske matindustrien. Hvordan kan vi skape en ny industri i Norge, og hvordan håper aktørene at denne skal se ut? Den norske matindustrien vil være et viktig marked for de nye tareprodusentene. Hvordan vurderer aktører i matindustrien denne råvaren, og muligheten for å bruke tare som ingrediens i sin produksjon, er spørsmål vi søker svar på i denne studien.

I dette skrevet gir vi deg informasjon om målene for prosjektet og hva deltakelse vil innebære for deg og bedriften/konsernet.

Formål

Forskningsprosjektet leveres som en masteroppgave ved Universitetet i Stavanger, på masterprogrammet Energy, Environment and Society. Studien er også en del av FOU prosjektet “SusKelpFood - Sustainable ingredient from cultivated kelp to the food industry”, hos Nofima som er en av aktørene i prosjektet, ved Dr. Dagbjørn Skipnes, seniorforsker ved Nofima Stavanger.

Formålet for SusKelpFood er å videreutvikle metoder for oppskalering av produksjon, og utvikle råvaren til storskala bruk i matindustrien. Prosjektet er tverrsektorielt, mellom partnere fra forskning, matindustrien og tare produsenter som skal jobbe sammen for å finne bærekraftige måter å produsere nyttige og sunne ingredienser av dyrket tare, for å skape nye verdikjeder og en ny norsk industri.

SusKelpFood blir ledet av Møreforskning og Havforskningsinstituttet, og starter opp i januar 2022. Miljøavtrykk, mattrygghet, næringsinnhold og tarens sensoriske egenskaper, skal det forskes videre på i prosjektet, for å gjøre råvaren klar til storskala matproduksjon hvor tare kan brukes som salterstatter, eller som en spennende smakskomponent.

I denne kvalitative eksplorative studien til mitt masterprosjekt vil jeg undersøke direkte med tareprodusenter i prosjektet, samt bransjeorganisasjoner og med aktører i matindustrien hvor jeg søker svar på følgende forskningsspørsmål:

Hvordan ønsker norske tareprodusenter å utnytte potensiale for tareoppdrett på kysten av Norge for å skape bærekraftig mat for fremtiden? Hvem er aktørene og hvor er de i prosessen? Hva fremmer og hva hemmer utviklingen for storskala produksjon?

Hvordan vil matindustrien i Norge bruke tare i sin produksjon for å skape verdier, møte nye forbrukertrender, og lage sunn og bærekraftig mat? Kan denne råvaren brukes strategisk i utviklingen av klima-og bærekraftsarbeid for konsernet/bedriften?

For å svare på disse forskningsspørsmålene ønsker jeg å intervju deg og din bedrift for å kartlegge hvordan dere jobber, eller planlegger å jobbe med tare som råvare. Målet er å danne et bilde av hvor de relevante aktørene for/i er i utviklingen i denne nye næringen og bruken av den nye maten fra den blå åkeren.

Hvem er ansvarlig for forskningsprosjektet?

Forskningsprosjektet blir utført som masteroppgave ved UIS, Samfunnsvitenskapelig institutt ved masterprogrammet, Energy, Environment and Society ved student Solfrid Sande. Oppdragsgiver eksternt er Nofima, Stavanger, ved Dr. Dagbjørn Skipnes og prosjektet SusKelpFood.

Hvorfor får du spørsmål om å delta?

For å oppnå formålene i prosjektet ønsker vi å ha med relevante bedrifter innen tareproduksjon, og store aktører i matindustrien som jobber med produktutvikling, bruker nye ingredienser, og som ser eller skaper mattrender. Vi ønsker å intervju eksperter på feltet i de relevante bedriftene.

Hva innebærer det for deg å delta?

Hvis du ønsker å delta i prosjektet innebærer det at du stiller opp til en intervju. Intervjuet vil foregå på lokasjonen med bedriftsbesøk hos **tareprodusentene** om mulig. Intervju over Microsoft Teams som alternativ. Ved bedriftsbesøk vil det blir tatt foto, og gjort intervju som tar cirka en time, et semistrukturert intervju med intervjuguiden vedlagt som guide.

For deltakere i **matindustrien** vil intervjuet foregår online på Microsoft Teams, og det vil omtrent ta 30 minutter. Det vil også være mulig med en skriftlig svar på spørsmålene, om et intervju blir vanskelig. Det vil i hovedsak inneholde spørsmål om din virksomhets rolle og

planer for tære som råvare. Men også spørsmål om bedriftens profil eller utvikling i forhold til ESG, klima- og bærekraft profi, med et semi strukturert intervju med intervjuguiden som base.

Intervjuet vil ikke bli tatt opp elektronisk, men det vil bli skrevet ned notater manuelt.

Ønsker informanten og bedriften å være anonymisert i rapporten vil det være mulig.

Frivillig å delta i prosjektet

Det er frivillig å delta i prosjektet. Hvis du velger å delta, kan du når som helst trekke samtykket tilbake uten å oppgi noen grunn. Alle dine personopplysninger vil da bli slettet. Det vil ikke ha noen negative konsekvenser for deg hvis du ikke vil delta eller senere velger å trekke deg.

Ditt personvern – hvordan vi oppbevarer og bruker dine opplysninger?

Opplysningene du vil oppgi under intervjuet vil kun brukes til ovennevnte formålene med prosjektet og vil behandles i samsvar med personvernregelverket.

Ønsket for studien er at bedriftene og ekspert kildene er åpne. Er det ønskelig med anonymisering kan dette gjøres om det må tas bedrift sensitive hensyn eller konkurransehensyn. Deltakerne i ekspertintervjuene vil få lese gjennom og godkjenne de data som skal brukes i studien fra det enkelte intervjuet. Masteroppgaven avsluttes etter planen er 15 juni 2022. Den ferdige oppgaven vil da være tilgjengelig hos Nofima og for forskningsprosjektet SusKelpFood, samt offentlig tilgjengelig gjennom utdanningsinstitusjonen Universitetet i Stavanger. Råmaterialet, eller intervjuene vil ikke lagres etter master prosjektets slutt, eller lagres elektronisk.

Dine rettigheter

Så lenge du kan identifiseres i datamaterialet, har du rett til: innsyn i hvilke personopplysninger som er registrert om deg, og å få utlevert en kopi av opplysningene, å få rettet personopplysninger om deg, å få slettet personopplysninger om deg, og å sende klage til Datatilsynet om behandlingen av dine personopplysninger.

Hva gir oss rett til å behandle personopplysninger om deg?

Vi behandler opplysninger om deg basert på ditt samtykke. Så lenge du kan identifiseres i datamaterialet, har du rett til å få innsyn i hvilke personopplysninger som er registrert på deg. Du kan få rettet personopplysninger, få slettet personopplysninger, få utlevert en kopi av personopplysningene. Du har også anledning til å klage til personvernombudet eller Datatilsynet om behandlingen av dine personopplysninger.

Du vil få mulighet til å lese intervjuet, samt sluttrapport for prosjektet.

På oppdrag fra Universitetet i Stavanger har NSD – Norsk senter for forskningsdata AS vurdert at behandlingen av personopplysninger i dette prosjektet er i samsvar med personvernregelverket.

Hvor kan jeg finne ut mer?

Hvis du har spørsmål til studien, eller ønsker å benytte deg av dine rettigheter, ta kontakt med:

Solfrid Sande, masterstudent ved UIS. Tlf. 99154034, epost@solfridsande.no

Dagbjørn Skipnes, Seniorforsker hos Nofima som co-veileder. 92692252, dagbjorn.skipnes@nofima.no

Veileder Universitet i Stavanger, Reidar Staupe-Delgado, reidar.staupe-delgado@uis.no

Hvis du har spørsmål knyttet til NSD sin vurdering av prosjektet, kan du ta kontakt med: NSD – Norsk senter for forskningsdata AS på e post ([HYPERLINK "mailto:personverntjenester@nsd.no" personverntjenester@nsd.no](mailto:personverntjenester@nsd.no)) eller på telefon: 55 58 21 17.

Med vennlig hilsen

Solfrid Sande
prosjektansvarlig og masterstudent

Samtykkeerklæring

Jeg har mottatt og forstått informasjon om prosjektet "Creating a new industry for large scale production of kelp and use in the food industry in Norway. A case study of possibilities and barriers", og har fått anledning til å stille spørsmål. Jeg samtykker til:

Å delta som intervju respondent i ekspertintervju.

Jeg samtykker til at mine opplysninger behandles frem til prosjektet er avsluttet 15.06.2022

(Signert av prosjektdeltaker, dato)

