OVERVIEW OF THE SEAWEED INDUSTRY BY COUNTRY

IRELAND, FRANCE, NORWAY, PORTUGAL, SPAIN, UNITED KINGDOM

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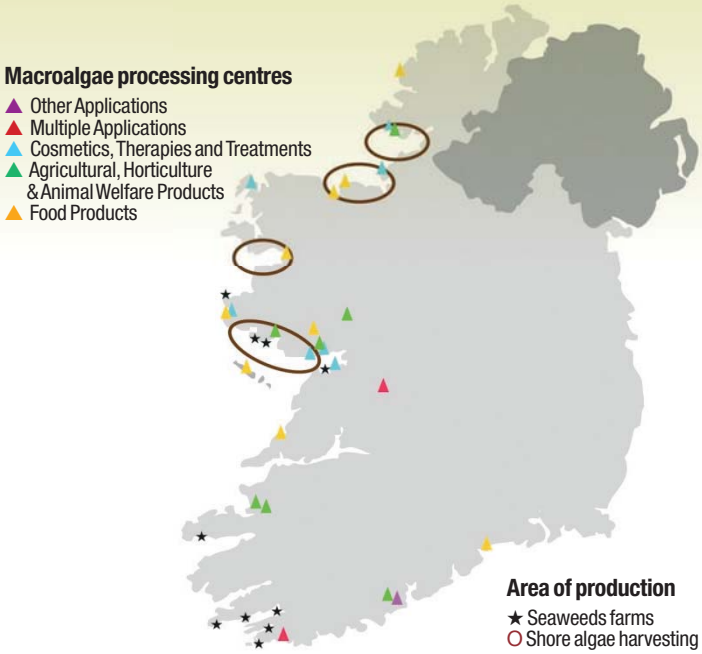
netalgae

A summary of the initial findings of the netalgae project regarding the current status of the seaweed industries in the participant countries

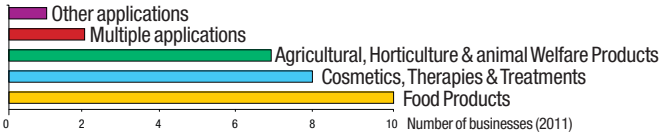
IRISH INDUSTRY

Overview of the Irish macroalgae industry



Uses of algae Resources in Ireland

(Domestic & Imported raw materials)



Source : BIM 2011

The Irish Macroalgae Industry

The Irish macroalgae industry employs 185 people and is worth approximately €18 million per annum*. Over 99% of raw material comes from the manual harvesting of natural resources, most of the harvesting occurs along the coasts of Donegal, Sligo, Mayo, Galway, Kerry and Cork. Every year, approximately 30,000 tonnes of algae is processed in Ireland. The most important species is *Ascophyllum nodosum*, which accounts for approximately 25,000 tonnes or 95% of domestic production. *Ascophyllum nodosum* is processed at two factories on the west coast (Donegal & Galway) and is used to produce fertilizers, horticultural products and animal feed. A significant quantity of national production is sold as raw material for further industrial processing. Numerous other species are harvested and used for commercial purposes in Ireland including; *Fucus serratus, Chondrus crispus, Laminaria digitata, Fucus vesiculosus* and *Saccharina latissima*. Ireland has been importing significant quantities of *Lithothamnion corallioides* from Iceland for processing into agricultural and nutritional products. Aquaculture of macroalgae is still largely experimental in Ireland and has not contributed significantly to domestic production of algae, experimental cultivation of *Asparagopsis armata*, *Alaria esculenta, Palmaria palmata, Laminaria digitata* and *Porphyra has* been achieved over the last 20 years. Recently, the potential of algae for bio-energy production and strong interest in developing integrated multi-trophic aquaculture systems has given a new dimension to algae aquaculture. The Irish macroalgae industry is mainly focused on servicing the international agricultural, horticultural and animal welfare markets with approximately 95% of production being directed into these markets; still, small quantities are processed for speciality products like cosmetics, pharmaceutical, nutraceutical, food and other applications. Ireland exports a great deal of domestic seaweed production either as raw material or as processed products ready for the end use application.

Markets

Source : BIM 2011

* Morrissey, K., Hynes, S., Cuddy, M., O' Donoghue, C., (2010) Ireland's Ocean Economy.

Organization of macroalgae industry, from seaweeds to uses

Kinds of algae	Seabed algae		Shore algae				Cultivated algae
Authority and management	The Department of the Enviornment, Community and Local Government						The Department of Agriculture,Fisheries and Food
Management systems	Foreshore Licence						Aquaculture Licence
Producers	Sub-littoral harvesters		Shore harvesters				Algae Growers
Species of algae	*Lithothamnium (imported)* **	*L.digitata L.hyperborea* *	*A. Nodosum* ***	*P. palmata, C. crispus M.stellatus, S. latissima* *	*Fucus spp* *	*P. palmata, Porphyra spp. L. digitata, A. esculenta, A. armata* *	
Transformation	Drying, Grinding, Packaging	Maceration, extraction	Drying, Grinding	Drying, Conditioning, Packaging	Drying, Grinding, Packaging	Maceration, extraction	Drying, Grinding, Packaging
Products	Meals €€	Food processing industry €€	Contract products €€ / Meals €€	Alginates €€ / Meals €€€€	Foodstuffs €	Contract products €€ / Meals €€	Contract products €	Foodstuffs €

Uses
- Agricultural supplies and water treatment
- Food processing industry, chemistry and microbiology
- Health, well being
- Food (seaweed vegetables)

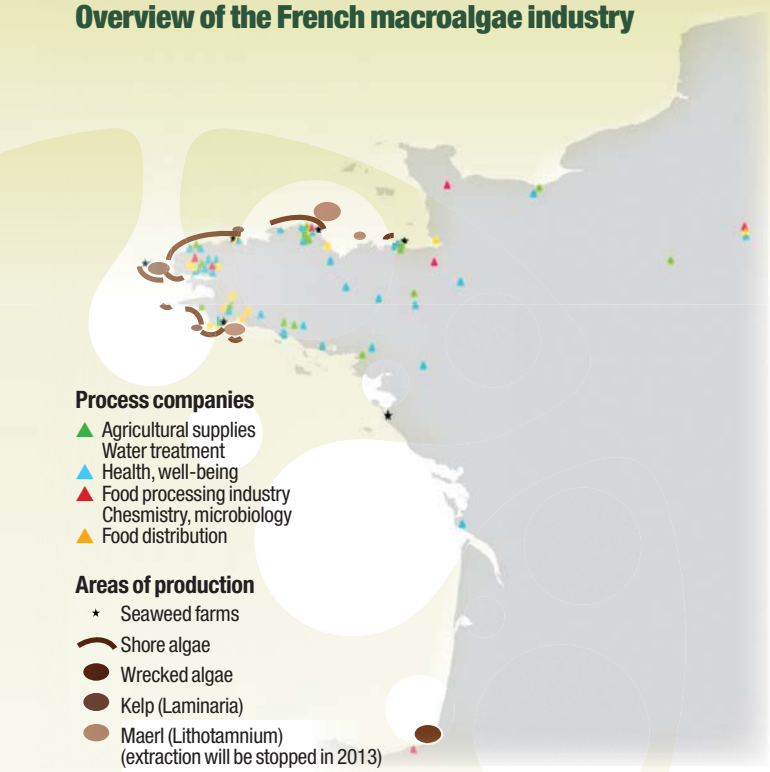
Degree of importance in harvested tonnage *(wet tons)*:
- **** : ≥ 100 000
- *** : 50 000
- ** : 5 000
- * : ≤ 1000

Economic importance *(in euros)*:
- €€€€ : very important
- €€€ : important
- €€ : less important
- € : not important

Irish Partners

FRENCH INDUSTRY

Overview of the French macroalgae industry



Process companies

- Agricultural supplies
  Water treatment
- Health, well-being
- Food processing industry
  Chesmistry, microbiology
- Food distribution

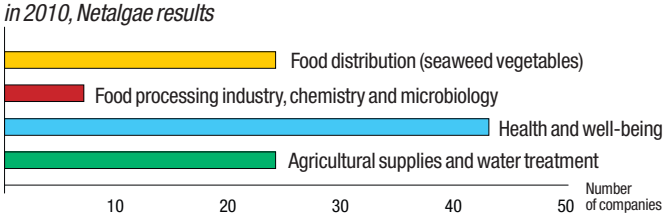
Areas of production

- Seaweed farms
- Shore algae
- Wrecked algae
- Kelp (Laminaria)
- Maerl (Lithotamnium)
  (extraction will be stopped in 2013)

- **Raw materials are sourced from wild resources**
  Almost 60 000 tons of seaweeds is produced annually (except Lithothamnium and Gelidium). Only 50 tons comes from seaweed aquaculture; the rest comes from wild seaweed (offshore, shore and beached seaweeds).
- **Brittany is the main area of production**
  Most French seaweed production comes from Brittany, and approximately 85% of the seaweed processing plants are based in this area. Only Gelidium, which is gathered in the Basque country, and seaweeds cultivated on a few seaweed farms come from other areas.
- **Diversified markets**
  - Food distribution (seaweed vegetables and additives)
  - Agricultural supplies (phytosanitary products, seaweed fertilizer and feed)
  - Water treatment (filtering and solutions)
  - Cosmetics, health and well-being
  - Chemistry and microbiology (culture media)

Markets

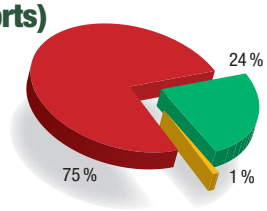
in 2010, Netalgae results



Uses (French production and imports)

CEVA (2005)

- Food distribution (seaweed vegetables)
- Agricultural supplies and water treatment, health and well-being
- Food processing industry, chemistry and microbiology



Organization of macroalgae industry, from seaweeds to uses

Category	Seabed algae		Wrecked algae	Shore algae			Cultivated algae
Authority and management	DDTM	DDTM (1) CRPMEM (2)	DDTM - CRPMEM				
Management system	Concession	Licence	Harvest authorization				Concession
Producer	Sand extractors	Offshore harvesters	Shore gatherers				Algae growers
Species of algae	Maerl - *Lithothamnium* *(extraction will be stopped in 2013)* ****	Laminaria *L. digitata* *L. hyperborea* ***	Gelidium *G. sesquipedale* **Not available**	*Chondrus crispus* *Mastocarpus stellatus* *	*Fucus ssp* *Ascophyllum nodosum* **	*Palmaria palmata, Porphyra umbilicalis, Undaria pinnatifida…* *	
Transformation	Drying and grinding		Hydrocolloid extraction		Drying and grinding	Maceration and extraction	Conditioning and packaging
Products	Filters and treatments €€	Meals €€€	Alginates €€€€	Agar-agar €€	Carrageenans €€€€	Meals and fertilizers €€€	Contract products €€€	Foodstuffs €

Uses

- Agricultural supplies and water treatment
- Food processing industry, chemistry and microbiology
- Health, well being
- Food (seaweed vegetables)

(1) Direction Départementale des Territoires et de la Mer
(2) Comité Régional des Pêches Maritimes et des Elevages Marins

Degree of importance in harvested tonnage *(wet tons)*:

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Economic importance *(in euros)*:

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French partners

NORWEGIAN INDUSTRY

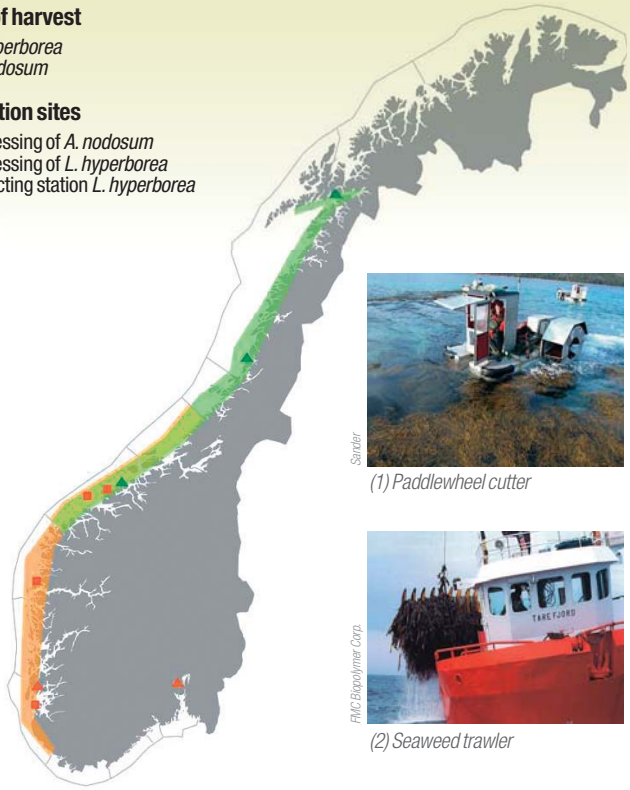
Overview of the Norwegian macroalgae industry

Areas of harvest

- *L. hyperborea*
- *A. nodosum*

Production sites

- Processing of *A. nodosum*
- Processing of *L. hyperborea*
- Collecting station *L. hyperborea*



Sander

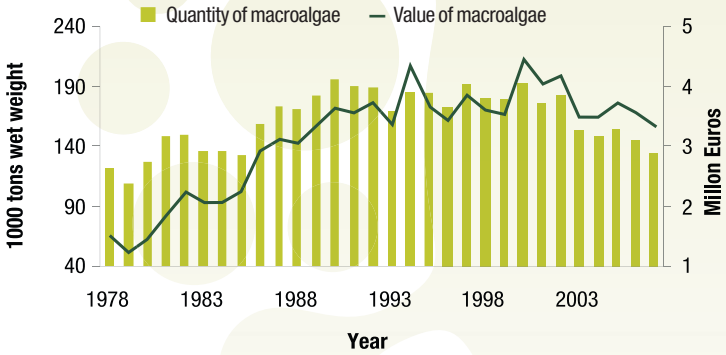
(1) Paddlewheel cutter

FMC Biopolymer Corp.

(2) Seaweed trawler

- **Raw materials harvested annually from natural resources**
  Nearly 200 000 tons of *Laminaria hyperborea* and *Ascophyllum nodosum*.
- **Mechanical harvesting**
  Harvest by use of paddlewheel cutters (fig.1) and seaweed trawlers (fig.2)
- **Long coastline**
  L. hyperborea is harvested on the western coast of South and Mid Norway.
  A. nodosum is harvested in Mid and North Norway.
- **Employment:** 250 people in harvesting and processing.
- **Diversified markets**
  Alginate industry, health food (additives), agricultural supplies (biostimulants, fertilizer, feed), cosmetics, health, well-being

Production and value of macroalgae *(A. nodosum and L. hyperborea)*



Organization of macroalgae industry, from seaweeds to uses

Category	Seabed algae	Shore algae			
Authority and management	The Ministry of Fisheries and Coastal affairs, The Directory of Fisheries	The Ministry of the Environment			
Management system	Open access to designated area at specific time	Landowner and harvester agreement			
Producer	Offshore harvesters	Shore harvesters			
Species of algae	*Laminaria hyperborea* 150 000 tons/year ****	*Ascophyllum nodosum* 20 000 tons/year **			
Transformation	Extraction	Drying, grinding			
		Extraction			
Products	Alginates €€€€	Food €€	Agriculture €	Biostimulants €€€	Health €

Uses

- Agriculture
- Industry
- Health, well being
- Food industry

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Economic importance *(in euros)*:

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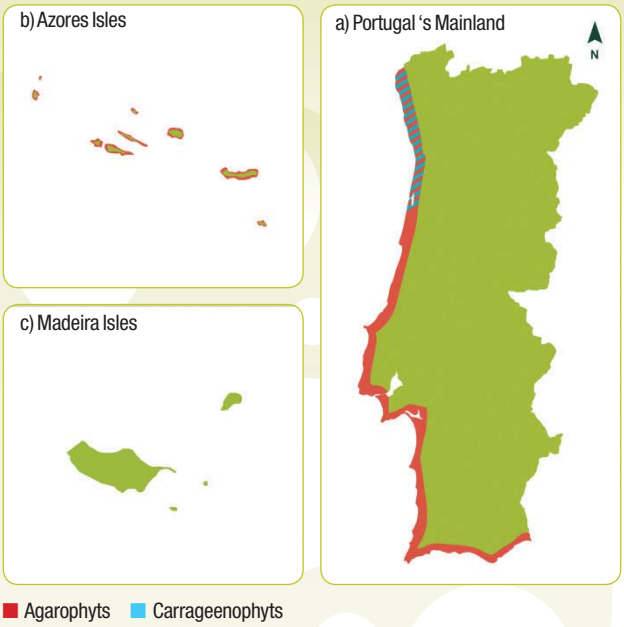
Norwegian partner Bioforsk

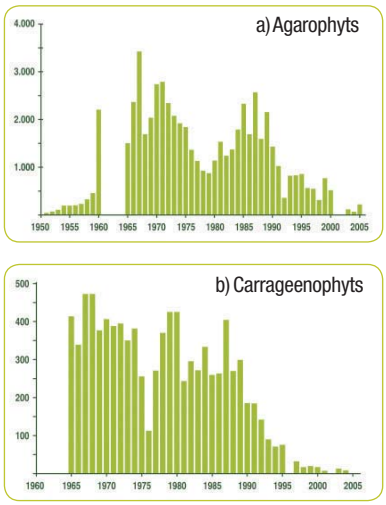
PORTUGUESE INDUSTRY

Geographical areas of macroalgae exploitation



- **Decline in production sector of agar agar**
  In the 80's Portugal had the world's 5th largest agar production. Nowadays it is minimal.
- **Main species harvested**
  Agarophyts : *Gelidium sesquipedale, Gracilaria spp., Pterocladia capillacea (Azores, residual)*
  Carrageenophyts : *Chondrus crispus, Mastocarpus stellatus, Gigartina pistillata*
- **Diversified markets**
  Food, diet supplements, animal use, health and beauty treatments, agriculture and fertiliser.

Production of agarophyts and carrageenophyts



Organization of macroalgae industry, from seaweeds to uses

Kinds of algae	Agarophyts					Carrageenophyts				
Authority and management	Ministry of Agriculture, Sea, Environment, and Spacial Planning / General Board of Fisheries and Aquiculture									
Management systems	Access to legal divers at specific time					Access to legal harvesters at specific time				
Producers	Diving					Hand harvesting on the shore				
Species of algae	*Gelidium sesquipedale (e.g.)*					*Chondrus crispus (e.g.)*				
Transformation	Extraction; purification; drying; grinding; final mix					Extraction; filtering; precipitation; drying; grinding; final mix				
Products	Food and additives €€	Biotechnology €€€	Medical and pharmaceutical €€€	Health and beauty €€	Fertiliser €	Food and additives €€	Biotechnology €€€	Medical and pharmaceutical €€€	Health and beauty €€	Fertiliser €

Uses
- Agricultural supplies and water treatment
- Food processing industry, chemistry and microbiology
- Health, well being
- Food (seaweed vegetables)

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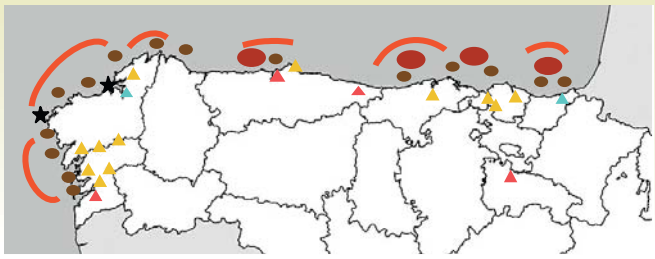
Portuguese partner

SPANISH INDUSTRY

Overview of the Spanish macroalgae industry



Macroalgae processing centres
- Cosmetic
- Food products, microbiology
- Food

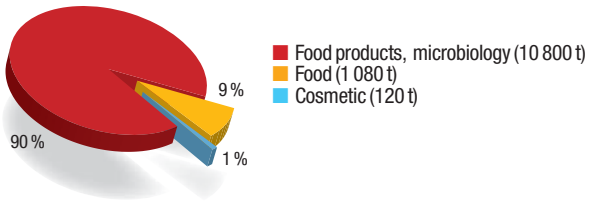
Zones de production
- Seaweed farms
- Seaweed zone
- Foot gathering
- *Gelidium sesquipedale*

The macroalgae industry in the Spanish state produces around 12000 wet tonnes per annum (2010). Over 99% of the production (11950 tonnes) is obtained from natural resources harvesting, being Asturias the most important region (50% of the total). The rest (50 tonnes) is produced by aquaculture, concentrated 100% in Galicia.
Principal species exploited are *Gelidium sesquipedale* for harvesting, and *Laminaria ochroleuca* and *Undaria pinnatifida* for aquaculture.
From the total production, 10000 tonnes are used for phycocolloid extraction industry (Agar agar, carragenats) and the rest for human consumption (raw and processed).
Over 90% of macroalgal industry is based in Galicia.

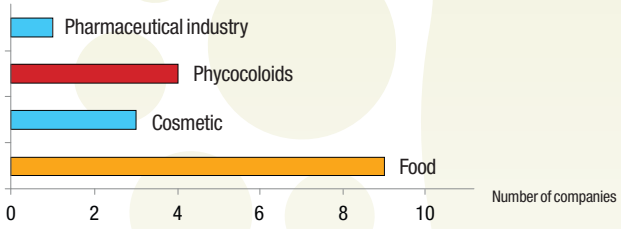
- **Seaweed market:**
  - Human food.
  - Cosmetics.
  - Chemical industry.

Uses of Algae Resources in Spanish. Domestic & Imported raw materials (2010)

Sources: Gobierno Asturias, Gobierno Galicia, Cofr. Donostia.



Primary Market Sector 2010



Organization of macroalgae industry, from seaweeds to uses

Kinds of algae	Seabed algae		Foot gathering	Shore algae			Cultivated algae
Authority and management	Autonomic Government, Fishing department	Autonomic Government, fishermen's association	Autonomic Government				
Management system	Concessions, License	Harvesting control	Licences for harvesting				Concessions
Producer	Sub-litoral harvesters		Shore harvesters				Seaweed Producers
Species of algae	Laminariaes *L. ochrolueca, L. saccharina* **		*G.Sesquipedale* ***	*C.crispus, M.stellatus* *	*G. pistilata, M. stellatus, C. crispus, Ulva sp, Codium sp, Porphyra sp, H. elongata* **	*A. nodosum F. serratus* *	*Undaria pinnatifida* *
Transformation	Drying, grinding		Extraction of Phycocolloid		Drying, grinding	Maceration, extraction…	Conditioning and Packaging
Products	Food €€€		Agar-agar €€€€	Carragenats €€€€	Food €€€	Cosmetic €	Food €€€

Uses
- Agricultural supplies and water treatment
- Food processing industry, chemistry and microbiology
- Health, well being
- Food (seaweed vegetables)

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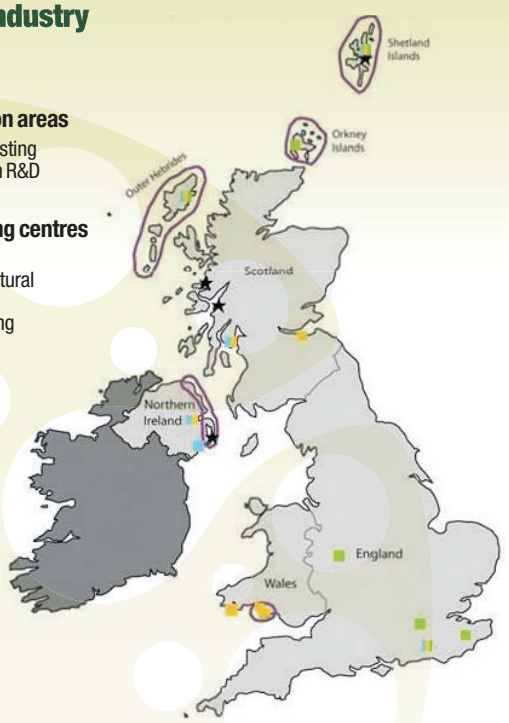
Spanish partners

UNITED KINGDOM INDUSTRY

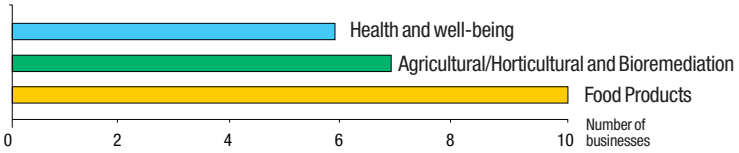
Overview of the British macroalgae industry



- **Overview**
  The UK macroalgae industry is made up of 15 small and medium sized enterprises (SMEs) that produce human food, agricultural and healthcare products. Total UK native seaweed production is currently estimated at 6,000 tonnes per year. The relatively small size of the macroalgae industry in the UK is reflected in its current estimated value of £1m, or 1.3m€.
- **Wild harvesting**
  The main centres for wild harvesting in the UK are the Outer Hebrides, where most seaweed in the UK is collected (approx. 5,500 tonnes), with smaller amounts harvested, largely for food and agricultural use, in the Orkney and Shetland Islands and Northern Ireland. Porphyra species are collected in South Wales for food as laverbread.
- **Seaweed Cultivation**
  There is currently limited seaweed cultivation in the UK. Research and development into seaweed aquaculture is ongoing in Scotland and Northern Ireland and a pilot scale seaweed farm is at the planning stage in Scotland. Trial cultivation of Saccharina latissima and Laminaria hyberborea is currently underway at two sites in the Shetland Islands.
- **Processing**
  Many wild harvesters undertake their own primary processing of seaweed for the production of human food, fertilizer and well-being products. The UK has not had the commercial capability for the extraction of high value chemicals from seaweed since 2009.

Markets

Netalgae responses, 2012



Organization of macroalgae industry, from seaweeds to uses

Kinds of algae	Seabed algae			Shore algae			Cultivated algae
Exploitation Rights	Crown Estate (Public Landlord)*			Crown Estate or Private Landlord*			Crown Estate*
Management systems	Seaweed Harvesting Licence*						Marine Licence*
Producers	Sub-littoral harvesters			Shore harvesters			Algae growers
Algae species	*Laminaria digitata* *Laminaria hyperborea* *Saccharina latissima*			*Chondrus crispus, Fucus vesiculosis* *Ascophyllum nodosum, Palmaria palmata* *Porphyra umbilicalis*			*Laminaria digitata* *Laminaria hyperborea* *Saccharina latissima*
Transformation	Conditioning and packaging	Drying, grinding and/or extraction		Conditioning and packaging	Drying, grinding and/or extraction		Still in Research & Development / Pilot Phase
Products	Food products €	Agriculture/ Horticulture €€€	Health and well-being €€	Food Products €	Agriculture/ Horticulture €€€	Health and well-being €€	

Uses

- Agricultural supplies and water treatment
- Food processing industry, chemistry and microbiology
- Health, well being
- Food (seaweed vegetables)

Economic importance *(in euros)*:

€€€€ : very important
€€€ : important
€€ : less important
€ : not important

*Harvester or cultivator must apply for a lease from the Crown Estate/Private Landlord and for the relevant licence with the Marine Management Organisation (MMO) in England, Marine Scotland in Scotland, the Welsh Government in Wales or the Northern Ireland Environment Agency (NIEA) in Northern Ireland.

United Kingdom partner Ardtoe Marine Laboratory

netalgae

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ATLANTIC AREA Transnational Programme
ESPACIO ATLÁNTICO Programa Transnacional
ESPACE ATLANTIQUE Programme Transnational
ESPAÇO ATLÂNTICO Programa Transnacional

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European Union
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Nordland COUNTY COUNCIL

Investing in our common future

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