This is one of a series of guides in which Seafish explores topical issues affecting the UK seafood industry. Here we look at the UK and European aquaculture markets, the global picture, opportunities and challenges and how the sector is moving forward.
A Definition

The United Nations Food and Agriculture Organisation defines aquaculture as:

‘The farming of aquatic organisms including fish, molluscs, crustaceans and aquatic plants with some sort of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators etc. Farming also implies individual or corporate ownership of the stock being cultivated.’

Farmed aquaculture species are either omnivores, herbivores or carnivores. Farmed species can also be categorised in three classes as: freshwater, marine and diadromous (i.e. those that live in both fresh and marine waters).

Generally fish and shellfish are farmed in ponds, in tanks, suspended on supporting structures or confined in nets or cages in lakes or coastal waters. The type and intensity of farming depends on the species and on market demand.

- Mussels and oysters, which feed on plankton and organic particles in the surrounding water, are grown on the bottom or on suspended ropes or racks.
- Warm water prawns are farmed in large ponds in coastal areas, predominantly in the Asia-Pacific region. When fed, artificial feeds come in the form of specially formulated, granulated feeds containing a range of ingredients including fishmeal and fish oil.
- Most marine fish are raised in net pens in coastal waters and are fed on pellets containing a range of ingredients including fishmeal and fish oil.

The intensity of farming method will depend on biology, economics and even the final consumer. In developing countries, where production is aimed at food for survival or to support the local economy, this can mean a family-owned operation where several species are cultured at the same time. In developed and developing countries market demand has led to increased intensification of aquaculture production methods to produce moderate to high-value species.

Key Facts

In the UK the total value of the shellfish produced in 2010 is estimated at about £25.5 million.

In the UK the total value of aquaculture finfish production in 2009 was £455 million.

Aquaculture remains the fastest growing food supply sector in the world.
The Global Picture

According to the UN Food and Agriculture Organisation *State of World Fisheries and Aquaculture* 2012 (SOFIA)\(^2\) report world aquaculture production attained another all-time high in 2010, at 60 million tonnes, with an estimated total value of US $119 billion.

When farmed aquatic plants and non-food products are included, this figure increases to 79 million tonnes with a value of US $125 billion.

In 2010, global production of farmed food fish was 59.9 million tonnes, up by 7.5% from 55.7 million tonnes in 2009 (32.4 million tonnes in 2000). Farmed food fish include finfishes, crustaceans, molluscs, amphibians (frogs), aquatic reptiles (except crocodiles) and other aquatic animals (such as sea cucumbers, sea urchins, sea squirts and jellyfishes), almost entirely destined for human consumption.

In the last three decades (1980-2010), world food fish production of aquaculture has expanded by almost 12 times, at an average annual rate of 8.8%. Aquaculture enjoyed high average annual growth rates of 10.8% and 9.5% respectively in the 1980s and 1990s, but has since slowed to an annual average of 6.3%. Its contribution to world total fish production climbed steadily from 20.9% in 1995 to 32.4% in 2005 and 40.3% in 2010. Its contribution to world food fish production for human consumption was 47% in 2010, compared with only 9% in 1980.

The growth rate in farmed food fish production from 1980 to 2010 far outpaced that of the world population (1.5%), resulting in average annual per capita consumption of farmed fish rising by almost seven times, from 1.1 kg in 1980 to 8.7 kg in 2010, at an average rate of 7.1% per year.

The global population is increasing and, in order to maintain at least the current level of per-capita consumption of aquatic foods, the world will require an additional 23 million tonnes by 2020.
The UK Aquaculture Sector

The majority of existing food finfish aquaculture activity is located in Scotland, although it is increasing in areas of Wales and England. Shellfish culture is spread more evenly throughout the UK.

Farmed UK shellfish production

Production (tonnes) of farmed shellfish in the UK in 2010.

<table>
<thead>
<tr>
<th>Tonnes</th>
<th>Scotland</th>
<th>England</th>
<th>Wales</th>
<th>Northern Ireland</th>
<th>UK Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pacific oyster</td>
<td>241.00</td>
<td>646.00</td>
<td>3.00</td>
<td>260.00</td>
<td>1,150.00</td>
</tr>
<tr>
<td>Native (flat) oyster</td>
<td>28.00</td>
<td>88.50</td>
<td>0.05</td>
<td>-</td>
<td>116.55</td>
</tr>
<tr>
<td>Scallops</td>
<td>7.60</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>7.60</td>
</tr>
<tr>
<td>Queens</td>
<td>7.30</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>7.30</td>
</tr>
<tr>
<td>Mussels</td>
<td>7,199.00</td>
<td>2,333.00</td>
<td>8,960.00</td>
<td>10,820.00</td>
<td>30,212.00</td>
</tr>
<tr>
<td>Clams</td>
<td>-</td>
<td>-</td>
<td>6.00</td>
<td>-</td>
<td>6.00</td>
</tr>
<tr>
<td>Cockles</td>
<td>-</td>
<td>7.30</td>
<td>-</td>
<td>-</td>
<td>7.30</td>
</tr>
<tr>
<td>Estimated value (£ million)</td>
<td>8.30</td>
<td>3.40</td>
<td>6.10</td>
<td>7.70</td>
<td>25.50</td>
</tr>
</tbody>
</table>

The total value of the shellfish produced in the UK in 2010 is estimated at about £25.5 million, from about 31,500 tonnes. This represents an 11% decrease compared with 2009. (The figures do not include hatchery/nursery seed production, for on-growing, much of which is exported.)

In England mussels are the main species although production decreased by a third in 2010 compared with 2009, and the total was the lowest for over 10 years. Production of native oysters increased significantly (by 65%) compared with preceding years. Pacific oyster production declined by 20%, but still represents the third highest recorded annual total.

In Northern Ireland the main species cultivated is mussels, where production of 10,820 tonnes was a 35% increase of that in 2009 and the third highest annual total. Production of Pacific oysters, at 260 tonnes was 16% less than in 2009.

In Scotland in 2010 mussel production increased by 14% to 7,199 tonnes; production of Pacific oyster increased by 4% to 2,900 shells; and native oyster production decreased from 39 tonnes in 2009 to 28 tonnes (350,000 shells). King and queen scallop production increased by 83% and 33% respectively from the 2009 total, targeting a small niche market.

New figures for 2011 show mussels and Pacific oysters remain the main species produced in terms of both value and tonnage. Mussel production (6,996 tonnes) decreased by 3%, while Pacific oyster production increased by 4% during 2011 to 3,136 shells. Native oyster production remained the same.

The UK is the third most important producer in Europe of both mussels and Pacific oysters. Just over 2,500 tonnes of native oysters were cultivated in Europe in 2010, but this is less than half of that produced four years previously.

Farmed UK finfish production

The main production in the UK is focused on Atlantic salmon, which is grown mostly on the west coast of Scotland, in Orkney and in Shetland. There is also a significant production of rainbow trout grown throughout the UK with concentrations in southern England, Yorkshire and Scotland. There are small quantities grown of carp, brown trout, arctic char, sea bass, cod, turbot and halibut, and more recently tilapia.

According to Cefas the total UK value of aquaculture finfish production in 2010 was £484 million, an increase from 2009 of £29 million.
The European Aquaculture Sector

**EU finfish production**

In the UK and in other northern European countries (Denmark, Estonia, Ireland, Finland, Sweden and Norway) production is dominated by diadromous species. Marine species dominate in Greece, Cyprus, Malta and Portugal; and freshwater species dominate in Belgium, Czech Republic, Latvia, Lithuania, Hungary and Romania. Other countries show less specialisation, with a more diverse spread of target sectors.

- Diadromous species make up the bulk (81%) of finfish farmed in Europe. European production is focused on Atlantic salmon and rainbow trout. There is a minor contribution from eel, sturgeon, whitefish, brook trout and Arctic char.
- Marine species make up 12% of all finfish produced in Europe including gilthead seabream and bass, with cod, turbot and tuna making a small relative contribution. Other minor marine species farmed are meager, halibut, mullets, other seabreams and sole.
- The freshwater fish sector is the smallest, contributing 7% to total finfish production. It is dominated by common carp (68%), but also includes catfish (siluris, clarias, ictalurus), other carps (silver, bighead), tench, pike, pike-perch (zander), perch, striped bass, tilapia, largemouth bass and barramundi.
- It is notable that several tropical finfish species are being farmed, and the UK is the leading tilapia producer within Europe.

**EU shellfish production**

European mollusc production of 0.63 million metric tonnes represents about 4.5% of the world total. Their value of US $1.21 billion, is just over 8.5% of the world total for this group. Crustacean production in Europe is very small on a world scale and in 2010 was valued at US $3.7 million, from 251 metric tonnes.

Mussels are the main group cultivated in Europe, with almost 477,000 tonnes (all species) produced in 2010. Pacific oysters are next in importance, with just over 105,000 tonnes produced in 2010, although this is 14% less than was produced in 2007.

Shellfish production in general in Europe is exhibiting a decreasing trend. Over the last five years production has fallen by 9% and 24% for molluscs and crustaceans, respectively.

**EU imports**

Imports represent a very significant percentage of European consumption. The EU imports a wide variety of aquaculture species and products, predominantly salmon from Norway, warm water prawns from South East Asia and South America, and fresh water fish such as pangasius and tilapia, primarily from South East Asia.

**Key Facts**

The total farmgate value of food fish production from aquaculture is estimated at US $119.4 billion in 2010.

In the EU, aquaculture at 1.3 million tonnes (€3.2 billion) accounts for one-quarter of EU production of fish, molluscs and crustaceans.
Opportunities And Challenges

Aquaculture is an opportunity to produce consistently great tasting, high quality, healthy seafood in large volumes. It has the potential to match the shortfall between supply and demand whilst reducing the pressure on wild fisheries.

Health benefits

The opportunities are immense. Fish and shellfish are excellent sources of Omega-3 fatty acids and are recognised as important components of a healthy diet. The Food Standards Agency (FSA) recommends we all consume at least two portions of fish a week, including one oily. A recent FSA consultation suggests that, on average, UK per capita consumption is about 1.2 portions per week. If consumption levels are going to increase it is only through the sustainable development of aquaculture that demand will be met.

Economic benefits

Economically the industry is of vast importance. Take for example Scotland. Aquaculture is a nationally important industry for Scotland, particularly for coastal and island communities, where it is often a mainstay of the local economy. The worldwide retail value of Scottish farmed salmon is estimated to be over £1 billion.

Key Facts

To maintain at least the current level of per-capita consumption of aquatic foods for a growing population an additional 23 million tonnes of aquatic food is required by 2020.

Scotland’s salmon farmers injected £500 million into the Scottish economy in 2009.

Environmental challenges

But there are challenges primarily with issues relating to the environment and animal welfare. The environmental pressures exerted by aquaculture are not uniform. The level of local impact will vary according to production scale, techniques and the species farmed. However aquaculture is a highly regulated industry and extensive measures are taken to manage these pressures and help reduce their impact.

Standards and certification

A series of certification and standard setting schemes are in place to demonstrate how the industry is regulated and controlled:

<table>
<thead>
<tr>
<th>Setting standards</th>
<th>Feed standards</th>
<th>IFFO Global Standard for Responsible Supply; organic standards such as Soil Association.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Farming standards</td>
<td>Global Aquaculture Alliance; GlobalGAP; Aquaculture Stewardship Council (ASC); Friend of the Sea; The Code of Good Practice for Scottish Fin Fish Aquaculture (CoGP); EU wide rules for organic aquaculture which sets legal minimum criteria.</td>
</tr>
<tr>
<td></td>
<td>Farmer and retailer schemes</td>
<td>Individual farming companies and most retailers have Codes of Practice and/ or standards which mostly add specific criteria to those prescribed by the organisations above; UK supermarket quality schemes; the Label Rouge quality scheme in France.</td>
</tr>
</tbody>
</table>
The Seafish Guide To Aquaculture

Fish In: Fish Out

FIFO is a calculation of the weight of wild fish in kg needed to produce one kg of farmed fish.

The need to provide fish as feed for other fish has been seen as a challenge to the growth of the aquaculture sector, given that the amount of fish that can be produced annually from the world is finite. A lot of focus has also been put on replacement of fish oil and fishmeal by vegetable products and other sources. However today the use of fishmeal and fish oil in trout and salmon diets has decreased to below 20%, and is forecast to further lower to less than 10% by 2020. In addition one-third of the world’s farmed food fish harvested in 2010 was achieved without the use of feed, through the production of bivalves and filter-feeding carps.

There has been a lot of research focused on finding replacements for fishmeal and fish oil in fish feeds in carnivorous diets and partial replacements have been identified. Aquafeeds have been seriously improved in terms of formulation, ingredient sourcing and technology, however fishmeal is an essential ingredient in almost all forms of finfish aquaculture requiring feed, even if it is only used early in the lifecycle.

A five to one ratio is often quoted for salmon and there is consensus that five metric tonnes of wild fish must be removed from the sea to produce sufficient oil to create one metric tonne of salmon at the end of the chain. But this fails to take into account the surplus fishmeal that is produced that can then be used for other species. According to the International Fishmeal and Fish Oil Organisation for every tonne of farmed product harvested, fed-aquaculture uses just 0.5 tonnes of wild, whole fish and the true ratio for salmon is around 1.7. The use of whole-fish is kept down as nearly 25% of the raw material for fishmeal comes from recycled fisheries by-products, much of which used to be dumped7,11.

The Movement For Change

Given the strong likelihood that fish landings will remain stagnant in capture fisheries, aquaculture remains the only apparent means to expand world supplies and there is a strong movement for change to make this a reality.

Under the reform of the Common Fisheries Policy (CFP) the EU Commission wants to give new political impetus and leadership to the sustainable development of EU aquaculture by helping to make EU aquaculture more competitive; ensure sustainable growth and improve the sector’s image and governance.

The Common Fisheries Policy and its related legislative instruments is currently under review and under the proposed reform aquaculture is seen as a priority area for development:

- The Common Fisheries Policy (CFP) is primarily concerned with the management of the stocks of wild fish in European waters.
- The Common Organisation of the Markets for Fisheries and Aquaculture Products (COM) looks to assist establishment of the best conditions for the markets in Europe.
- The European Maritime and Fisheries Fund (EMFF) is the financial instrument for supporting and implementing the CFP and the COM.

There is already an established aquaculture industry in Scotland; Wales has a robust aquaculture strategy and has invested in regionally distinct, sustainable aquaculture technologies with positive commercial outcomes; and in England, a strategy for sustainable aquaculture is emerging.

Key Facts

One-third of the world’s farmed food fish harvested in 2010 was achieved without the use of feed, through the production of bivalves and filter-feeding carps.
Other Seafish guides

There are a number of other Seafish Guides in this series, covering different aspects of responsible seafood sourcing, fisheries management and aquaculture. For more details and the most up to date information consult our website at www.seafish.co.uk/media/sustainability and www.seafish.org/aquaculture/guides-and-information.

There is also a series of Responsible Sourcing Guides12 outlining the key characteristics of four of the main farmed species consumed in the UK.

References

2. www.fao.org/docrep/016/i2727e/i2727e00.htm
7. www.scottishsalmon.co.uk/userFiles/882/61910_10_FEAP_Annual_Report_2011_web_2.pdf
10. www.scottishsalmon.co.uk
11. www.iffo.net/default.asp?contentID=807
12. www.seafish.org/retailers/responsible-sourcing/responsible-sourcing-guides

Key Facts

In 2010, global production of farmed food fish was 59.9m tonnes – an all-time high

For further information on the UK market and certification see:

www.scottishsalmon.co.uk
www.britishtrout.co.uk/
www.shellfish.org.uk/
www.iffo.net
www.globalgap.org
www.gaalliance.org/
www.asc-aqua.org/
http://ec.europa.eu/agriculture/organic/eu-policy/legislation_en
www.shetlandaquaculture.com
www.defra.gov.uk/food-farm/fisheries/
www.dardni.gov.uk
www.scotland.gov.uk/Topics/Fisheries/Fish-Shellfish/
www.aquamedia.info/pdfflip/FEAPPROD2011/ByCountries/index.html#59/

About Seafish

Seafish was founded in 1981 by an Act of Parliament and aims to support all sectors of the seafood industry for a sustainable, profitable future. It is the only pan-industry body offering services to all parts of the industry, from the start of the supply chain at catching and aquaculture; through processing, importers, exporters and distributors of seafood right through to restaurants and retailers.