



SEAWEED INDUSTRY IN EUROPE

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INTRODUCTION

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In the past, storm cast* seaweed was gathered on foot and without mechanization or any equipment. Since the beginning of the 17th century, the commercial use of seaweed, for commercial purposes, such as in the production of glass, encouraged local populations to regulate the activity by establishing rules. For example in France, the first national text, regulating seaweed harvesting, is an ordinance of 1681 which fixed the harvesting seasons of kelp and the number of authorized harvesting days. The use of seaweed for iodine production and later for alginate prompted improvements in harvesting techniques, in order to meet the increasing industrial demand industry for the raw material. Equipment to cut seaweed and boats to carry the algae ashore were first used early in the twentieth century. In 1970, harvesting of *Laminaria digitata* and *Laminaria hyperborea* was mechanized in France and Norway. In Europe, the main exploited algae species are *Laminaria hyperborea*, *Laminaria digitata* and *Ascophyllum nodosum*. These species, and especially kelp forests, are considered among the most ecologically dynamic and biologically diverse habitats on the planet. Other species are found on the European Atlantic coast but few of them currently have a commercial value.

European scientists have mainly focused their research mainly on kelp which is considered a Keystone Species and whose presence affects the survival and abundance of many other species in the ecosystem. Nowadays, the preservation of kelp forests is placed at the center of environmental concerns and some countries have decided to protect these habitats by restricting the use of mechanical harvesting or by creating protected areas around them.

Within this context, mechanical kelp harvesting and seaweed gathering by foot, generate much discussion between scientists, fishers, processing industries and environmental non-gouvernemental organisations. Kelp harvesting is blamed for harming the ecosystem because of the damage it can cause to substrates and to the habitats of certain fish. For some scientists the removal of the kelp species provokes negative effects on the invertebrate species that live in the holdfast, the stipe or fronds or under the fronds. In countries where *Laminaria spp* is harvested with mechanical equipment, scientists appear to be concerned with the equipment's impact on the species and also on the surrounding ecosystem.

This document presents the main characteristics of the seaweed industry in Europe, illustrated by examples from six European countries (Norway, France, Ireland, Spain, United Kingdom and Portugal). The aim is to have an overview of the European seaweed industry from the six baseline reports prepared by the partners of this project, from literature sources and information gathered during semi-structured interviews of different stakeholders.

This document briefly presents the history of seaweed harvesting activity in Europe, the current production and the techniques used in the different countries. The different regulatory systems for the resource and coastal access are detailed followed by the management of the resource and finally the management of the human beings focusing on the social dimension of the activity. The diverse uses of the seaweed resource are outlined.

*material deposited on the shore after storms.



SEAWEED HARVESTING: AN ANCIENT ACTIVITY

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On the European Atlantic coast, macroalgae have been harvested by coastal populations for a long time. Two main uses were identified: human consumption and agriculture (cattle food and soil enrichment). Archaeologists and ethnologists have mentioned other uses such as fuel, mattresses, etc.

The first recorded commercial use of seaweed is in the 17th century when it was used for the production of glass (France, Norway). Coastal populations, mainly farmers, gathered and burnt algae to produce ash, a source of potash for the production of glass and soap.

The development of these industries has strongly changed the functioning of coastal populations. Several historical sources from Norway refer to conflicts between farmers and navigators regarding the dense smoke from algae burning. In, 1800, Norway exported 1500 tons of potash for the production of glass and soap. On the French Atlantic coast, the farmers also gathered seaweed and dried them on the dunes. The use of kelp, for potash production, became so intensive that it altered the structure of the harvesting. This activity was so labour intensive to meet the industry's demand and that it required the participation of the whole family. In addition, the coastal communities often called the inland communities for help.

Meanwhile, seaweed harvesting also considerably increased in Ireland. As the population increased and as the land was divided among children of a same family, pressure on the productivity of the land lead small holders to use seaweed as fertilizers to produce quantities of subsistence crops beyond the normal capabilities of their lands.

In the 19th century, the use of seaweed shift from for the potash production for the glass industry to the production of iodine. The iodine production constituted the main use of seaweed until the 2nd World War when chemical material replaced seaweed. The European seaweed industry however persisted thanks to the discovery of hydrocolloids and especially alginic acid. Even the first extraction of alginates began early in some countries, it was only at the end of 1950's that industrial production became established.



*Kelp harvesting on Molène Island (Brittany, France), 1953,
Revue Semaine du Monde, © molene.fr*

Soda oven used to burn kelp,
Balanec © Vincent Squiban,
molene.fr

SEAWEED PRODUCTION AND SPECIES IN EUROPE

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The European seaweed industry is mainly based on the harvesting of macroalgae. Consistent data about seaweed production are difficult to find and also subject to caution as it is rarely made clear if the data refer to raw material or to dried material. FAO statistics are the only source of data covering all countries in the world. According to these data, over 15 million tons of macroalgae (brown, red and green) were produced worldwide from capture and aquaculture in 2009. The world production increases by 5.7% every year. Capture production accounts for only a few percent of the total. Cultivated seaweed is produced mainly in Asia. In Europe the production remained stable above 350,000 tons until 2000 and has since decreased by almost one third. The reversal of this trend will depend on stable access to raw material, the development of value added products and the transfer of expertise between regions where the production is well developed and those wishing to promote the industry.

In the six countries studied several hundred of species are found but only few dozen all of them are exploited.

The commercial value and the amount of landing for each species vary and are directly linked to harvesting techniques. The most important, in terms of landings and value, are *Laminaria digitata*, *Laminaria hyperborea* and *Ascophyllum nodosum*. This importance is explained by the fact that *Laminaria digitata* and *Laminaria hyperborea* are both harvested mechanically by boat in France and Norway. *Ascophyllum nodosum*, is harvested by boat in Norway. In France and Ireland, *Ascophyllum nodosum* is harvested manually. All the other species are harvested manually either on foot or by diving.

Species harvested and harvesting techniques in Europe

Species	Gathered by hand on shore (drift and attached)	Mechanical harvesting	Diving	Farming (including trials)
<i>Alaria esculenta</i>				  
<i>Ascophyllum nodosum</i>	    			
<i>Asparagopsis armata</i>				  
<i>Chondrus crispus</i>	    			 
<i>Codium sp.</i>	 			
<i>Corallina officinalis</i>				
<i>Dilsea cariosa</i>				
<i>Fucus ssp</i>	    			
<i>Gelidium corneum</i>				
<i>Gelidium sesquipedale</i>	 		 	
<i>Gigartina pistillata</i>	 			
<i>Gracilaria spp.</i>				
<i>Himanthalia elongata</i>	   			
<i>Laminaria digitata</i>	   	 		  
<i>Laminaria hyperborea</i>	  	 		
<i>Mastocarpus stellatus</i>	    			
<i>Palmaria palmata</i>	     			  
<i>Porphyra umbilicalis</i>	  			  
<i>Saccharina latissima</i>	   		 	   
<i>Ulva sp.</i>	     			 
<i>Undaria pinnatifida</i>				 

HARVESTING TECHNIQUES

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Two main techniques of seaweed harvesting can be found within the six countries: mechanical and manual harvesting (from the coast or diving).

Mechanical harvesting

Mechanical harvesting is undertaken by boats and is mainly practiced in Norway (Rogaland to Sør-Trøndelag), France (Brittany), Spain (Galicia and Asturias) and to a lesser degree in the Basque country (France) and Ireland. The development of the mechanization of seaweed harvesting occurred in the middle of 1970's in France and Norway in response to the increasing demand for raw material for the alginate extracting industry. The evolution and success of mechanization was due to the close collaboration between scientists and fishers, and to exchanges between these two countries.



(1) Vessel with seaweed trawl, used to harvest *Laminaria hyperborea* in Norway © FMC biopolymer Corp.



(2) Vessel with a « scoubidou », used to harvest *Laminaria digitata* on the coasts of Brittany (France) © Maguire.



(3) Vessel with a paddle wheel cutter, used to harvest *Ascophyllum nodosum* in Norway © Sander.



(4) Vessel with a vacuum-sucker, used to harvest *Ascophyllum nodosum* in Norway © Rebours.

Manual harvesting



Fucus cutting with a knife © Agrocampus Ouest

Manual harvesting of seaweed and gathering of storm cast seaweed are important in all the countries studied, with the exceptions of Norway and the UK where seaweed harvesting seems to be limited to domestic use. Harvesters gather either the cast or cut seaweed at low tide. Seaweed gatherers use specific equipment to harvest seaweed, for example knives, rakes, pitchforks, sickles, nets, etc.

The seaweed is cut and put in bags or onto a boat to be transported to the land. Some gatherers use small boats that they load with seaweed and then pull them to the beach with the help of the rising tide. In Ireland, for example, when the harvesting is finished, and when the tide rises, the bundles of seaweed (*Ascophyllum nodosum*) float to the surface and the harvester then takes a small boat out to pull the bundles ashore. Diving is another way to harvest seaweed manually and is practiced mainly in Portugal.

ACCESS REGULATION TO FORESHORE AND RESOURCES

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Another important issue, differentiating the Northern European and Southern European countries, is the access rights to foreshore and to the coastal resources. In Southern Europe (France, Portugal and Spain) the beach, the foreshore and the sea are public domain and are under the responsibility of the State. The use of this maritime space is at the discretion of public authorities. In France, the maritime prefect is the representative of the State at sea. His competences extend from the bottom of the watermark to the end of the waters within French jurisdiction.

In Spain, the regional fisheries administration has authority within the 8 nautical miles from shore to sea and the State administration for the area between 8-12 miles.

In Portugal, the fisheries authorities, at national level, have the competency to manage the area within the 12 nautical miles in addition to all fisheries activity. In the Northern European countries (Norway, United Kingdom, Ireland) the maritime space can belong to the state, the crown (in UK only) or to landowners.

For example in Ireland, in the 19th century, some landowners were given “seaweed rights” allowing them to harvest seaweed along the foreshore alongside the boundaries of their lands. These rights, given during the British dominion, are still valid if landowners are able to produce the title. “Seaweed rights” are today, considered as one of the main obstacles to seaweed harvesting development in Ireland.

In Ireland, following the “Foreshore Act” (1933) all persons or companies, seeking to harvest wild seaweed, must possess a license from the Department of Environment Heritage and Local Government. This “Foreshore Act” prohibits the removal of “beach material” from any area of the shore with a special mention concerning seaweed: “(...) and also seaweeds whether growing or rooted on the seashore or deposited

or washed up there on by the actions of tides, winds; and waves or any of them”. The process to acquire a license is very complicated and many people are discouraged from seeking one. Mechanical harvesting also requires authorization but for the moment Irish authorities, do not issue such authorizations, because the National Parks and Wildlife Service (NPWS) has expressed its opposition to the introduction of mechanical harvesting of seaweed (specifically kelp) in Ireland. The NPWS has expressed a negative opinion on the removal of seaweed from the marine ecosystem, specifically “that such activities are not compatible with the conservation objectives of, and should not be permitted in Natura 2000 sites”.

In the United Kingdom, part of the foreshore, the area between the edge of high and low tides, can be privately owned. This is the case in large areas of Scotland where harvesters need a lease from the beach-owners to remove seaweed from the beach. However, harvesting seaweed below the low tide mark anywhere in the UK requires a lease from the Crown Estate (authority) in addition to one from the beach-owner (for access). The Crown Estate authority, a semi-Govt organisation, manages most of the UK seashore, which extends from high tide level to the 12 mile limit. So if one wants to harvest in this area one needs a lease from the Crown Estate. Only two seaweed leases exist in the UK; one in Northern Ireland for seaweed used in thalassotherapy and one for which no information is available.

In Norway, the harvesting of *Ascophyllum nodosum* is conducted within private lands. Companies need to obtain agreements with a large number of private owners in order to operate in these coastal areas. They pay a fee to the landowners and the harvest agreement has to be renewed every time an area is harvested. As the only company exploiting *Ascophyllum nodosum* started in 1937, the landowners are familiar with the company and they usually renew the agreement.

MANAGEMENT OF SEAWEED HARVESTING AND RESOURCE

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Management tools implemented differ according to the country, the species and the harvesting technique. Seaweed harvesting is regulated with different tools: licenses or harvesting authorizations, quotas by harvesting zone, individual quotas by boat, harvesting size and rotation systems.

These regulations can be managed by national and regional administration or fishers' organizations with the approval of the public authorities (France, Spain). In countries where the processing industries harvest raw material directly (Norway), the total amount of landings is fixed by the industry based on two conditions: the availability of the stocks and their needs.

For example, in Brittany (France), the regional committee of fisheries through commissions, gathering fishers, seaweed harvesters, processing industries and scientists suggest regulations which are then approved by State administration. In 1986, the regional committee of fisheries established a license system for *Laminaria digitata*. The maximum handling capacity of the local processing industry also plays an important role in the management of kelp harvesting. In 2008, a weekly quota was instituted for *Laminaria digitata*. The commercial exploitation of *Laminaria hyperborea* started in 2008 and is subject to a license and quota system proposed by the scientific institute in charge of the monitoring of this activity. Since 2010, the processing industry has signed contracts directly with fishers in which they specify the maximum amount they wish to buy from them. The industry's power is very important and fishers must respect the quantities set if they want to avoid financial penalties (for example, if they exceed the volumes set). Its powers are not limited to landings; they also set the purchase price of the raw material. In the past, the prices were negotiated, collectively between fishers and the two main industries. But since 2010, the situation has changed and each company sets a purchase price with a fisher for a given harvesting season. The seaweed gatherers on foot are subjected to harvesting authorizations which have to be renewed every year.

In Norway, the harvest of seabed algae has been regulated since 1963, originally to avoid conflicts with fishers. Seaweed harvesting of *Laminaria hyperborea* and *Ascophyllum nodosum* is conducted by two processing industries. Seaweed harvesting is regulated by the State and national and regional regulations define the sectors open for exploitation and are subjected to a rotation system. Before the enactment of the law on Management of Wild Marine Resources in 2009, the seaweed processing industries had the responsibility to undertake the stock evaluation studies with scientists and then to establish the management rules to regulate the activity. This is now directly under State control.

Both in Norway and France a rotation system was implemented for the harvesting of *Laminaria hyperborea*. To allow for the renewal of the exploited stock, which has a lower growing rate than *Laminaria digitata*, each harvesting area is closed for 4 or 5 years after harvesting.

In other countries, licenses or individual quotas, imposed by market demand, are available for mechanical harvesting. The administrative authorities and other stakeholders taking part in the management of the activity seek to fairly share the resources between harvesters especially when the area is managed by fishers' organizations. Manual harvesting is less regulated and less controlled by the authorities. Each gatherer on foot acts individually with the objective to gather the maximum.

In Ireland, the public authorities, in charge of natural conservation policies, have more power in seaweed management than the administration regulating fisheries activity. There are no legal rules concerning the type of seaweed that can be harvested. Harvesters follow the traditional and informal rules of harvesting which are often limited to the size of plants required by the processing industries.

SOCIAL DIMENSION OF SEAWEED HARVESTING

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Little information is available in Europe on the social status of seaweed harvesters. The legal status of harvesters varies between countries and has been a focus for our study. Seaweed harvesters can be employees of the processing companies, independent workers, fishers or illegal workers.

Harvesters working on boats

In France, harvesters working on board kelp boats have a legal status, which gives them access to health insurance, pensions and other social benefits. They are considered as fishers and practice seaweed harvesting only for one part of the year. French fishers have their own social security fund and they pay a monthly contribution.

The majority of Norwegian harvesters are employed by the processing industries and they have access to regular social benefits. Others are declared as self-employed and also access regular social rights and benefits. This situation was altered in 2009 with the introduction of a

new law on the management of wild marine resources. With this law, seaweed harvesters on board are registered in the fisheries' register and harvesters are considered as fishers and have the same rights and duties as fishers.

In the Spanish regions, where seaweed harvesting is still practiced, the harvesters operating by boat are considered as fishers and have their own social security system. This system is managed by the Marine Social Institute and it gives access to a pension. Health is covered by another system.

Seaweed gatherers on foot

The situation of seaweed gatherers on foot is different. Traditionally, gathering on foot is an activity undertaken by coastal populations seeking to increase their income. In countries, where the seaweed industry is based on manual harvesting, it is difficult to control the activity and to obtain agreements on the status of harvesters. For example, in the Basque country and in Cantabria, seaweed gatherers on foot are mainly immigrants and are not officially registered, so it is difficult to find information about them. In Galicia and Asturias, the situation is different because the regional fisheries authorities have supported the development of seaweed harvesting. Seaweed gatherers contribute to the fishers' social security systems.

In Portugal, seaweed foot gatherers or divers are declared as self-employed and not as fishers. In fact in Portugal the payment of fishers' social security is within the auction system where the contribution is a percentage of the fish sales. Seaweed is not sold in the auction system so harvesters cannot be part of the fishers' social security system. In theory, seaweed harvesters and divers should contribute to the self-employment social security system, but in practice nobody knows if they contribute to any social security system.

In France, up until 2008, there have been campaigns for a system more favorable for

the harvesters. The new system, introduced in late 2008, maintains only two categories of harvesters: the professional gatherers, who can be affiliated to fishers' or farmers' social security systems and the temporary workers who are employed casually (maximum of 3 consecutive months) by the processing industries. Each year, the different local processing industries have to ask for authorization to employ a specific number of gatherers as temporary workers. Their social security is paid directly by the industry to the farmers' social security system. Each company provides the fisheries administration with the name of all the people employed by them. The same person can be employed by different industries as their salary is based on the quantity harvested. Permanent employees of the processing industries can also be seaweed gatherers, provided they obtain authorization from the fisheries authorities.

In Ireland, the majority of harvesters are not declared except the harvesters, who have a license. Harvesting of *Ascophyllum nodosum* constitutes a complementary income for the coastal population living in the western coast of Ireland but only a few people are declared as seaweed harvesters. As a result, the number of harvesters is unknown. It seems that in 2011 the number may be higher than in the past due to the economic crisis and the increase in migrants returning to the coast.



Gelidium sesquipedale harvesting on the coasts of the Basque country (Spain) © Carballo

CURRENT USES OF SEAWEED

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Nowadays, the European seaweed processing industry is divided into two main categories: those producing alginic acid and those producing products for agriculture (fertilizer, animal feed). The production of alginate and the production of meal for agriculture require vast quantities of raw material. In order to limit transportation costs of wet material and to remain competitive with the importation of dried material, industries often decide to settle close to seaweed landing areas.

In France, for example, the two main companies are located in North Finistère, where the most important kelp forest is found. In Norway, the geographical area for *L. hyperborea* harvesting is very large and the processing company uses boats to transport seaweed. In Ireland, the company processing *A. nodosum* is located on the west coast of the country where seaweed is gathered. Other small companies are located in the same area. In Norway, the company exploiting and processing *Ascophyllum nodosum* for cattle food, fertilizer, and other products is also based on the coast near the harvesting areas.

An element to be noted is that the majority of European seaweed processing industries are owned by multinational companies. In Ireland, however, the main processing industry has a semi-state status.

An issue, arising from the Netalgae project data, is the reduction of the size of the seaweed processing industry. Different reasons can explain this phenomenon such as the decrease in seaweed stocks, the high cost of European labor and the environmental constraints. For example, seaweed harvesting has been recently forbidden in the Spanish Basque country due to the implementation of a marine Natura 2000 area. In Ireland, environmental NGOs claims halted the expansion of mechanical harvesting.

Local seaweed production is not fully sufficient to satisfy the high demand of the processing industries and especially the ones extracting alginates. The processing industries, which have access to the raw material locally (example France, Norway, Ireland), also import dried seaweed when local supplies are out of season or not sufficient. Some processors can chose to delocalize their processing tools to third countries, where they can access cheap raw materials and cheap labour (Chile, Philippines, China and others). The recent interest of bio-fuel production industries in the macroalgae sector will probably generate further pressure on wild resources. It may also lead to the development of macroalgae farming in Europe.

Main macroalgae uses in Europe

Species	Uses
<i>Alaria esculenta</i>	 
<i>Ascophyllum nodosum</i>	
<i>Asparagopsis armata</i>	
<i>Chondrus crispus</i>	 
<i>Codium</i> sp.	 
<i>Corallina officinalis</i>	  
<i>Delesseria sanguinea</i>	
<i>Dilsea carnosa</i>	 
<i>Fucus</i> ssp.	  
<i>Gelidium corneum</i>	
<i>Gelidium sesquipedale</i>	
<i>Gigartina pistillata</i>	 
<i>Gracilaria</i> spp.	
<i>Himanthalia elongata</i>	
<i>Laminaria digitata</i>	   
<i>Laminaria hyperborea</i>	  
<i>Laminaria ochroleuca</i>	
<i>Laurencia pinnatifida</i>	
<i>Mastocarpus stellatus</i>	 
<i>Palmaria palmata</i>	 
<i>Pelvetia canaliculata</i>	
<i>Porphyra umbilicalis</i>	 
<i>Saccharina latissima</i>	  
<i>Ulva</i> sp.	 
<i>Undaria pinnatifida</i>	 



Agricultural supplies



Seaweed vegetable



Health and well-being



Food processing, chemistry

Seaweed use: hydrocolloids

Nowadays, the European seaweed industry can supply several markets (human consumption, cosmetics, pharmacology, etc.) but seaweed is mainly used to produce hydrocolloids: alginate, agar-agar and carrageenan.

ALGINATE

Alginates are polysaccharides that are extracted from brown algae (especially *Laminaria digitata*, *Laminaria hyperborea* and to a lesser degree *Ascophyllum nodosum*). They are of commercial importance because of their very good gelling and bio-active properties such as being natural, bio-compatible, biodegradable and bio-adhesive. Nowadays, alginates are used in the food processing industry as thickening and gelling agents and are commonly used in the pharmaceutical industry, and in the production of textiles as well as in many other applications. The

development of alginate extraction uses contributed to the intensification of seaweed harvesting and the development of mechanical harvesting gear. Nowadays, alginates are mainly extracted in Norway and in France by respectively one and two multinational companies, respectively.

AGAR-AGAR

Agar-agar is obtained from *Gelidium spp.*, *Gracilaria spp.* and *Porphyra spp.*. Agar-agar is a gelling agent that is stable at relatively high temperatures. This product is thermoreversible over 85°C and re-gels when cooled. These properties make agar-agar a useful product as a substrate for culturing media and for the food-processing industry. The producers of agar-agar are located in France (Basque country), Spain and Portugal, since local seaweed has the right quality for this product. In Spain it seems that the promotion of this activity was undertaken by Japanese companies' around 1950. In the Spanish Basque country, the agar-agar production closed down in 2000 when the regional authorities prohibited seaweed cutting. In Asturias, where seaweed harvesting is still practiced, there are several processors industries producing agar-agar. In Galicia, seaweed harvesting is still important and the number of processing operations is higher than in the two previous regions. Of all macroalgae harvested in Portugal, *Gelidium spp.* is the most sought-after for the production of agar-agar. The production is nevertheless much less important than in the 60's when Portugal was one of the first producers of agar-agar worldwide.

CARRAGEENAN

Chondrus crispus (photo opposite), *Mastocarpus stellatus* and *Gigartina pistilatta* are used to produce carrageenan. Carrageenans are especially used in the manufacturing of dairy products and meat reconstruction for their thickening, gelling and stabilising properties. In Spain, one processor company extracts carrageenans. In Norway, one company produces carrageenans from imported species. This is also the case in France.

Seaweed uses in agriculture

The primary applications of algae and/or their extracts in agriculture are as fertilisers and animal feed. In France, soil improvement using fresh seaweed is seldom practiced. In Portugal, two main mixes of algae are traditionally used in agriculture as fertiliser, "moliço" (*Ulva*, *Gracilaria*, *Lola* and also *Zostera*, *Ruppia* and *Potamogeton*) and "sargaço" (*Saccorhiza*, *Laminaria*, *Fucus*, *Codium*, *Palmaria*, *Gelidium* and *Chondrus*). In Ireland, most seaweed production is used in agriculture and horticulture.

Seaweed uses for human consumption

Some species are exploited and used for human consumption. In the countries studied, and particularly in France, Spain (Galicia) and Ireland, there are small and medium enterprises using edible seaweed. These new types of industry have been developed over the past few years following the increasing demand from European consumers. All the edible algae are harvested manually and dried in an artisanal way.

Seaweed farming

Macroalgae farming is not very well developed in Europe. Commercial aquaculture of seaweed is found in France (Brittany, 6 farms) Spain (Galicia, 2 farms) and on an experimental basis in Ireland, Asturias (Spain), Norway and the United Kingdom. The main cultivated species are *Saccharina latissima* and *Undaria pinnatifida*. In Ireland, *Palmaria palmata* farming is being experimented with on the west coast but the results seem limited.

The main constraints on the development of seaweed farming have been the lack of markets and the high cost of European production compared to Asian production.

In France, new projects for the development of seaweed farming started in 2010. The aim is to diversify the activity of oyster farmers facing economic difficulties due to the over-mortality of oysters. These projects benefited from regional and national subsidies (national research agency) to develop seaweed farming based on natives species.

The possibility to produce bio-fuel from macroalgae may be a factor in the development of macroalgae aquaculture in Europe. A Norwegian company suggested the development of 5 clusters of seaweed farming producers between Norway and Portugal each producing 15 millions of tons of wet products for the production of 3200 millions of liters of bio-ethanol. These projects will depend on the development of macroalgae farming in Europe.

Another project is proposing to grow seaweed as a means of water purification. Studies are currently being conducted to investigate the economic potential of the commercial production of seaweed around salmon aquaculture facilities. The work is funded by EU research programs and is a collaboration between companies from Norway and the Netherlands.

DISCUSSION

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The European seaweed industry is dominated by Norwegian, French and Irish production. Spain and Portugal are small suppliers and production has almost disappeared in the UK since the last processing plant in Scotland closed recently.

The presence of processing industries is a major driver in the persistence of seaweed production. These are always located close to production areas. Although the uses of seaweed vary according to species and country and have changed over time, alginates production is the main end product of seaweed in Europe today.

Despite the development of mechanized harvesting gear on boats, there is still a significant amount of activity conducted by foot gatherers. Their status is not fully recognized in all European countries leaving room for further discussion on their professional status and development. In most cases, local or national public authorities, fisher organizations (where they exist) and the processing industries are jointly involved in the development of regulations concerning seaweed harvesting and also in the marketing related rules.

Due to the lack of competitiveness of the European industry compared to its Asian counterpart and despite the rising world demand, the production of seaweed in Europe has decreased in the past decade. The processing industries raise doubts concerning the usefulness of remaining based in Europe and partly compensate for the lack of European product by using external supply. New markets may reverse this trend, such as the increase in edible seaweed production, (this is currently a niche market), the growing demand of the biotech sector or the development of bio-fuel based on seaweed. The rise of conservation claims however may modify models of wild stock exploitation and increase the appeal of a sustainable seaweed farming sector.

References

This document has been drafted within the framework of the Netalgae project. It includes elements presented in national reports produced by the project partners. All the reports are available online at: www.netalgae.eu

Red algae, *Chondrus crispus*,
used to extract Carrageenans
© Ifremer Olivier BARBAROUX






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ATLANTIC AREA Transnational Programme
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