National Strategic Plan for Sustainable Aquaculture Development

Ireland's EU Structural and Investment Funds Programmes 2014 - 2020
Co-funded by the Irish Government and the European Union

Department of Agriculture, Food and the Marine
An Roinn Talmhaíochta, Bia agus Mara

Table of Contents

Executive Summary

Article 34 of the Common Fisheries Policy Regulation requires Member States to prepare multi-annual national strategic plans for aquaculture. In accordance with article 34, the European Commission published non-binding Strategic Guidelines for the Sustainable Development of EU Aquaculture in 2013, which are intended to guide the preparation of national plans. The national plans are intended to inform investment priorities for aquaculture under Member States' operational programmes under the European Maritime and Fisheries Fund, although the scope of the national plans is broader than investment needs.

Chapter 1 of this Plan sets out the Irish, EU and international policy context for this Plan.

Chapter 2 presents a SWOT analysis of the aquaculture industry that was conducted with the input of stakeholders and relevant State agencies. Arising from this SWOT, Chapter 2 identifies a number of overarching needs.

Chapter 3 presents analysis of the present situation with regard to each of the main species farmed in Ireland.

Chapter 4 identifies the primary aim of this Plan, i.e. to sustainably grow the production of the aquaculture industry by 45,000 tonnes across all species. It explains the basis for this target, how this relates to peak production across each of the main species framed in Ireland, the opportunities to grow production and key challenges for each species and how financial supports will be deployed through the Seafood Development Programme to support the industry in achieving this target.

Chapter 5 identifies the importance to aquaculture of fostering knowledge, innovation and technology transfer. It identifies the key areas of study, research and development and technological trial needed to address issues specific to each of the main species and how financial supports will be deployed through the Seafood Development Programme to support this work.

Chapter 6 focuses on the importance of environmental sustainability to the continuation and growth of the aquaculture industry. It presents a new set of Guiding Principles for Sustainable Development of Aquaculture generally, and with regard to salmon farming presents new scale limits and phasing guidelines.

Chapter 7 identifies the importance of coordinated marine spatial planning to future planning of aquaculture, notes ongoing work by the Minister for the Environment, Community and Local Government in preparing a framework for such spatial planning, and identifies key initiatives to support the input of aquaculture to that process.

Chapter 8 analyses the present situation with regard to aquaculture licensing and the main challenges to overhaul the regulatory framework and procedures to deliver a streamlined system to support the sustainable development of the industry.

Summary of Actions within this Plan

Chapter 4: Aiming for Growth

1. Build capacity and scale in the industry
2. Dedicated supports to new entrants to the sector
3. Promote organic aquaculture practices and certification
4. Aid shellfish producers affected by major biotoxin episodes

Chapter 5 Knowledge, Innovation and Technology

5. Foster knowledge, innovation and technology transfer.
6. Enhance the skills base to foster a knowledge economy.
7. Provision of expert advice to improve environmental and business performance and enhanced strategic planning by aquaculture enterprises.
8. Support best husbandry and disease management practice.
9. Applied research and collaborations between industry, scientific and development bodies.
10. Development of commercial scale growing systems for novel species.

Chapter 6: Ensuring Sustainability

11. Application of Guiding Principles for the Sustainable Development of Aquaculture.
12. Application of scale limits and phasing in relation to the development of individual offshore salmon farms.
13. Development of an industry Code of Practice for Invasive Alien Species.
14. Continuation of Invasive Species Ireland Project in relation to aquaculture.
15. Quantify the environmental contribution of aquaculture.
16. Ensure that aquaculture monitoring is consistent with the requirements of the Marine Strategy Framework Directive.

Chapter 7: Coordinated Spatial Planning

17. Develop opportunities and constraints mapping for aquaculture taking specific account of environmental issues, Natura 2000 sites and inshore fisheries.
18. Identify marine tourism opportunities from aquaculture.
19. Study on integrated multi-trophic aquaculture and possible synergies with offshore wind farms or other marine renewable energy.
20. Study on how aquaculture contributes to communities in rural areas.

Chapter 8: Aquaculture Licensing

21. Progressively remove the current aquaculture licensing backlog.
22. Review and revision of the aquaculture licensing process, including the applicable legal framework.
23. In the context of a reviewed process and revised legal framework, consider the phased introduction of appropriate timescales for licence determination.
24. Develop a data management and information system with online aquaculture licence application and tracking functionality and spatial mapping of aquaculture sites and exclusion areas.

Chapter 1
Introduction

Article 34 of the Common Fisheries Policy Regulation[1] requires Member States to prepare multi-annual national strategic plans for aquaculture. In accordance with article 34, the European Commission published non-binding Strategic Guidelines for the Sustainable Development of EU Aquaculture[2] in 2013, which are intended to guide the preparation of national plans. The national plans are intended to inform investment priorities for aquaculture under Member States' operational programmes under the European Maritime and Fisheries Fund[3], although the scope of the national plans is broader than investment needs.

Global Context

Agriculture, fisheries and aquaculture are central to providing opportunities to increase food security for a growing population estimated to reach nine billion by 2050 and to meeting the challenge of alleviating poverty and addressing hunger especially prevalent in many developing countries of the world.

According to the FAO, foods derived from aquatic resources have a significant role to play across the food supply and value chain, linking ecosystems, economic development and human well-being.

Since the contribution of capture fisheries to global food fish supplies has levelled off, aquaculture production has emerged as a major supplier.

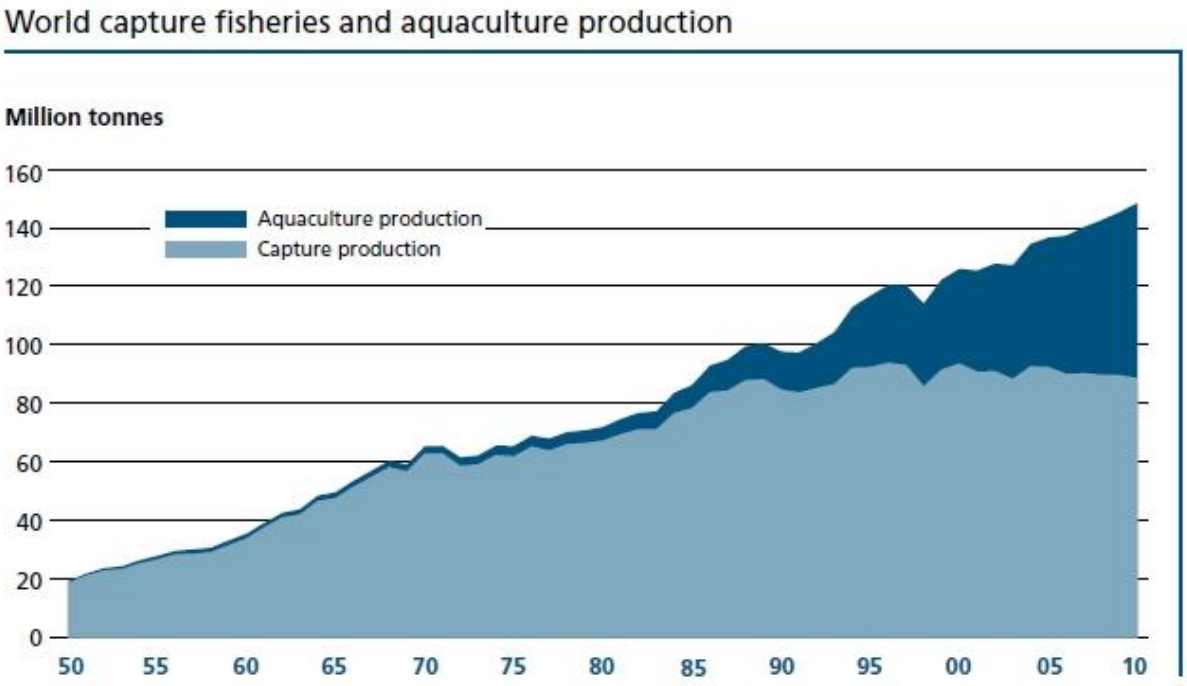
Over the last 30 years global production of aquaculture has expanded almost 12 fold, albeit the rate of growth was higher in the 1980's and 90's.

World aquaculture production reached 67 million tonnes (an all-time high) in 2012. The contribution of aquaculture to global production has grown from 26% in 2000 to 42% of the total production of 158 million tonnes of fish produced in 2012.

[1] Regulation 1380/2013

[2] COM (2013) 229 Final

[3] Regulation 508/2014

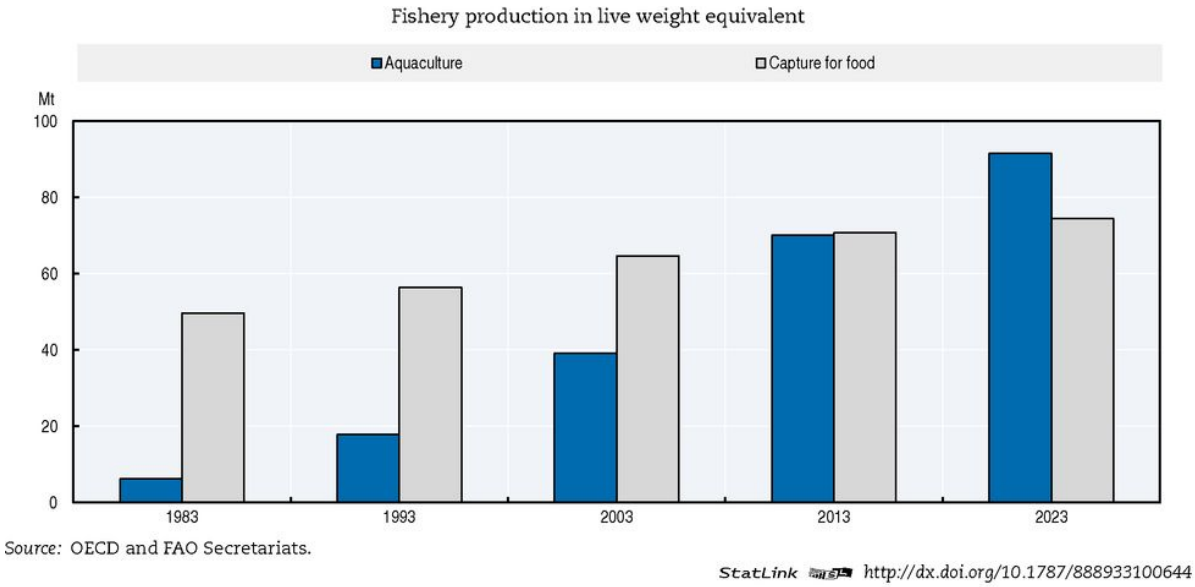


Source FAO

The future supply of fish has been estimated using several models and different scenarios and according to the most recent projections from the OECD-FAO 2014 major increases in future seafood production will derive from aquaculture (Agricultural Outlook 2013-2022).

By 2022, world fisheries production is expected to reach 181 million tonnes (of which 161 million tonnes will be destined for direct human consumption) compared to 147 million tonnes in 2010. As capture fisheries production is projected to increase by only 5%, most of the additional fish is expected to be produced by aquaculture. Aquaculture production should reach about 85 million tonnes in 2022 and will represent 47% of global fishery production and 55% of total fish destined for human consumption. The World Bank provides recent projections to 2030, which provide a similar scenario, and these projections predict that aquaculture production will increase to the point where it equals global capture production by 2030 and contributes 62% of the global supply by 2030.

However, according to these projections, annual production growth for aquaculture is expected to slow and OECD and FAO predict a growth rate averaging 2.5% per year in 2013-2022 compared to over 6% of the previous decade.



Out of the 67 million tonnes of farmed food fish produced in 2012, two thirds were finfish species grown from inland and marine aquaculture, while farmed molluscs accounted for 23% and crustaceans for 10%. Finfish species cultured such as carp, tilapia, pangasius, and catfish make the greatest contribution to the supply of affordable protein food for direct consumption. It is particularly so in developing countries in Asia, Africa and Latin America.

This subsector of aquaculture production is also expected to be the lead player to fulfil the long-term food and nutrition security and to meet the increased need for food fish supply by the growing population in many developing countries in the coming decade.

According to the World Bank's report *Fish to 2030* the production of tilapia is projected to more than double between 2008 and 2030, and some high value species such as shrimp and salmon are expected to grow by 50 to 60% over the period. This suggests that farmed salmon production should increase somewhere in the region of 1 – 1.5 million tonnes by 2030, given this projection, which is backed up by the strong historical performance of the global Atlantic Salmon farming industry, the question that arises in the context of this document is how should Ireland as a salmon farming country seek to claim its share of this demand driven opportunity and how much growth should it project?

Although there is currently no evidence for a substantial shift in the relative market share enjoyed by the major players in the global salmon markets, Latin America seems likely to grow to account for a third of global farmed salmon supply by 2030. Coming from its current low base and given the overall size of the global market there seems no doubt that Ireland could substantially increase its farmed salmon output without causing any significant disruption to the dynamics of the market.

As with agriculture, aquaculture production is vulnerable to adverse impacts of disease and environmental conditions. Disease outbreaks in recent years have affected farmed Atlantic salmon in Chile, oysters in Europe and marine shrimp farming in several countries in Asia, South America and Africa, resulting in partial or sometimes total loss of production.

The World Bank's projection for total fish supply from both capture and aquaculture stands at 187,000 tonnes by 2030 *(Fish to 2030)*, and if fish consumption patterns do not change significantly, with countries mainlining the level of aquaculture production growth of recent years, there would be enough fish to feed the growing population.

However, people tend to consume more fish as incomes grow, therefore per capita fish consumption may be expected to grow accordingly. The FAO, using fish consumption and income data, projects that some 261 million tonnes of fish will be required to meet demand by 2030.

It is strongly inferred that the additional demand of 74 million tonnes above the "Fish to 2030" estimate, will have to be met from aquaculture and this food production will have to be significantly increased. Even if every country continued to grow its aquaculture production in line with its recent trend, which would double aquaculture production during 2010-2030, the resulting 211 million tonnes of global fish supply in 2030 will not satisfy the 261 million tonnes of expected future fish demand. If the supply/demand gap is not bridged, clearly the price of fish will increase, thus reducing many global communities' access to fish. To have enough fish to satisfy future demand, world aquaculture production would need to increase threefold during the 2010-2030 period, a truly daunting task.

Clearly realizing the full potential of the oceans and wetlands will demand responsible and sustainable approaches to its economic development. A more effective, socially and environmentally responsible aquatic food chain can contribute to sustainable growth, social cohesion and food security, reducing the pressure on marine and land resources.

It can, in particular, influence the governance and management of these resources, the conservation of biodiversity and habitats and the empowerment of concerned communities including through better adaptation of vulnerable communities to climatic changes and improved resilience to emergencies, natural disasters and other forms of crises.

All of the credible projections anticipate a need for increased supply of fish protein to meet the health needs and general aspirations of global societies. This will need to happen at affordable levels in relation to income and other proteins. The challenge goes beyond the need for growth, and requires the production of sufficient quantities of seafood using energy and resources more efficiently and employing low carbon

technologies that strengthen sector sustainability, while conserving the function and integrity of habitats during the process of expansion and intensification of systems and practices.

EU Policy Context

Whilst aquaculture has been the fastest growing food sector globally for the last 15 to 20 years according to the FAO, the situation in the European Union has not followed the worldwide trend. Essentially, aquaculture output in Europe has stagnated and there has been little or no net growth in output over the last 10 years. Ireland and other Member States through EU institutions have recognised the unsustainable position that the EU finds itself in with regard to seafood supply and has targeted resurgence in growth in output from aquaculture as a major priority over the remainder of this decade.

The following strategies and policies set out the framework within which the EU aquaculture sector will develop over the medium term;

EU 2020[4] is the European Union's 10-year jobs and growth strategy. It was launched in 2010 to create the conditions for smart, sustainable and inclusive growth. Five headline targets have been agreed for the EU to achieve by the end of 2020. These cover employment, research and development, climate/energy, education, social inclusion and poverty reduction.

EU Integrated Maritime Policy[5] *seeks to provide a more coherent approach to maritime issues, with increased coordination between different policy areas. It focuses on issues that do not fall under a single sector and issues that require the coordination of different sectors and actors. Specifically, it covers issues relating to* Blue Growth, Marine Data and Knowledge, Maritime Spatial Planning, Integrated Maritime Surveillance and Sea-basin Strategies. It seeks to coordinate, not replace policies on specific maritime sectors.

Blue Growth[6] is the long term strategy to support sustainable growth in the marine and maritime sectors as a whole. It is the maritime contribution to achieving the goals of the Europe 2020 strategy for smart, sustainable and inclusive growth. It identifies aquaculture as a focus area that has the potential to deliver sustainable growth and jobs in the blue economy.

[4] Europe 2020 – A Strategy for Smart, Sustainable and Inclusive Growth - COM (2010) 2020 Final.
[5] An Integrated Maritime Policy for the European Union - COM(2007) 575 Final
[6] Blue Growth opportunities for marine and maritime sustainable growth - COM/2012/494 Final

Common Fisheries Policy[7] (CFP) covers the conservation of marine biological resources and the management of fisheries and fleets exploiting such resources, together with fresh water biological resources, aquaculture, and the processing and marketing of fisheries and aquaculture products. The CFP seeks to ensure that fishing and aquaculture activities are environmentally sustainable in the long-term and are managed in a way that is consistent with the objectives of achieving economic, social and employment benefits, and of contributing to the availability of food supplies.

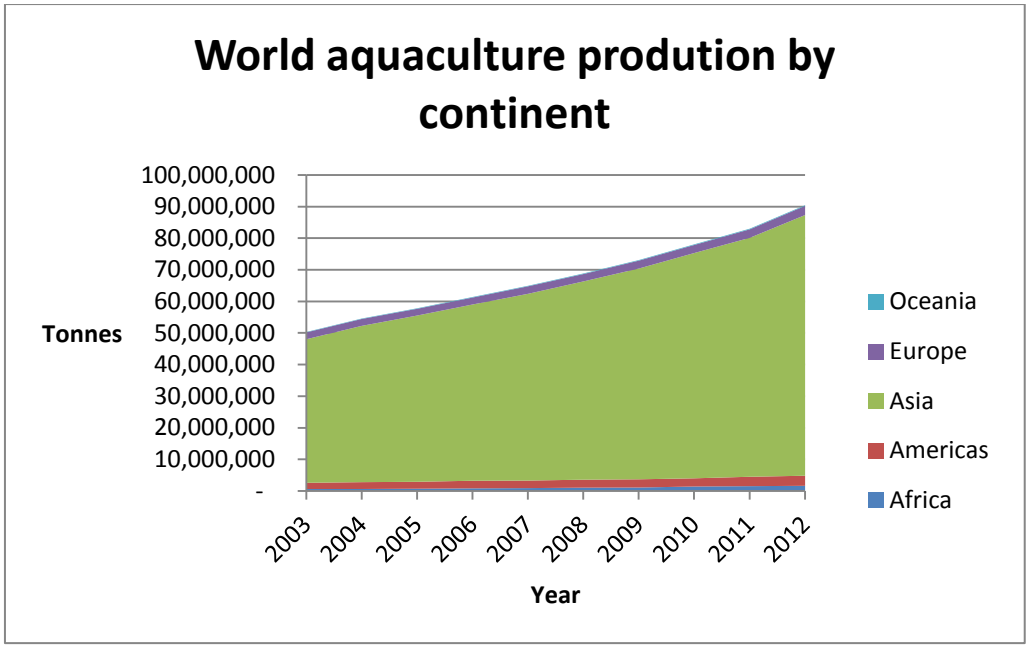
Strategy for Sustainable Development of European Aquaculture[8] published in 2002 sets out the European policy for the development and growth of aquaculture. The Strategy is considered to have been successful in the areas of environmental management, food safety and quality, but has not resulted in growth of production in the sector across the EU, in contrast with the rest of the world, as illustrated in the table below. In 2009 the Commission undertook a review of the strategy[9]. The renewed strategy sought to identify causes of the EU stagnation and identified policy actions to address competitiveness, sustainability and governance in the sector. In 2013, the Commission published *Strategic Guidelines for the Sustainable Development of EU Aquaculture*[10]. The Strategic Guidelines implement the new CFP approach to promoting aquaculture through an open method of coordination: a voluntary process for cooperation based on Strategic Guidelines and Multiannual national strategic plans identifying, common objectives and, where possible, indicators to measure progress towards these goals. The Strategic Guidelines aim to assist Member States in defining their own national targets taking account of their relative starting positions, national circumstances and institutional arrangements.

[7] Regulation (EU) no 1380/2013

[8] COM (2002) 511 Final

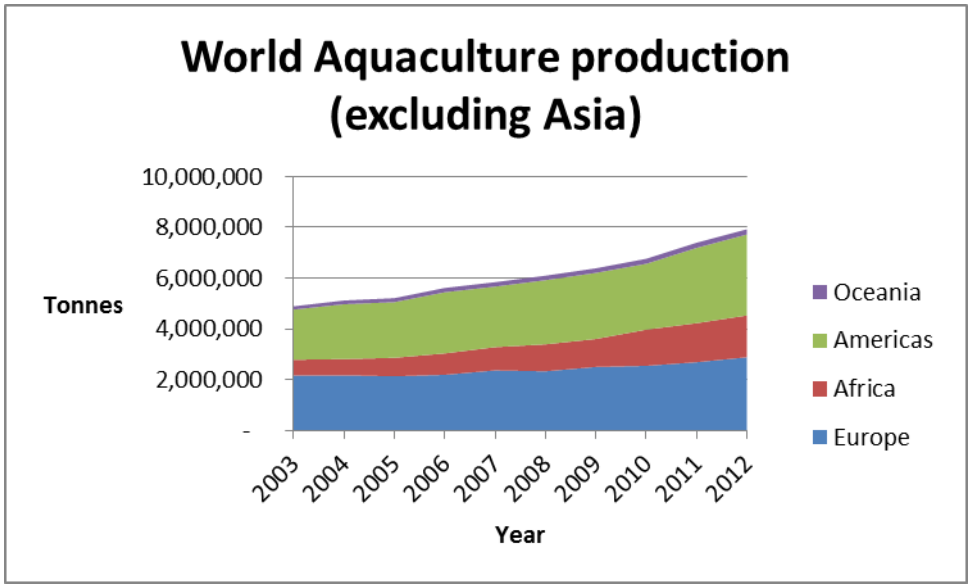
[9] Building a Sustainable Future for Aquaculture. A New Impetus for the Strategy for the Sustainable Development of European Aquaculture - COM/2009/162 Final.

[10] COM(2013) 229 Final



Source FAO

If Asia is excluded from the table so that the growth in the other continents is more visible, it shows that aquaculture production in Europe has flat lined since 2003



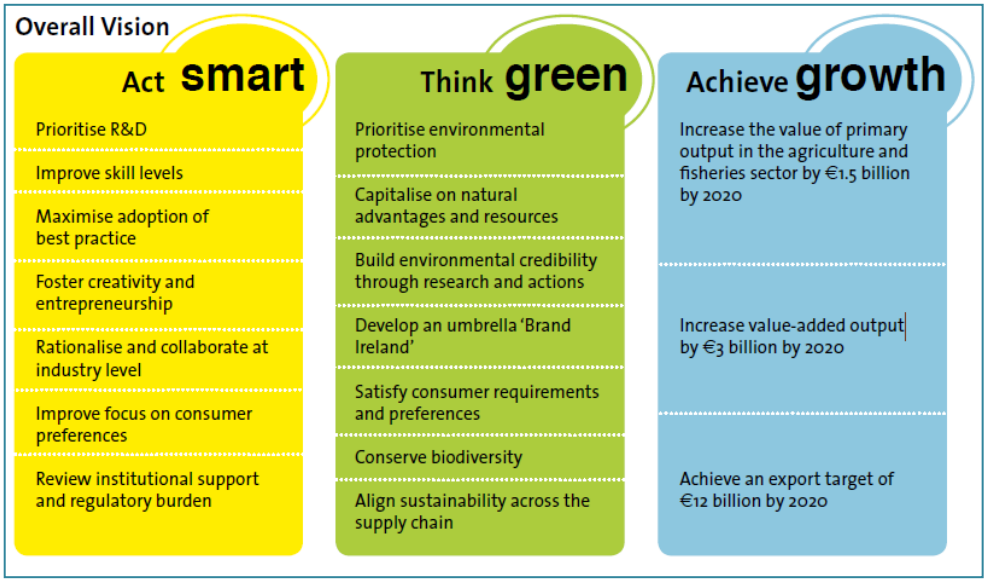
Source FAO

This shows that European aquaculture has not delivered additional production despite the strategic importance put on aquaculture by the European Commission and various individual Member States, the availability of funding for growth under the European Fisheries Fund and the increased consumer demand for seafood. This is despite the fact that the current seafood trade deficit for the EU is estimated by the OECD at €16 billion per annum, which is plainly unsustainable from an economic perspective.

Irish Policy Context

Harvest 2020

Harvest 2020 is the Government's national strategy for the sustainable development of the food industry, including seafood. The strategy was published in July 2010. The following table provides a overview of the Strategy.



Harvest 2020 made a number of recommendations in relation to the seafood sector. Those of relevance to the aquaculture sector are reproduced below.

Competitiveness

- While recognising the place of specialist processors serving niche markets, restructuring and enhanced co-operation within the production, sales, marketing and processing areas should be supported by specific programmes.
- The skills levels in the sector should to be augmented by focused technical training and boosting of management competence through the introduction of training, mentoring programmes and Graduate Placement programmes.

Marketing

- There should be a greater integration of the seafood sector into the Irish food sector and treatment of it as such.
- The implementation of quality and traceability labelling including voluntary labelling and certification for Irish fish products should be accelerated by the

sector with appropriate supports from BIM and Bord Bia to differentiate Irish products on domestic and export markets.

Aquaculture Management

- The relevant Departments and state agencies should resolve perceived current difficulties related to environmental protection, to facilitate a timely processing of licence applications consistent with EU conservation directives. This will underpin existing investments and underpin additional investment.
- The Marine Institute in conjunction with Bord Iascaigh Mhara should work with industry to research and develop inshore and offshore aquaculture and alternative species on a commercial and profitable scale.

Environmental Issues

- Ireland, principally through the Marine Institute, should continue taking a leading role in improving the quality of marine science related to water quality and wild fish stocks.
- The industry, supported by BIM and MI, should continue to develop environmentally sustainable fishing and aquaculture production methods to secure a sustainable resource base and to underpin the development of a smart, green and clean image which contributes to the overall strategy for the food industry.

Foodwise 2025

Foodwise 2025, the Report of the 2025 Agri Food Strategy Committee, sets out a cohesive, strategic plan for the development of the agri-food sector over the next decade. For seafood, the report identifies 3 strategic priorities:

1. Expand the raw material base.
2. Enhance the industry's structure and skills.
3. Optimise product added-value, export markets and environmental sustainability.

In relation to aquaculture, the report recommends two specific actions:

- Commission an independent review of the existing aquaculture licensing system involving all key stakeholders, to identify the current shortcomings and

bottlenecks (lefislative, resource and logistical), to report by early 2016 and implement necessary changes to the aquaculture licensing system as a matter of priority.

- Develop a strategy to expand shellfish and aquaculture production taking account of the carrying capacity of bays.

Harnessing Our Ocean Wealth – An Integrated Marine Plan for Ireland

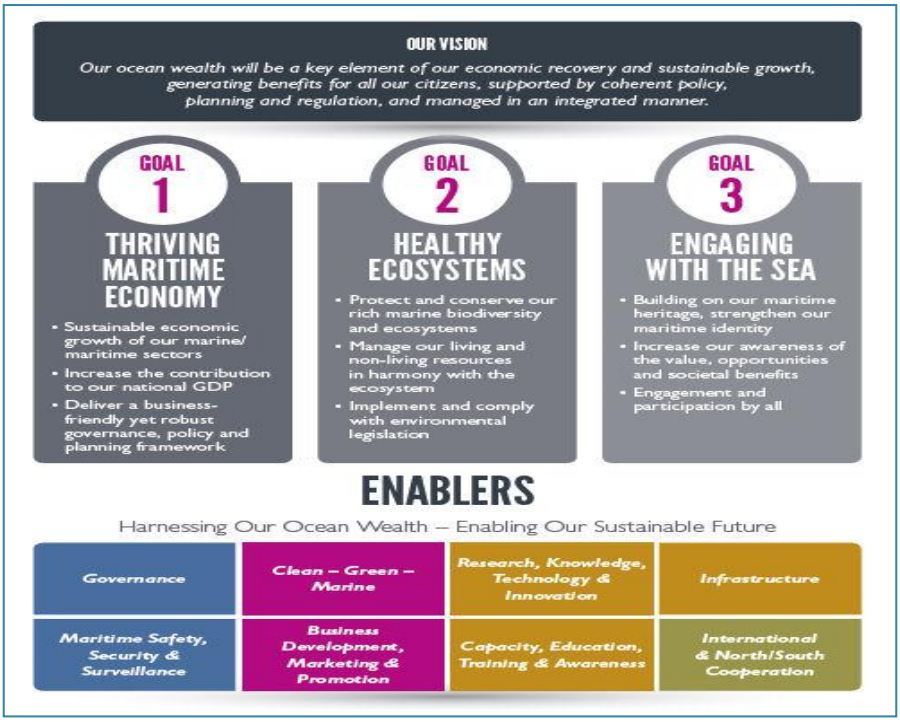
Harnessing Our Ocean Wealth[11] (published in 2012) is Ireland's first Integrated Marine Plan (IMP), setting out a roadmap for the Government's vision, high-level goals and integrated actions across policy, governance and business to enable Ireland's marine potential to be realised. In implementing the Plan, Ireland has been gradually developing an integrated system of policy and programme planning for marine affairs. The Plan is being delivered within the over-riding medium-term fiscal framework and budgetary targets adopted by the Government.

The vision and goals presented in Ireland's IMP have been framed within the context of what is happening at the broader global and EU levels, particularly the Integrated Maritime Policy for the European Union and the Atlantic Strategy and associated Action Plan[12] which recognise the contribution the 'blue economy' can make to European and global economic growth and the need for appropriate policies, strategies and funding mechanisms to enable this.

Similar to the Integrated Maritime Policy for the EU, Ireland has put in place a range of integrated actions across all relevant policy areas related to the seas; including transport, environment, offshore renewable energy, enterprise, employment, research, seafood and external relations.

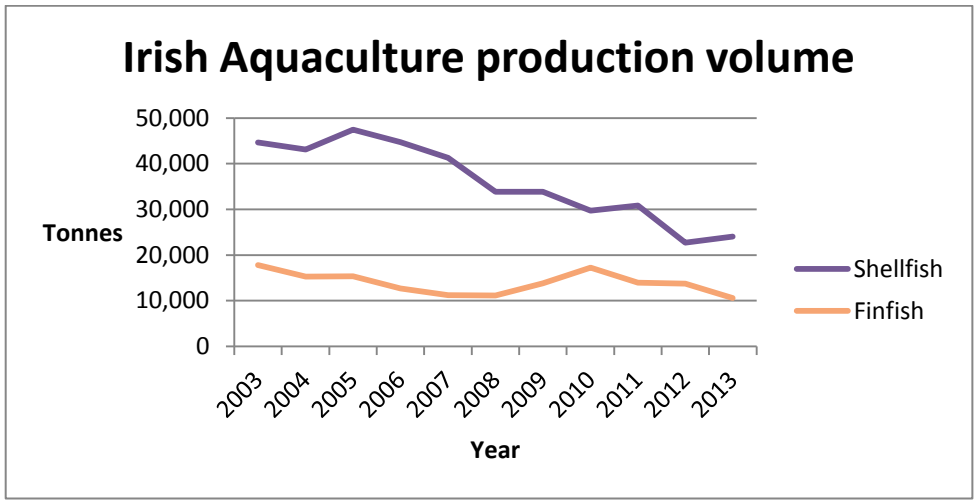
[11] http://www.ouroceanwealth.ie

[12] The Atlantic Strategy and Action Plan is available from http://ec.europa.eu/maritimeaffairs/policy/sea_basins/atlantic_ocean/index_en.htm



Focusing on Ireland as an EU aquaculture producer

A similar picture to the EU trend of general stagnation can also be seen in the Irish production trends, which have declined over the same time period, set out below. An analysis of the specific reasons for this situation and a suggested approach to improve the situation is presented in the following chapters, which analyse the industry on a species by species basis.



Source: BIM

Aquaculture Production

Annual Production in the Irish aquaculture sector in the period 2008 -2012 is indicated in the following table.

Variable	2008	2009	2010	2011	2012	Change 2012/11	Development 2012/(2008-11)
Sales weight (thousand tonnes)	***45.0***	***47.4***	***46.7***	***44.8***	***36.2***	*-19%*	*-21%*
Marine	9.2	12.3	15.9	12.5	12.4	*-1%*	*0%*
Shellfish	33.9	33.6	29.4	30.8	22.7	*-26%*	*-29%*
Freshwater	1.8	1.4	1.2	1.3	0.8	*-34%*	*-41%*
Hatcheries & nurseries	0.1	0.1	0.1	0.2	0.2	*9%*	*37%*
Sales value (million €)	***94.3***	***106.6***	***122.5***	***128.5***	***130.3***	*1%*	*15%*
Marine	47.1	65.4	77.6	74.2	75.7	*2%*	*15%*
Shellfish	39.2	34.6	38.6	47.4	47.3	*0%*	*19%*
Freshwater	6.4	4.8	4.4	4.3	2.8	*-36%*	*-45%*
Hatcheries & nurseries	1.5	1.9	2.0	2.6	4.6	*75%*	*128%*

Source: EU Member States DCF data submission

Weight and value Irish Aquaculture Sector (Source: The Economic Performance of the EU Aquaculture Sector 2014)

Overall seafood exports have been performing well and exports have increased. In 2011 the sea fish landings to Irish ports were 198,937 tonnes, valued at €269 million. Provisional data in 2012 shows an output from aquaculture of 36,700 tonnes, valued at €138 million, as shown in Table 2.13[13].

	2006		2010		2012	
Species	**Value (€000's)**	**Live Weight (tonnes)**	**Value (€000's)**	**Live Weight (tonnes)**	**Value (€000's)**	**Live Weight (tonnes)**
Finfish	61412	12726	81125	13942	86830	13880
Shellfish	63,248	44,696	40716	30145	48940	22820
Total Aquaculture	**124,660**	**57,422**	**121,841**	**44,087**	**135,770**	**36,700**

Aquaculture Output in Ireland 2006-2012 (Source: BIM Strategy 2013-2017)

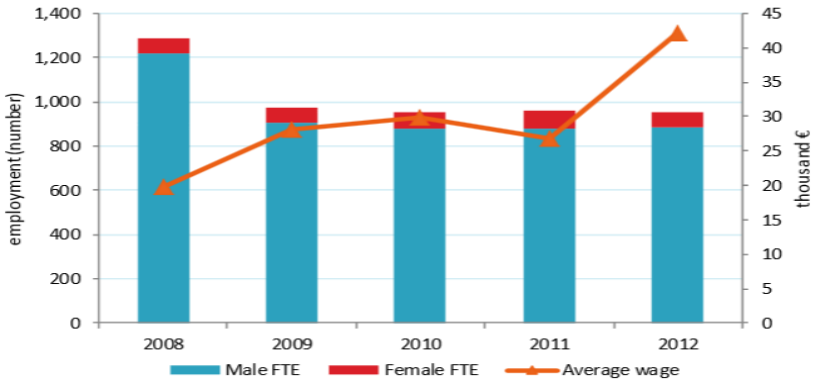
Aquaculture Employment

In 2012, there were 279 aquaculture enterprises, a decline of 4% from 2011 and of 8% since 2008. The Irish aquaculture sector is dominated by small enterprises with fewer

[13] http://www.bim.ie/media/bim/content/publications/BIM%20Strategy%202013-2017.pdf

than 5 employees. 68% of Irish enterprises had less than 5 employees but the structure of the industry is changing.

Smaller companies have consolidated and larger companies have contracted in the face of tough market conditions. Between 2011 and 2012 the effect has been a 16% increase in middle - sized companies employing between 6 and 10 staff and declines of 9% in those with 5 or fewer employees and of 16% in those employing more than 10. Over the period 2008 to 2012 there has been a 34% increase in middle-sized companies employing between 6 and 10 staff and declines of 18% in those with 5 or fewer employees and of 13% in those employing more than 10. The bulk of these changes have occurred in the last two years.



Irish aquaculture sector employment trends: 2008-2011. (Source: The Economic Performance of the EU Aquaculture Sector 2014)

The number of enterprises and FTEs has decreased from 2008 to 2012, but the average number of FTEs per enterprise has been rather constant over the period. It is clear that enterprises have managed to increase labour productivity, measured as gross value added per full time employee. From 2011 to 2012 the labour productivity increased by 14% and from 2008 to 2012 the labour productivity trebled.

Economic Performance in Aquaculture Sector

The impact of the improved profitability has been increasing income with a less than proportionate increase in operating costs. From 2011 to 2012, total income decreased by 1%, a fall of almost 3% in real terms, while the operational cost increased by 4%. The total income is dominated by the turnover from the sale of salmon from the farms, which contributes 58% of total income, with 27% of income provided by oysters.

The expenditures are dominated by the cost of wages and salaries (27% in 2012), cost of feed (16%) and cost of livestock (10%). Compared to some other countries, labour costs represent a high percentage of turnover compared to feed and livestock costs, indicating the reliance on coastal production and shellfish.

In spite of the problems of the global economy and the difficult trading conditions created over the period, gross value added for the sector as a whole increased by 120% and both EBIT and net profit were positive in 2012, having been negative in 2008. The total value of assets and debts increased by 33% and 24% respectively, between 2011 and 2012, indicating significant investment.

Variable	2008	2009	2010	2011	2012	% of total income	2012-11 Change	Development 2012/(2008-11)
Income (million €)								
Turnover	94.3	106.6	122.5	128.5	130.3	*95%*	*1%*	*15%*
Other income	0.9	1.6	0.6	10.3	5.7	*4%*	*-45%*	*71%*
Subsidies	0.0	0.1	0.0	0.3	1.9	*1%*	*465%*	*1732%*
Total income	*95.2*	*108.2*	*123.2*	*139.1*	*137.9*	*100%*	*-1%*	*18%*
Expenditures (million €)								
Wages and salaries	23.7	25.1	27.4	23.5	37.9	*27%*	*61%*	*52%*
Imputed value of unpaid labour	1.9	2.3	0.9	2.1	2.4	*2%*	*15%*	*33%*
Energy costs	1.9	1.7	3.3	6.1	10.2	*7%*	*68%*	*213%*
Repair and maintenance	7.9	7.7	5.8	7.3	10.6	*8%*	*45%*	*47%*
Raw material: Feed costs	17.5	28.7	25.5	27.7	22.3	*16%*	*-20%*	*-10%*
Raw material: Livestock costs	12.6	10.9	7.6	5.4	13.7	*10%*	*156%*	*51%*
Other operational costs	27.5	26.0	34.8	39.0	18.6	*14%*	*-52%*	*-41%*
Total operating costs	*93.0*	*102.4*	*105.3*	*111.1*	*115.7*	*84%*	*4%*	*12%*
Capital Costs (million €)								
Depreciation of capital	4.0	4.5	13.3	5.7	8.1	*6%*	*42%*	*17%*
Financial costs, net	1.7	1.4	2.4	0.8	2.1	*2%*	*157%*	*33%*
Extraordinary costs, net	0.0	0.0	0.0	0.0	0.0	*0%*	*0%*	*-100%*
Capital Value (million €)								
Total value of assets	133.1	168.7	170.9	142.6	189.7	*138%*	*33%*	*23%*
Net Investments	6.7	18.5	8.7	3.6	2.3	*2%*	*-36%*	*-75%*
Debt	48.9	65.3	105.6	101.6	125.6	*91%*	*24%*	*56%*

Input & Production (thousand tonnes)									
Raw material: Feed	13.4	16.6	20.5	16.8	16.1		-4%		-4%
Raw material: Livestock	25.1	25.3	23.9	21.9	15.2		-31%		-37%
Performance Indicators(million €)									
Gross Value Added	27.7	33.2	46.2	53.3	60.6	44%	14%		51%
Operating cash flow	2.1	5.8	17.8	28.0	22.2	16%	-21%		65%
Earning before interest and tax	-1.9	1.3	4.5	22.3	14.1	10%	-37%		115%
Net profit	-3.6	0.0	2.1	21.5	12.0	9%	-44%		141%
Capital productivity (%)	20.8	19.7	27.0	37.3	32.0				
Return on Investment (%)	-1.4	0.8	2.7	15.7	7.5				
Future Expectation Indicator (%)	2.0	8.3	-2.7	-1.4	-3.0				

Economic performance of main Irish aquaculture segments (Source: The Economic Performance of the EU Aquaculture Sector 2014)

Context Indicators

For the purpose of consistency with the EMFF Seafood Development Programme, the following baseline indicators for aquaculture from that Programme are proposed.

Context indicator presenting the initial situation	Baseline year	Value	Measurement unit	Source of information
Aquaculture Production	2011	36,700	Tonnes	*BIM Strategy 2013-2017*
Aquaculture Production	2011	132,770	'000 €	*BIM Strategy 2013-2017*
Net Profit	2012	12,500	'000 €	The Economic Performance of the EU Aquaculture Sector (2014)
Recirculating aquaculture systems (RAS)	2013	4 Finfish 4 Shellfish	Units	pers. com BIM
Organic aquaculture production	2013	Salmon – 82% Sea-Reared Trout 100% Arctic Char – 100% Rope Mussels -56% Bottom Mussels – 9%	% production tonnage	BIM annual production and employment survey
Employment (Total)	2012	956	FTE	The Economic Performance of the EU Aquaculture Sector (2014)
Employment (Male)	2012	887	FTE	The Economic Performance of the EU Aquaculture Sector (2014)
Employment (Female)	2012	69	FTE	The Economic Performance of the EU Aquaculture Sector (2014)

Chapter 2
SWOT Analysis of Aquaculture Industry

The following SWOT analysis of the aquaculture industry has been developed in consultation with stakeholders concerned with the industry.

Strengths	• Nutrient rich waters • Sheltered bays suitable for aquaculture production • Environmentally sustainable production techniques. • Global recognition as a leading producer of organic species. • Established production capabilities. • Experienced operators with proven track record. • Technically advanced systems
Weaknesses	• Complex Environmental requirements leading to delays in licensing process. • Insufficient investment in R&D. • Insufficient product availability to meet market demand. • Limited business planning from smaller operations. • Fragmentation within certain sectors • Lack of private investment. • Narrow focus of skills base and lack of entrepreneurship in the sector. • Lack of scale in comparison to comperitors and market size. • Uncertainty in seed supplies for oysters. • Uncertain seasonal availability of mussel seed. • Lack of support services and ancillary industries.
Opportunities	• Employment potential in Coastal Communities • Significant Export potential • Global demand for high- quality seafood • Off-shore aquaculture sites • Cost / efficiency benefits from consolidation • Underutilised aquaculture sites. • Land and sea based nursery sites. • Market gaps (e.g. oysters) • Development of shellfish hatcheries. • Novel species and niche products. • Use of Financial Instruments.
Threats	• Fish diseases and parasites. • Co-existence with other marine activities. • Public opposition to industry. • Natural occurring events such as algal blooms and diseases such as Amoebic Gill Disease. • Spatial restrictions on aquaculture activities. • Increased competition from companies outside the EU. • Competition in the organic salmon sector. • Further revisions of regulatory limits for biotoxins. • Lack of access to finance.

	• Constrained national public co-funding. • Impacts of climate change on aquaculture. • Impact on biodiversity from alien species • Impact on aquaculture due to eutrophication of marine water

Arising from this SWOT, the following over-arching needs have been identified.

1. A streamlined and efficient licensing system that provides greater business certainty to applicants and more transparency to the general public.
2. Need to grow sustainable production, value and employment in the aquaculture sector.
3. Encourage the entry into the sector of new aquaculture enterprises.
4. Support evolution of SME enterprises through scaling.
5. Develop and commercialise new and under-utilised species, develop new seed sources, new husbandry practices, mew processes and products, new disease management practices, new technology and equipment, and new ways to reduce the environmental impact of aquaculture.
6. Promote through professional training, skills development and networking of the uptake of best husbandry, environmental and disease management products and practices, adoption of innovative technology, and scaling.
7. Provision of advisory services in terms of health and safety, environmental management, animal welfare and professional business and marketing strategies.
8. Assist shellfish producers affected by major biotoxin episodes to recover from prolonged harvesting suspensions so as to preserve productive capacity and employment.
9. Promote organic aquaculture practices and certification.
10. Promote development of multi-trophic aquaculture practices.
11. Protect biodiversity in marine habitats, including species and habitats protected under Natura 2000, with acquisition and analysis of data, assessment of environmental impacts, preparation of plans, networking and capacity building, monitoring and reporting and alien species management.

12. Support good governance of aquaculture and reduction of the administrative burden on operators through investment in support systems that facilitate online licence application and tracking and that facilitate spatial mapping of aquaculture sites and exclusion areas, in particular areas protected under Natura 2000 and requiring spatial protection.
13. Need to develop marine spatial planning and equitably incorporate aquaculture into that framework.

Chapter 3
Sector Analysis

Snapshot of Aquaculture in Ireland

Aquaculture takes place mainly in coastal areas but also occurs inland in freshwater and in land-based recirculation systems. As such, it provides a vital source of employment and economic activity that contributes to the preservation of viable rural communities on a year-round basis. It is a relatively diverse sector encompassing a substantial shellfish farming element, combined with a significant finfish element. There are certain areas within Ireland that have higher concentrations of aquaculture, such as Co Donegal, Carlingford Lough, Co Wexford, Co Waterford, West Cork, Co Kerry, Co Galway and Co Mayo.

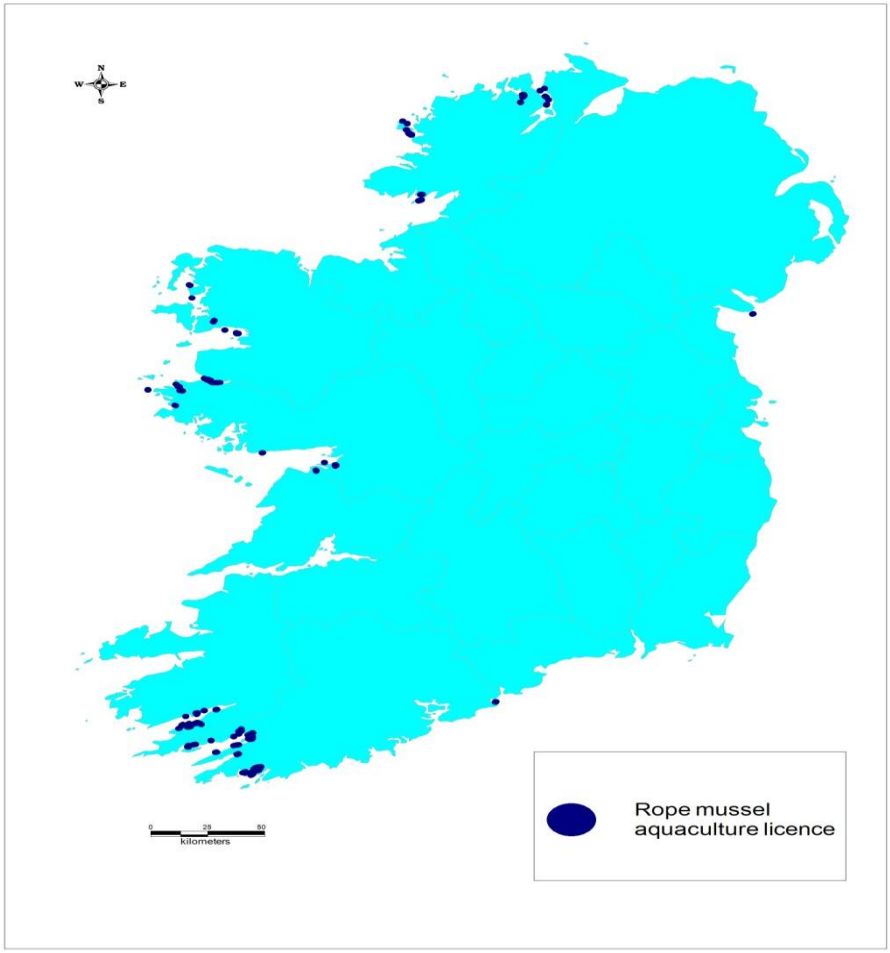
Marine aquaculture can be divided into finfish and shellfish farming. The number of active enterprises engaged in marine aquaculture has remained stable with a total of 292 enterprises currently trading. Since 2000, there have been both increases and decreases in salmon output. Gigas oyster production has increased steadily, while mussel production has decreased somewhat due to poor seed supply for the bottom grown sector and because of a serious disruption in the route to market arrangements for the rope grown sector.

Rope Mussels

Rope mussel farming is carried out in relatively sheltered bays from Cork up to Donegal. The majority of production is in the Southwest.

Culture Type

Mussels are grown on culture ropes suspended at intervals from a horizontal long line on the surface down to a depth of between 6-10m. The long line is kept afloat using purpose built mussel floats and is usually about 100m in length. Culture ropes can be hung as individual droppers or as a continuous line. The average grow-out time for rope mussels is about 24 months. Mussel spat is collected on special collector rope in the Spring, usually stripped from that rope within 6 months and restocked onto grow rope until the mussels are ready for harvest.



Volume and Value Data

Between 2004 –2007 the rope mussel sector experienced a significant increase in production from over 8,700 tonnes to a high point of 14,000 tonnes. There were a number of contributing factors:

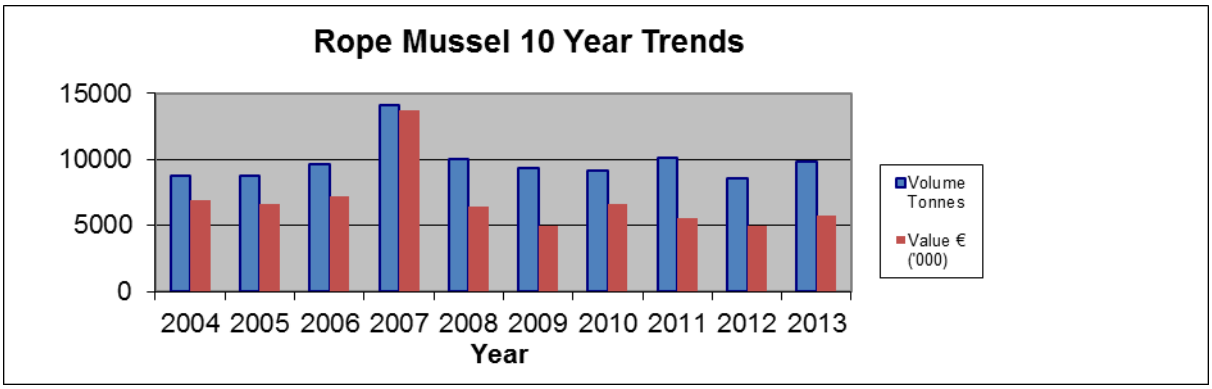
- There were few prolonged biotoxin harvesting suspensions in the main production areas;
- There was a strong demand for raw material from several competing processing plants;
- The adoption of the 'New Zealand continuous recyclable rope 'technology and husbandry techniques which enabled operators to maximise yields from their farms whilst reducing labour costs. The strong demand for product encouraged producers to invest and to increase their capacity.

Production Trends

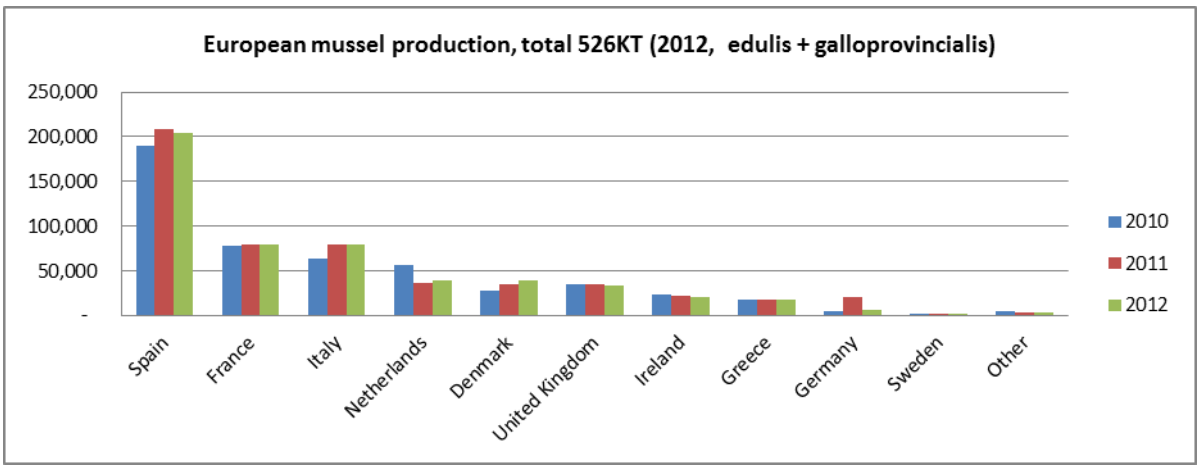
By 2008, production had fallen back to 10,000 tonnes and has stayed between 8,000 and 10,000 tonnes since then. The biggest factor affecting rope mussel production continues to be market interruptions, loss of product and product devaluation arising

from temporary harvesting suspensions associated with naturally occurring biotoxins. However, the inability to recover from prolonged closures is down to a number of factors, all of which can be mitigated against if the lessons from the recent past are taken on board. These include;

- Difficulties with the operation of the aquaculture licensing system have led to a situation whereby the bulk of the operators have been rendered ineligible for state developmental grant aid. This has caused a loss of confidence in the sector amongst financial lending institutions which in turn has starved the industry of investment.
- The loss of the major route to market arising from the closure of the pre-eminent and largest of the mussel processing companies in 2009 due to serious failures within its food safety management regime, resulting in a series of very expensive product recalls which were financially catastrophic to that company. Low cost competition in the market place from products produced in Chile and shipped in bulk by sea to the EU.



Source: BIM



Source FAO

Bottom Grown Mussels

This sector of the aquaculture industry is unusual in that it is operated on an all-island basis. It has been the subject of a detailed 2007 review 'The Rising Tide' carried out by Government departments from both jurisdictions and the relevant state agencies. Most of the recommendations contained in the review have been implemented, including the formation and ongoing operation of an ad-hoc industry advisory body – the 'Bottom Grown Mussel Consultative Forum'.

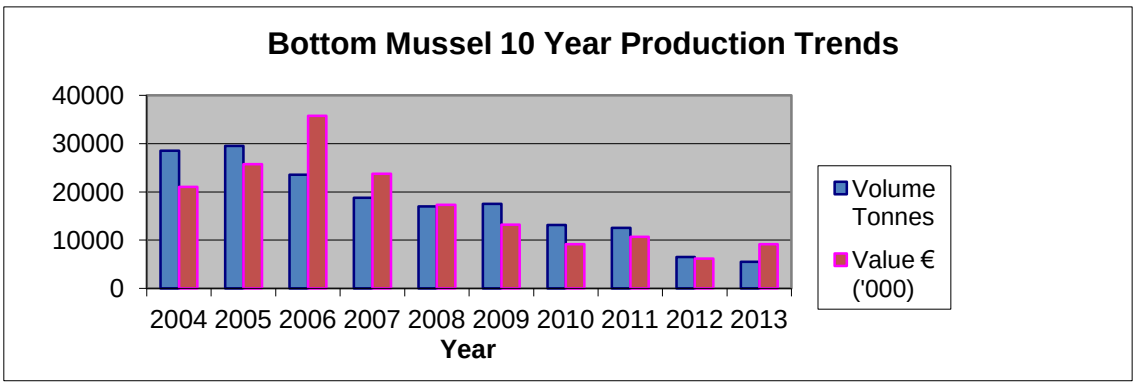
There are 5 major production areas for bottom mussel in Ireland: Wexford Harbour, Waterford Estuary, Castlemaine Harbour in County Kerry, Carlingford Lough in County Louth and in Lough Foyle in County Donegal. There are also some smaller areas in County Cork and Lough Swilly in County Donegal.

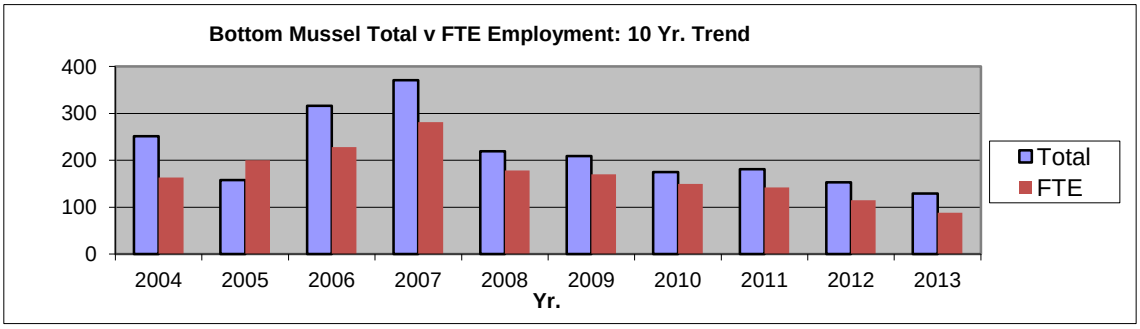
Culture type

The production is done directly on the seabed in shallow coastal bays predominantly in sub tidal areas. Shallow draught vessels and dredges are used to work the grounds. Young mussels, also known as seed mussel, are fished in coastal waters and re-laid in inshore bays. The main source of juveniles is wild seed mussel from seasonal beds mainly located in the western Irish Sea; local settlements are found in Castlemaine Harbour and periodically in Lough Foyle. The industry is heavily dependent on availability of these wild settlements. Rope mussel seed has been re-laid from time to time in case when wild seed has been unavailable. Very little handling is done once the seed has been re-laid on licensed ground. Virtually all of the production is exported to Holland and to a lesser extent France. Occasionally, some has been used for processing in Ireland.

Volume and Value Data

For 2013, the production was 5,527 tonnes for a value of € 9.173 million. An all-time high was reached in 2005 with 29,510 tonnes valued at € 35.789 million. Since then both production and value have decreased sharply. Employment in the sector has also decreased proportionally.



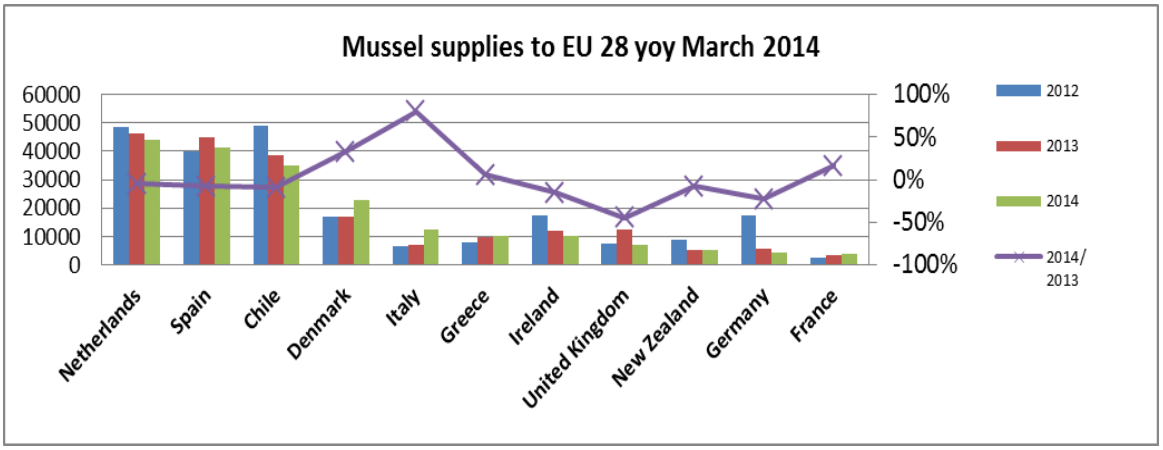


Production trends

From the highest in point in 2005 to 2013, the annual production has dropped by approximately 25,000 tons per annum. Poor yield from the seed mussel fishery has

been the main reason for the decline. As mentioned previously, the bottom grown mussel industry is highly dependent on seasonal seed mussel fishing. There has been a downward trend in seed availability since 2009 around the Irish coast, due to natural variability and unsuitable weather patterns, involving strong North-Easterly gales over the winter. A further limiting factor was that until 2013 the fishery was somewhat limited due to the designation of substantial areas of the fishing grounds as SACs and SPAs, in accordance with the Habitats and Birds Directives respectively. Pending appropriate assessment, those areas were unavailable for fishing. This issue has now been addressed by re-opening those areas for fishing.

The seed mussel fishery for 2014 has shown a marked improvement over the previous two years, with 10,036 tonnes fished for relaying.



Both the seed mussel fishery and the production end of the bottom grown sector have been certified with the Marine Stewardship Council (MSC) label; this development is maintaining access to the premium markets and will bring added value to the Irish bottom mussel product on the market. The bulk of the output is now covered by this prestigious sustainability label.

Oysters

Farming of pacific oysters commenced in the early 1980s and has grown from small and artisanal beginnings to become a substantial element of the Irish aquaculture industry with a lucrative export trade.

Culture Type

In Ireland, the Pacific oyster is farmed in the inter-tidal zone between the Mean High Water Spring Mark and the Mean Low Water Spring Mark in sheltered bays around the

coast. Oyster spat is purchased mostly from hatcheries in France and, with a small amount available locally, in Ireland.

The oyster stocks are reared in plastic mesh bags secured to steel trestles and are harvested at a commercial size of anything from 75g to 150g, depending on market demand. The growth cycle is between 24 and 48 months depending on the farm site. The sites are generally accessed by tractor and trailer or in some cases by a flat bottom boat.

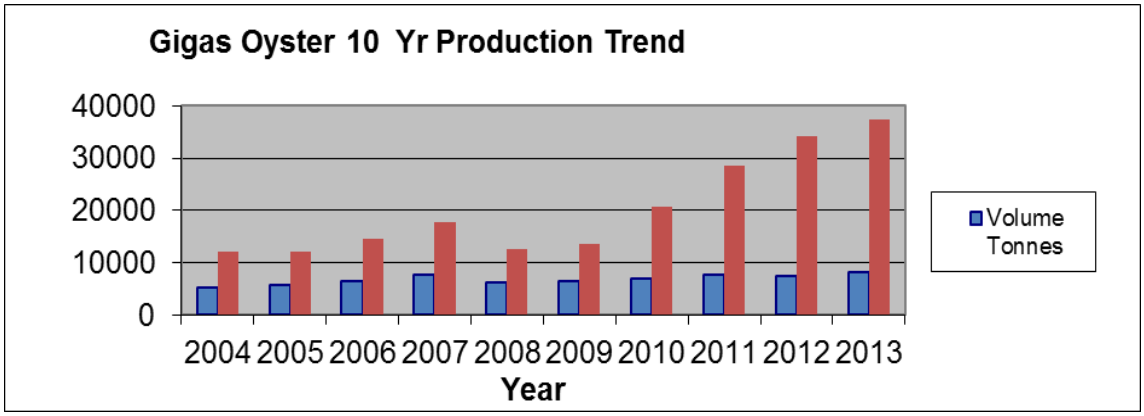
The practice of oyster farming is highly labour intensive. Once oysters are stocked on a farm, the mesh bags must be turned and/or shaken as often as possible, preferably once on every set of spring tides. They must also be taken on to land and graded two to three times during their growth cycle and moved to different areas of the shore to ensure optimum growth rates. Site maintenance involves the lifting and moving of trestles, which sink into the ground over time, and replacement of old, broken trestles.

Production Trends

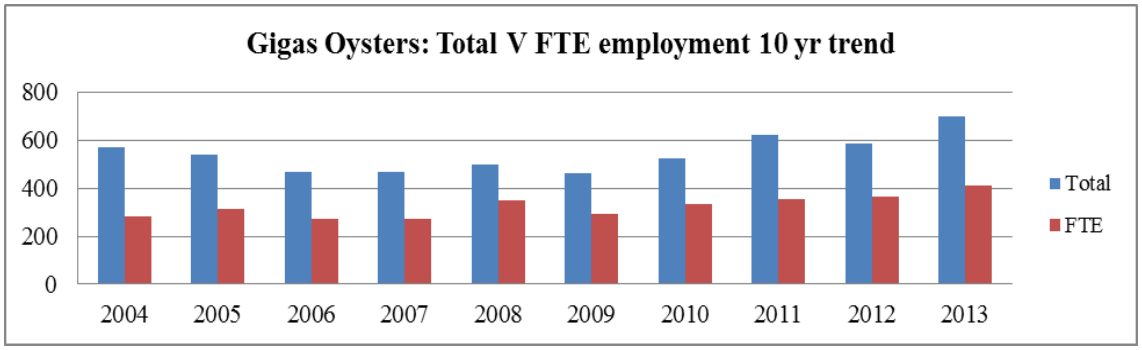
Over the past decade, there has been an increase in production of oysters from just over 5,000 tonnes in 2004 to the current level of 8,000 tonnes. Constraining factors include;

- The effects of exceptional mortalities in juvenile and adult oysters in 2007, caused by a toxic algal bloom, resulted in a decline in production that was not recovered until 2011.
- The emergence of a new strain of oyster herpes virus (OsHv1) in Ireland in 2009, which causes mortality in spat, has slowed the growth in the sector since then. In some instances, mortality rates as high as 80% have been reported.

Volume and Value Data



Source: BIM

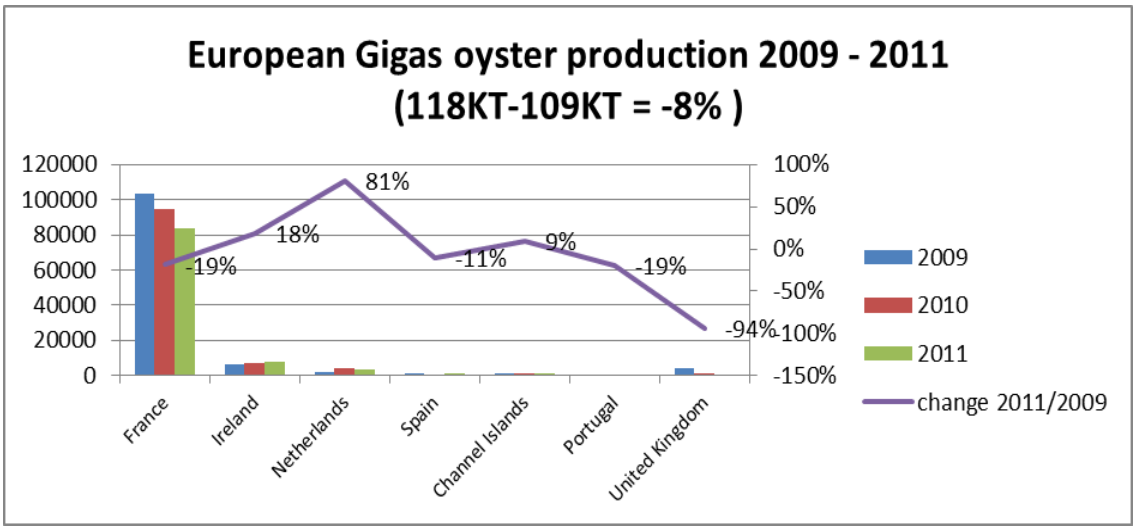


Source: BIM

Employment in the Gigas oyster sector has shown steady growth over the last 5 years in line with the growth in production volumes.

Whereas the increase in the level of production has been slow, the value of the sector has experienced rapid growth since 2009. This is directly attributable to the growth in

export of Irish oysters to France, to service a market not fulfilled by local production. The industry in France has been stricken with exceptional mortalities in all year-classes since 2008.



Source: Bord Bia

Production trends

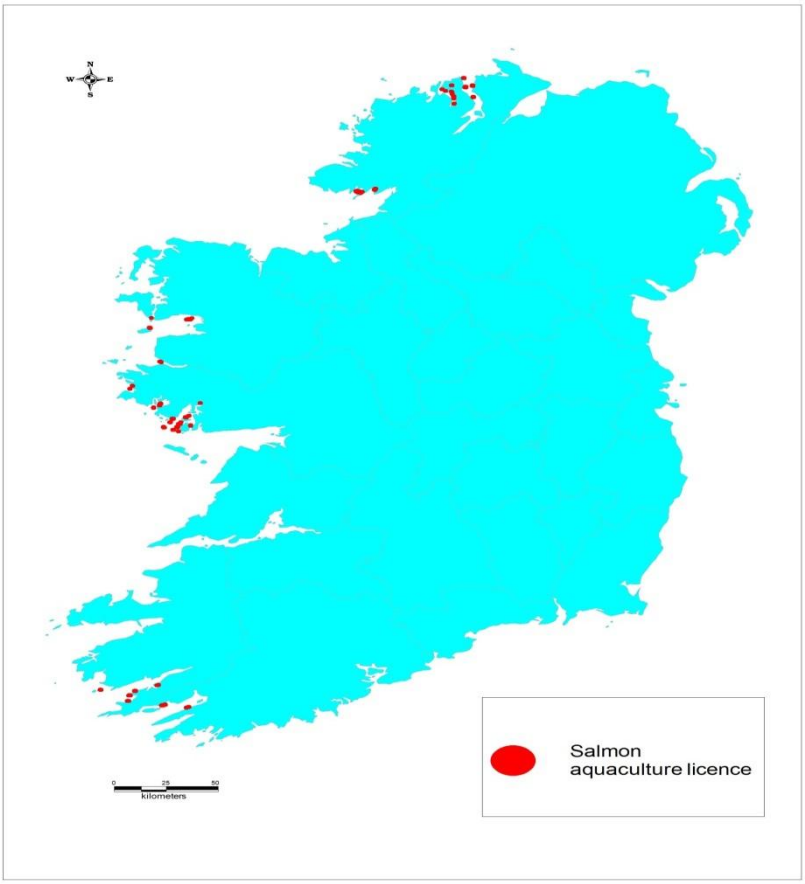
Irish oyster growers have been very successful in recent years due to the high quality of their production and their exploitation of market opportunities arising from production difficulties in France. French production fell 37% from 126,000 tonnes in 2006 to 79,000 tonnes in 2013.

To prevent overdependence on the French market, Irish producers have already begun to explore new potential markets for their product. New direct routes to other international markets have recently been established. However, developing these new opportunities requires a strategic shift from offering bulk non-purified product to packed purified oysters. The sector will need to build scale and a co-operative route to market approach to make an impact on the market. This would ensure significant returns could be made with improved margins for the producers. Moreover, improved logistics with more frequent supplies should eventually allow Irish exporters to access other EU markets directly such as Belgium, Germany and Northern Italy.

Once the strategic shift to packed purified oysters is achieved, then it will be possible to add other mollusc species such as clams, periwinkles, sea urchins etc. in a range expansion that fits perfectly into the ingredient range of the continental European seafood platter.

Salmon

Atlantic Salmon *Salmo salar* has both a freshwater and sea-water phase to its life cycle. The natural breeding cycle of the Atlantic salmon requires spawning in freshwater, migration and growth in the sea until sexual maturity is reached, at which point the fish returns to its parent river to spawn. The complete life cycle of the Atlantic salmon can be reproduced in a period of 3-4 years using farming systems. This anadromous habit results in Atlantic salmon farming being divided into two separate stages, freshwater and seawater. Salmon aquaculture production in Ireland is typically based on smolt production in freshwater in a land based hatchery and farming at sea.



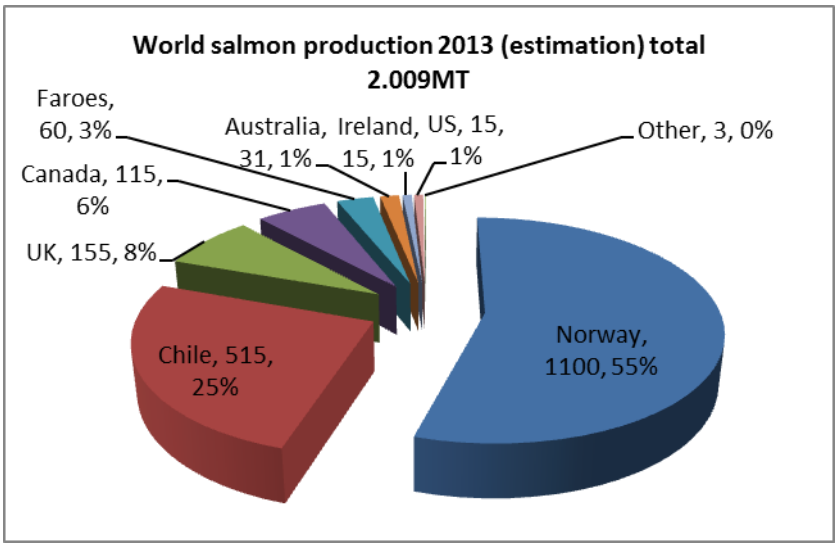
Volume and Value Data

Finfish production overview

Ireland has a natural resource base for aquaculture production, but despite all this Ireland has not managed to consistently increase its salmon output over the past 13 years.

In 2013, according to FAO estimations the total volume of farmed salmon in the world was around 2 million tonnes. Ireland produced around 15,000 tonnes compared to 1.1

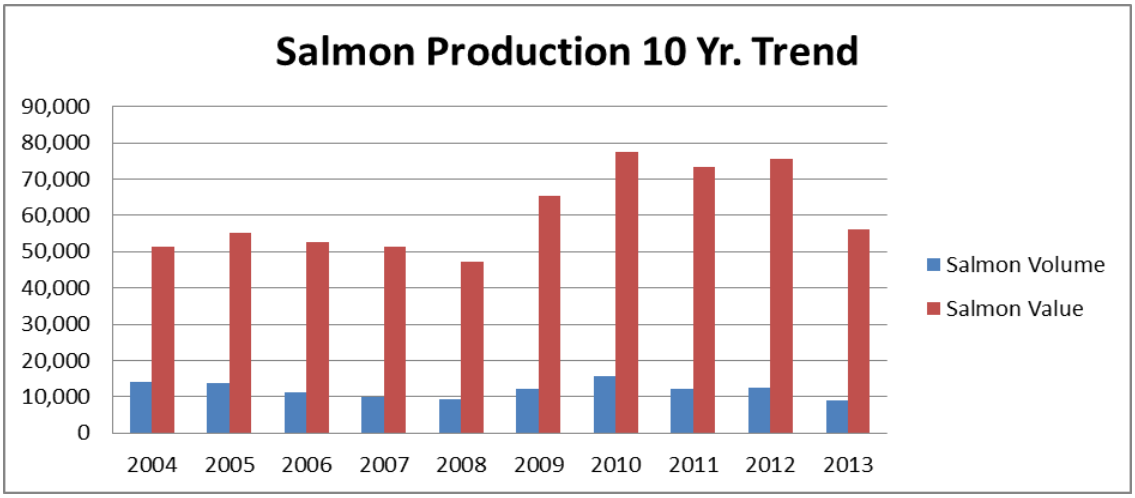
million tonnes in Norway, 515,000 tonnes in Chile and 155,000 tonnes in the UK. Ireland's global market share in salmon production is less than 1%.



Source: FAO

Farmed salmon output reached a peak in production of 23,312 tonnes in 2001. Thereafter, total annual salmon harvest volumes suffered a series of setbacks, which resulted in a reduction in production to a low of 9,353 tonnes recorded in 2008. Production increased and was stable at 12,000 tonnes during 2009 through to 2012, with a secondary peak of 15,691 tonnes in 2010. However, in 2013 total on-growing production volume and value decreased significantly from 2012 from 12,000 to 9,000 tonnes due to the incidence of Amoebic Gill Disease (AGD), which caused significant losses of young stock in 2012.

Despite the decline in output in 2013, salmon culture remains the highest value sector of the Irish aquaculture industry, accounting for 58% of the value. Average salmon prices continued to be extremely positive, ranging above €6,000 per tonne first sale value in 2013. Organically certified salmon accounts for over 80% of total output of total salmon production. Donegal and Cork are the main production areas, accounting for over 60% of all Irish salmon production.

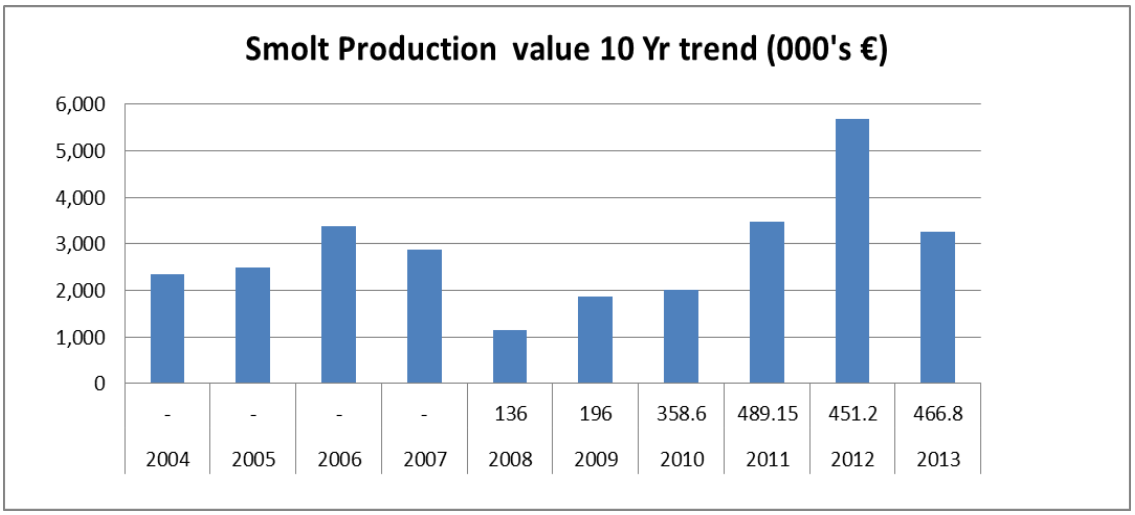


Source: BIM

There are 12 commercial units currently involved in smolt production. The number of smolts produced in 2013 was in the region of 3.5 million.

The main destination of the smolts produced nationally was to on-growing units in Ireland, with a small percentage being exported to Scotland and France.

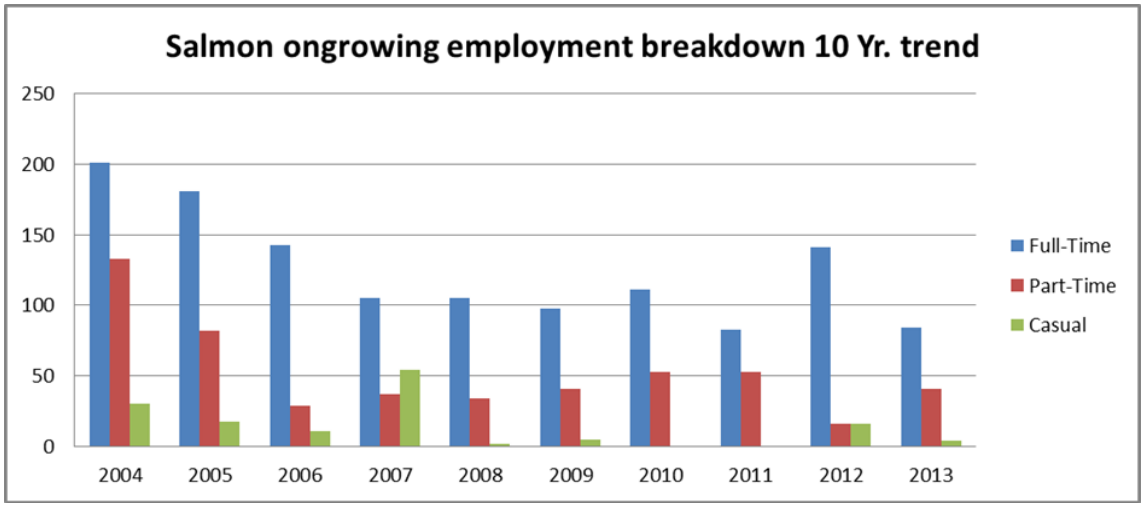
Mowi/Fanad strain comprised the majority of the salmon farmed in Ireland since 2007, with Aquagen strain representing a small proportion of farmed fish. Salmon egg production in Ireland is carried out by one company which provides the Mowi/Fanad strain eggs, which have organic certification, to several hatcheries in Ireland.



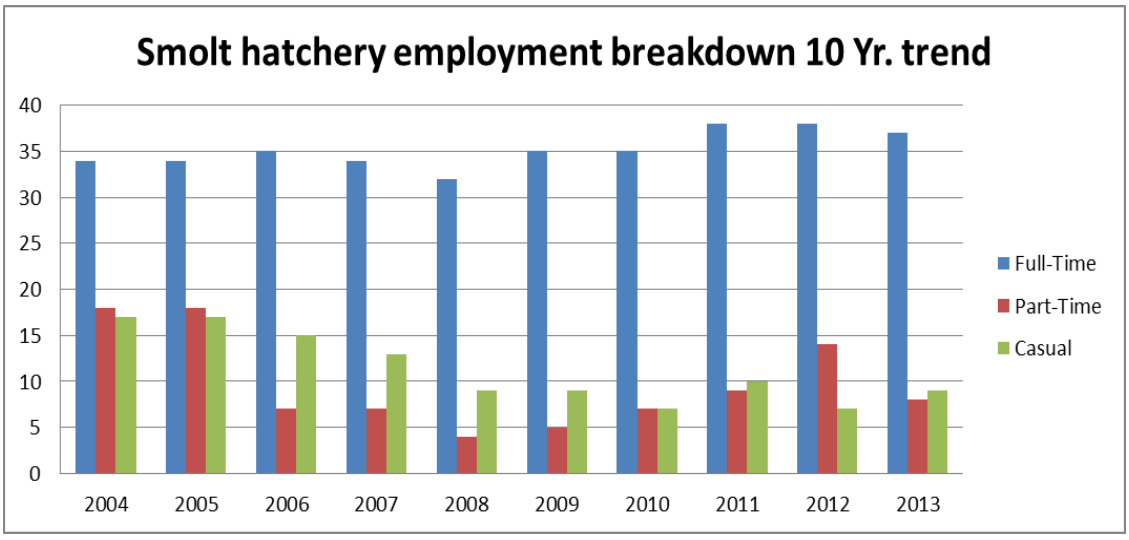
Source: BIM

Salmon Employment

Full Time Employment (FTE) has fallen in the salmon sector while the part time employment number has increased.



Source: BIM



Source: BIM

Production Trends

Notwithstanding declines in salmon production output, the Irish salmon farming industry maintains extremely positive market trends by delivering a product that is viewed as distinct and desirable in the marketplace by virtue of its origin. Ireland's high-energy, exposed sites and low stocking densities result in high quality salmon that achieve a price premium in the market place.

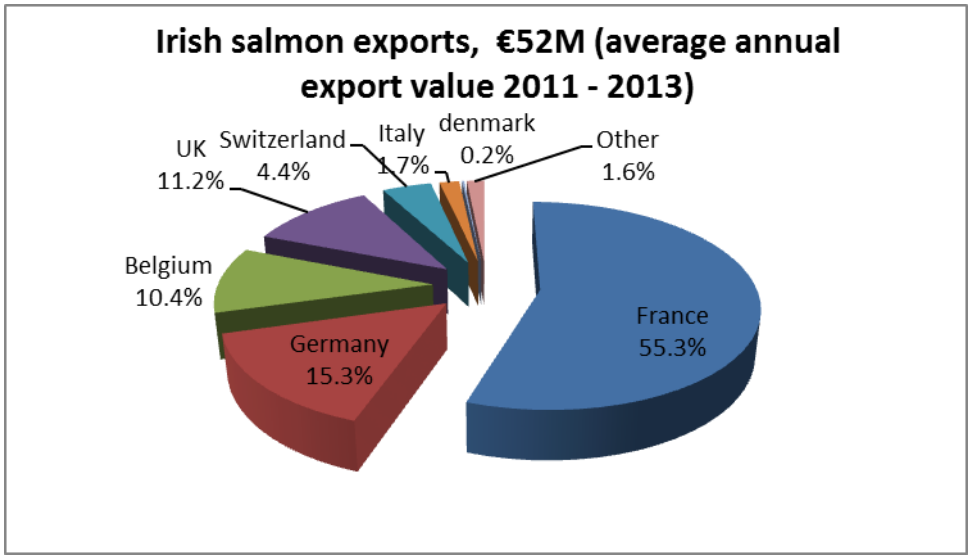
Over the past decade, the Irish salmon industry has focused on organic status production, which has proven to be a beneficial strategy for Ireland's low-volume, niche output in terms of achieving a favourable price differential.

The production of organic aquaculture has been the success story of the organic movement in Ireland, with organic salmon production leading the way, and known as

the world pioneer in the organic salmon sector. Ireland is the main organic salmon producer in Europe and first in quantity with over 80% of its total production certified organic. The overall European organic food market is valued at over €18.9 billion, with the key markets being Germany, France, Italy, the UK and Spain. Irish production represents about 50% of the total European organic salmon production, and 90% of its production is exported, mainly to French and German markets.

The production of organic salmon in Ireland ties in effectively with an image of Irish aquaculture that is 'as green as the island' and also fits in well with Irelands' new food marketing drive 'Origin Green'.

The export value of Irish salmon is around €50 million per year, which places the species in first place for value exports amongst aquaculture species. The three main export markets, France, Germany and Belgium, represent over 80% market share. The main reasons for this are affordability, supply and proximity. The cost base for salmon production in Ireland is higher than in Norway or Scotland due to the lack of scale in the sector. This has led to the adoption of the innovative market strategy of organic certification, with the potential of generating high market returns. Germany and France are Europe's highest organic food consumer markets, as well as having a critical population mass of affluent buyers. Belgium also has an affluent population, as well as being relatively close from a logistics point of view. All three markets are within easy reach for regular deliveries by road for the fresh market. The supply constraint, however, prevents Irish salmon producers from actively prospecting new markets when they have difficulty in satisfying the demand of core clients, thence, the high export share of the top three export destinations.



Source: GTA

Salmon can be regarded as a species with the potential for increased value. The current traditional European market is an obvious channel to increase market share. However,

the fast emerging high end sushi – sashimi market is also a potential target sector both in Europe and in the emerging markets, particularly Asia. The potential is double fold: growth as a high end supplier of fresh high quality organic salmon for the traditional market, while at the same time creating a high end frozen market for high quality frozen raw cuts, thus opening the way for substantial job creation in factories at production source, as frozen product can be stocked, container packed and distributed far easier than fresh produce and to a substantial range of markets. Frozen is particularly suited to the raw fish market.

The consumer of raw fish tends to be very health conscious and could be encouraged to be even more receptive to organic certification. However, there is a challenge to obtain recognition of the EU organic certification in international markets such as Asia and also the US, where there is resistance from some parts regarding organic certification of salmon production overall.

Aside from marketing considerations, production success is also dependent on a variety of interrelated factors including natural ones, such as biology and environment, as well as access to licensed production sites and access to investment finance from both public and private institutions.

Amoebic Gill Disease

Production losses due to Amoebic Gill Disease (AGD) became a serious health and welfare challenge for marine salmon farms in 2011 and 2012, when over 25% of the sites in Ireland were affected by AGD. It was seen previously in Ireland in 1997, but subsided and did not recur for many years. It appears to have now re-established and persisted during 2013 and into 2014.

AGD is a gill disorder found in marine fish. The disease only appears to threaten farmed species, with fish in their first year at sea seeming particularly susceptible to the disease. In Ireland, fish with an average weight in excess of 2kg appear resistant.

The impact of AGD in Ireland includes mortalities, loss of growth, an increase in percentage of low condition fish, increased susceptibility to other disease and mortalities during either bath treatments (for sea lice) or livestock movements as a result of compromised gills.

Freshwater baths have been used in Ireland in plastic pen liners and well-boats and although the technique is time consuming and labour intensive, clearance of amoeba and recovery of the fish has been excellent with behaviour improving within a day of

treatment and gill sores decreasing within a week. Freshwater treatment also has beneficial effects on sea lice infestations and gill challenges generally. No medicines or chemicals are used.

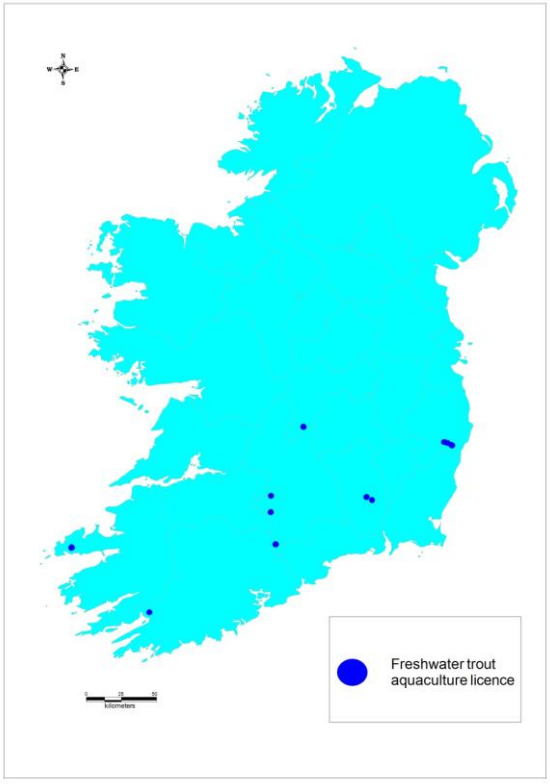
Trout

Culture type

Rainbow trout (*Oncorhynchus mykiss*) is an imported species of salmonid originating from North American rivers draining into the Pacific Ocean. Due to its great adaptability it has been introduced into many parts of the world. Rainbow trout is an anadromous fish meaning that it has both freshwater and sea water phases to its life cycle. In the wild, rainbow trout can follow both an anadromous pattern or live its whole life in fresh water. The anadromous pattern, where rainbow trout are on grown at sea is characterised by rapid growth and the production of large fish, whereas rainbow trout permanently inhabiting freshwater can only attain a certain, much lower growth within the same time span.

Trout farming in Ireland is divided into two mains products:

- Fresh water Rainbow trout;
- Sea trout – on growing of Rainbow trout at sea.



Volume and Value Data

Freshwater Trout

In 2013, the production of freshwater trout increased by over 17% to 728 tonnes. Freshwater trout production is concentrated in Kilkenny and Wicklow, accounting for 87% of all production. Irish produced freshwater trout sell mainly on the domestic market.

Sea Trout

Production of sea reared trout reached 600 tonnes in 2011. Donegal and Mayo were the main production areas, reflecting one operation in each region. Sea trout production was converted to salmon in Donegal after 2011. Production then reduced to 180 tonnes in 2012 and remained the same in 2013.

Production trends

Freshwater Trout

The production of rainbow trout has grown exponentially since the 1950s, especially in Europe and more recently in Chile. This is primarily due to increased inland production in countries such as France, Italy, Denmark, Germany and Spain to supply the domestic markets, and mariculture in cages in Norway and Chile for the export market. Chile is currently the largest producer. Other major producing countries include Norway, France, Italy, Spain, Denmark, USA, Germany, Iran and the UK.

In Ireland, the freshwater trout sector is significantly smaller and production and price have remained static. All production supplies the domestic market. When there is a gap in supply, trout from Spain and France are imported.

Sea Trout

The production of organic Rainbow seawater trout in Ireland follows a similar trend to its production of Atlantic salmon, going hand in hand with an image of Irish aquaculture that is ‘as green as the island’. Even if it has only 7% share of the European market, it represents 100% of its national production. Ireland exports all of its organic trout to Europe.

Overall the production of freshwater trout has remained relatively static over the past 10 years.

Market Size

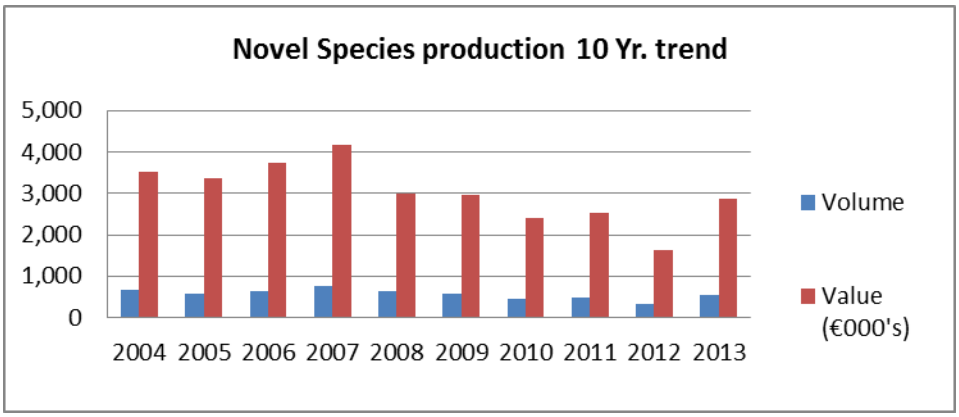
The Irish freshwater trout industry is a fraction in size of that in neighbouring countries. The sector primarily supplies only to the domestic market which still requires imports from France and Spain when there is a gap in home grown supply.

In addition, freshwater farms only grow fish to 300-350g due to space limitation, but the market requires larger fish.

Novel species

Novel species include a wide range of finfish, shellfish and seaweed species in both freshwater and saltwater. The common factors amongst all of these disparate species are their relatively untried production techniques and the necessity to develop new markets.

Among the species being explored are; the gastropod shellfish abalone, *Haliotis discus-hannai, Haliotis tuberculata* and the echinoderm or sea urchin, *Paracentrotus lividus*; the freshwater coarse fish perch, *Perca fluviatils*; and various seaweeds including; *Alaria esculenta*, *Saccharina latissimi and Palmaria palmata.* Nine tonnes of seaweed (macroalgae) was produced in 2012 and ten tonnes in 2013.



Source: BIM

Abalone and Sea Urchins

These species are generally cultured in land based structures with sea-water being pumped ashore and include a water reservoir and tanks. This culture type typically involves conditioning brood animals before spawning them and settling the juveniles.

Combined value for the production of juveniles is not apparently significant since the juveniles are often grown by parent companies, which are generally integrated in this regard. Therefore, only the cost of production is evaluated. The production of abalone juveniles has been on a plateau for 3-4 years. Sea urchins on the other hand have been expanding in recent years with a possible output of 1.5 million juveniles by 2015. There has been a strong demand for purple sea urchins as a possible diversification for the aquaculture industry, coupled with strong prices and successful trials of various on growing methods. Hatchery production will be expected to increase as the demand for juveniles grow.

As with most novel hatchery techniques, the issues of biotoxins and other not yet fully understood issues can contribute to lower than expected levels of production. This is to be expected since such hurdles have not been encountered before.

Future growth will occur in these smaller sectors when the demand from on-growers increases. This is likely to materialise should appropriate on growing licences be granted and funding sources for individual producers begin to flow into the marketplace. This is particularly true for sea urchins, where sea-based on-growing is highly effective, but is less true for abalone, where Irish winter sea temperatures are low and growth rates decrease.

Commercial scale on-growing is likely to make advances in terms of diet formulation and type of on-growing structure utilised, whether this is on land or at sea. At sea, recent aquaculture licences have been issued that combine seaweed, filter feeding shellfish and grazing shellfish. It is hoped that this can form a basis for integrated multi trophic aquaculture (IMTA) and that this type of approach might expand into the future. The long lead time to obtain licensing is reported as being a significant disincentive to being involved in such novel industries.

We might reasonably also expect advances in the field of marine hatcheries in terms of species diversification opportunities, some of these have been trialled before and others remain in their infancy and are not yet fully explored. A scallop hatchery is a good example of the former. Previous hatching of the king scallop has taken place in several locations in Ireland over the years with the process not yet having reached commercial viability. This outcome was likely the result of several coinciding factors

such as hatchery location, budget availability and technical difficulties. As the Irish experience base has grown in recent years, a new impetus for scallop hatching, and as a result farming, is expected.

There will also be interest in other species such as razor clams and sea cucumbers. It is in these areas that the Irish industry has first mover advantage given the high skill levels in hatchery operations.

Seaweed

There is a small number of aquaculture sites licensed for seaweed cultivation, and in excess of 20 new seaweed aquaculture applications awaiting determination. Should these licence applications be approved and production starts on these sites, farmed seaweed production would increase significantly over the coming years.

It is envisaged that further research and development will be needed on seaweeds, in particular on the two more commercially valuable red species, *Palmaria palmata* (Dulse) and *Porphyra umbilicalis* (Nori). These species have complex life stages and work carried out in Ireland on life stage manipulation has shown up deficiencies in knowledge and ability. *Palmaria* is subject to catastrophic spore crashes after early settlement of spores on nets in the marine hatchery. The lifecycle of *Porphyra* involves an alternate generation or conchocelis stage, which produce spores that settle on nets for grow out (Asia). So far in Europe, this has not been achieved on a commercial scale, although there is research and development taking place on *Porphyra*. Mass production of conchocelis and spores at sea may be the only realistic option for manipulation of this species.

Perch

At present two types of Perch culture are carried out in Ireland, pond culture and Recirculating Aquaculture System (RAS). The largest farm in Ireland is a RAS facility located in Co. Tipperary.

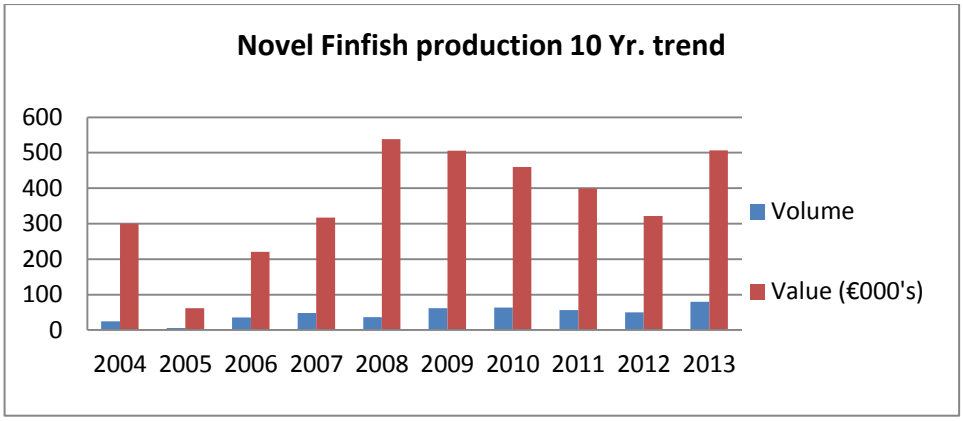
RAS involves the reuse of water in a controlled environment and the Irish facility consists of a number of insulated polytunnels where temperature and light are controlled year round. The facility has separate hatchery, nursery, broodstock and on growing facilities. There are four separate broodstock modules producing juveniles four times per year through out of season spawning. A biofilter in each unit, in conjunction

with drumfilters, ultra violet and other ancillary equipment cleans the water coming from the fish tanks.

A pond facility is operated in Co. Sligo. This system is more traditional and involves the culture of juveniles in a hatchery, before they are stocked in ponds for grow out.

A third type of system is currently being developed based on the American split pond design. This type of farming is new to Europe and will incorporate intensive production in pond systems modified along the principles of multi-trophic aquaculture. Such systems will incorporate reed bed and wetland treatment systems. A trial is currently running to develop this type of system.

In 2013 approximately 55 tonnes of perch were produced in Ireland with an ex-farm value of circa €400,000. Production in 2014 was around 70 tonnes and projected tonnage for 2015 is 100 tonnes. Value of product is further increased by processing, which is carried out before delivery to the market, which is mostly in Switzerland.



Source: BIM

Production is steadily increasing and is dependent on sufficient juvenile supply and market demand. BIM is involved in a number of projects aimed at reducing production cost, improving growth rate through genetic based broodstock programmes and developing new production technologies such as split ponds.

Production has steadily increased since the first perch farm was developed in 2001. Early issues, such as juvenile availability and quality, out of season spawning, cannibalism and bacterial infections, have largely been overcome through targeted R&D. The focus now is on the expansion of production and market development. BIM is actively engaged with a number of European and Swiss partners in reducing production costs and improving on-growing techniques. The development of juvenile production through out of season spawning has proved particularly successful and Ireland now has a stable and high quality supply all year round.

Market analysis for novel species

The market for lesser known species is difficult to ascertain. Regionally “restricted” species such as fresh water perch from the Swiss lake regions present barriers in gaining reputation and traction outside of the traditional consumption area where the species may be considered too expensive compared to substitute products. High quality aquaculture products may fit into the regional niche, but the market would be highly sensitive to saturation as soon as supply overtakes demand. A partner approach to markets for expensive niche species such as European perch or Arctic char is no doubt a more rational means to develop, where producer and customer can agree on production volumes and timelines together.

Novel species of shellfish may prove attractive in certain markets as an addition to oysters, as mentioned in the oyster sector review. As these products may not reach a critical mass on their own, they may suffer supply chain constraints. A rational approach

would be to use them as range extensions for a supplier of high volume shellfish, such as purified oysters, thereby offering additional ingredients for the traditional continental European seafood platter. Significant quantities of Irish sea urchins were sold to the European market in the 1980s and early 90s, indicating potential for future sales if volumes were to rise again.

While abalone is well known in Asian markets, progress has been slow in penetrating the traditional European market, where price and consumer awareness appear to be a barrier. Again, this may change as fresh product becomes more available and economies of scale are reached. In general, the main issue for novel species is whether there are obvious competitive advantages in producing the species in Ireland, which would be evident to the buyer. Some potential competitive advantages are listed below.

Competitive advantage	Species	Strength	Opportunity	Threat
Growing conditions	Perch – arctic char – cold water species tolerant of temperate climates.	Faster growing cycle. Availability of fresh water.	Organic – eco label receptive in niche high end markets.	Niche market prone to saturation.
Availability of coastline and polyculture opportunities	Seaweed as a compliment to salmon / shellfish farming.	Potential fits into existing aquaculture structure and adds eco credentials.	Lack of space in traditional production latitudes and high demand in international markets. Positive new food & health trend in traditional markets.	High cost due to labour requirement may not be met with market price return.
Technical knowledge	Abalone	Hatchery techniques to obtain juveniles in a controlled environment non dependant on ambient climate.	Sale for on growing to more climate and labour competitive origins such as southern Europe.	Knowledge acquisition in target on-growing market.
Range extension	Abalone, sea urchins, bivalves, seaweed for human consumption.	Some Irish seafood companies are becoming highly efficient and achieving critical scale to be major suppliers to international buying centres in Europe but also internationally.	Being in daily contact with the most important international buyers it is relatively feasible for these companies to extend product range to include novel species in the spirit of coopetition.	It would be crucial to secure consistently high quality from small dispersed producers of novel species in order for coopetition to work.

Chapter 4
Aiming for Growth

Vision for 2020

"A sustainable and competitive aquaculture sector, where production will grow according to market and consumer demands and in balance with nature and society."

Actions to achieve the vision

The following actions are proposed to be undertaken in order to progress towards the vision outlined above. These actions may be undertaken by the State, by private actors, or a combination as appropriate, and some may be financially supported through the Seafood Development Programme, co-funded by the Exchequer and European Maritime and Fisheries Fund.

Action 1	***Build capacity and scale in the industry***
Action 2	***Dedicated supports to new entrants to the sector***
Action 3	***Promote organic aquaculture practices and certification***
Action 4	***Aid shellfish producers affected by major biotoxin episodes***

Growth Potential

The market driven development opportunity to expand output presented by the aquaculture sector both in Ireland and in the wider EU has been widely recognised. In Ireland, this potential has been set out in the overall national food strategy, '*Food Harvest 2020*' and in the national integrated marine strategy '*Harnessing Our Ocean Wealth*'.

In terms of projected production metrics, this plan is carefully aligned with the *Seafood Development Programme 2014-2020* (EMFF Operational Programme). The result indicators of the SDP and of this plan anticipate that there will be an increase of 45,000 tonnes in the output from the sector by 2023, taking 2012 as the base year, with an

output of 36,700 tonnes. This combination gives an estimated production volume outturn of 81,700 tonnes by the end of 2023. It should be understood that this estimate is at the upper level of reasonable expectation.

This level of projected increase has been arrived at following careful consideration of a range of factors which have impinged on the output volume of the sector since 2000. Because the Irish aquaculture sector is based on a number of key species and different production methods, it is difficult to achieve precision in terms of forecasting projected output over the time span of this plan. The approach taken has been to review the historic performance of each of the key species and production systems and then to allow sufficient scope within the projections to realise a scenario where they all achieve production levels at or near previous historic maxima simultaneously (see table below) Thus, a scenario is envisaged, whereby total output from all species and production systems will be in the region of 82,000 tonnes. However the precise makeup of this total output may not exactly mirror the historic scenario, as the sectoral growth will depend on market demand, which may fluctuate. The planned actions set out later in the chapter are designed to mitigate the current constraining factors, which are limiting volume growth in each of the key species and production systems.

Historic Production Maxima

Culture Type and species	Maximum production (Tonnes)	Year
Rope grown mussels	14,065	2007
Bottom grown mussels	29,976	2003
Finfish farming	25,082	2001
Oyster	9,277	2014
Novel species (inc seaweed)	2,015	2008
Total	**80,415**	

This output increase will be derived from a combination of increased and or restored productivity from the existing aquaculture licence portfolio and from a limited number of new licences. The makeup of this increased output will include shellfish, finfish, novel species and seaweed in a variety of different production systems, both intensive and extensive. This overall output increase will be largely dictated by market forces and site suitability for the cultivation of particular species.

Given the very wide variability of production systems and the large number of species being farmed, with more to be added into the future, it is not feasible to offer a

meaningful prediction of precisely which species and which production systems will yield the projected increases in specific years. However, a 30% increase in production derived from recirculating aquaculture systems is targeted (albeit from a very low base), together with an increase of 25% in organically certified output, when compared to existing levels.

Assessment of environmental impact from these targeted changes in output will be strictly controlled at two levels. The aquaculture licensing system combines both a bay-scale assessment element in Natura 2000 designated areas, capturing in-combination effects, as well as individual project assessment or screening (EIS and EIA).

Growth in value and employment in aquaculture are intrinsically linked to increases in output volume. This is especially true in the current situation of rising prices for seafood raw material. The trend of rising prices is likely to continue for the foreseeable future, as it is driven by the global growth in human population, as discussed in chapter 1.

The increases in output value and employment will be generated from a combination of:

- Increased productivity from the existing aquaculture licence portfolio;
- The establishment of new aquaculture enterprises;
- The cultivation of novel aquaculture species;
- Increasing the level of organic and eco-label aquaculture products;
- Introduction of multi-trophic aquaculture techniques.

The Growing Potential for the Development of Irish Aquaculture

There are a number of macro trends which are determining the future potential of the Irish aquaculture sector. Most salient among these are the continuing global population growth and the shifting economic power towards the east. As the world population is set to reach nine billion by 2025, a huge expansion in food production, including seafood, will be required to meet the demand created by this population surge. In addition, the levels of economic growth in southern and south east Asia, and in particular the growth in middle classes in this region, has spurred a major demand increase for many products including seafood as there is a strong cultural preference for seafood in the Asian Pacific region. In order to fulfill this anticipated growth in demand for seafood, when existing patterns for capture fisheries are at or near their maximum sustainable yield, it is inevitable that the majority of this demand will have to be met by increases in output from aquaculture production.

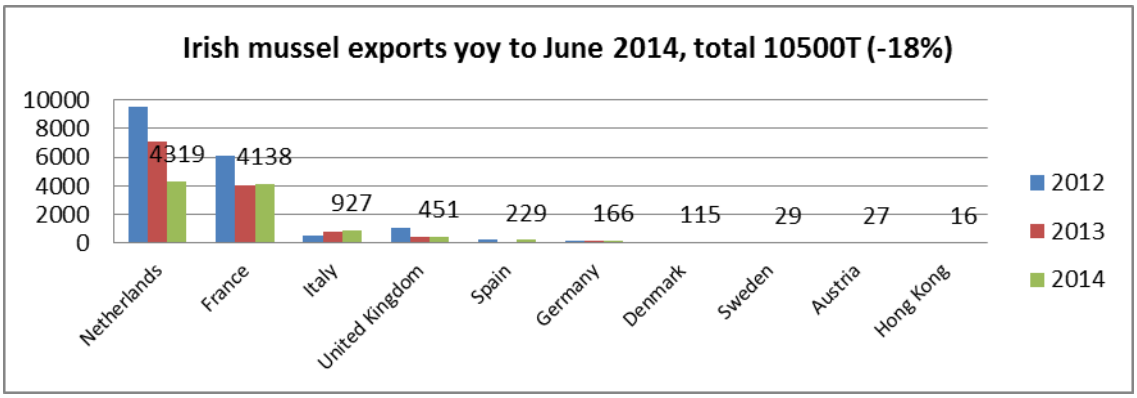
The Irish industry must position itself to be ready to avail of this global market opportunity which is expected to be on a scale not previously experienced. Ireland is uniquely placed to capitalise on this opportunity with an excellent natural resource base from which to expand the supply of aquaculture. Buoyed up by strong and consistent market demand, there is general agreement that the sector in Ireland offers strong potential for the creation of jobs and growth in value. This view is mirrored in the Government's Food Harvest 2020 and Harnessing Our Ocean Wealth 2020 Strategies as well as in the Action Plan for Jobs.

Growth opportunities for the main species

Rope Grown Mussels

At present, mussel production in Europe is fluctuating and the market is somewhat unstable, although the price trend over the last two to three years is modestly positive. This is due to less aggressive competition from Chile, where there has been a combination of production problems, logistical difficulties and greater market demand from the US market, where the Chilean producers are not exposed to currency risks.

An exceptional French mussel mortality of an estimated 20,000 tonnes in the summer of 2014 further compounded supply / demand tensions in the EU market place, as it represents around 30% of French *edulis* production (60,000 tonnes). Over 80% of Irish mussels (rope and bottom grown) are exported to either Holland or France for re-immersion, before distribution to the end market. As a result, Irish fresh mussel sales have traditionally suffered from being squeezed between the French Bouchot and the Dutch mussel season.



Source: GTA. YOY = Year on Year, ie 12 months to mentioned date.

To overcome this and to reinforce the identity of Irish mussels, EU organic mussel certification was adopted in 2011 by Irish producers. This has since led to increased brand recognition and higher product visibility in the French market.

Whilst prices in the EU mussel market will always be dependent on fluctuating supply and demand, organic certification has proven to be a definite benefit in terms of raising market awareness and stabilising price. There may also be potential for both new product development and for winning back the business lost in the processed mussel sector. Re-establishment of a bulk frozen mussel product route to market would be an important development to complement the progress made with organic certification in the fresh market. The shucked mussel meat market, which has been neglected in recent years due to extremely low prices for product from Chile, may also hold promise for Irish producers. Should Chilean imports to Europe continue to decrease as more of their production is diverted to what is for them a more attractive US market, there may be an opportunity to develop some upmarket organic mussel meat products as a salad or meal ingredient.

Bottom grown mussels

The main problem for the industry is unpredictable seed mussel availability. There is currently no 'back up' provision in seasons where there is a lack of seed. The second issue is the return on the seed fished, as big variations have been observed within production areas. These are the two main variables that can be targeted for potential improvement.

Pilot scale projects are already underway to establish a secondary source of seed, using immersed structures such as rope to collect seasonal spat. Collaborative trials with industry are on-going. If successful, this development could provide a stable supply of seed in case of lack of settlement on the seabed, as it is well established that mussel larvae are widely present in the production areas.

Another avenue to increase output from this sector is to improve yield from the re-laid wild seed mussels. Currently, it stands at approximately 1:1 in terms of tonnage of seed laid relative to harvested mussels sent to market. This implies a large mortality rate. With improved husbandry, international experience shows that this level of yield can be improved substantially.

Oysters

Historically, the Irish industry has relied on the French market for sales, as well as for its oyster spat. In recent years, however, other international markets have opened up, particularly in Asia. Because of our cool, nutrient rich waters, Ireland can produce top quality oysters. Irish producers are very competitive in terms of quality, and this is now being recognised in Asian markets. However, individual producers lack scale. There is a need for investment into brand development and large, centralised depuration and packing facilities dedicated to oysters, so that the sector can exploit this emerging market opportunity. This work could be undertaken with an existing seafood processor where Asian markets are already established.

Oyster farming is highly labour intensive and productivity varies between sites based on the natural conditions in each individual bay. There are many alternative technologies available to producers to use their sites more effectively. The transfer of such technology should be facilitated to enable the industry to continue to develop in a sustainable fashion.

Ireland has a unique opportunity in Europe, as since 2010 Irish operators have been building up a source of certified disease free sterile oysters. The first of these sterile stocks will be produced in spring 2015. Currently, one hatchery is carrying out this work, funded jointly by BIM and the Marine Institute, and this stock will be made available to other Irish hatcheries. To exploit this properly, it is vital to invest in a full scale breeding programme run collaboratively with all Irish hatcheries. There is an opportunity to use fertile stocks from different disease free sources around the coast to maintain genetic diversity, while selectively breeding for resilience and other characteristics in an Irish produced sterile oyster.

In tandem with developing Ireland's hatchery capacity, investment in nursery sites around the coast is essential so that market requirements for spat can be met.

Salmon

Organic production

The farmed Irish organic salmon market is still underexploited. Prices for organic salmon remain relatively high and have been very stable, not following the volatility of the spot market, demonstrating the strong consumer demand. Irish organic salmon is largely sold into the German and to a lesser extent, the French markets and is usually offered as a smoked product to the consumer. It has been estimated by Bord Bia that the market place could absorb a further 10,000 tonnes of Irish production over a 3-5 year period, without an adverse impact on price, such is the demand for the product.

Off-shore farming

Ireland's salmon farmers have significant experience in operating successfully in exposed sites. In fact, the bulk of current Irish salmon production is being produced from such locations. That knowledge should be leveraged through more salmon farming in offshore areas that have suitable characteristics. These locations are characterised by high water flows, giving rise to lower environmental impacts, in terms of fish wastes, and they are also remote from the mouths of rivers with migratory salmonid populations, thus reducing the possibility of any negative interactions between the farmed and wild stocks.

On-shore farming

Considerable international developmental effort is being put into determining the commercial viability of land based RAS systems for the large scale production of salmon. There appears to be a market niche for such a product if the current technological challenges associated with an economically viable production system can be overcome.

Trout

Profitability on Irish trout farms can be improved by growing the fish to a higher average weight at the point of harvest. This has the effect of improving the yield per individual ratio as a larger fish covers the cost of juvenile production more efficiently. Technical improvements relating to biomass and innovation in terms of product formats will be required to accommodate this development.

In Ireland, freshwater trout farms generally operate using quite traditional methods. Existing production systems linked with space and water allowance is itself limiting. Without the use of oxygenation and partial recirculation/reuse systems, it is not possible for trout farmers to increase their production. However, new technologies to increase production and increase efficiencies require investment.

Sea trout

An opportunity exists to increase the production of Sea trout by utilising inshore sea sites that are more suitable for on-growing trout than salmon.

The organic sea trout market is still underexploited. Prices for organic sea trout remain relatively high. However, the market requires larger fish >2kg. There is the opportunity to increase the value of this market by on growing the fish to over 2kg and achieving a stronger market price.

Novel Species (including seaweed)

Perch

Percid culture in Europe and North America shows significant potential for expansion. Its firm white flesh is particularly unique amongst freshwater species and has potential to develop beyond its current niche market status. Initial demand in Switzerland and the surrounding area is in the order of 4,000 tonnes of fillets per year and the focus over the next few years will be in satisfying existing markets. The potential to develop new markets will then be assessed.

Seaweed

Farmed seaweed (macroalgae) production is just starting up in Ireland. It is likely to increase due to the significant number of new entrants applying for aquaculture licences for seaweed.

Future growth opportunities exist in seaweed cultivation, in particular for edible seaweeds for human consumption. The brown seaweeds, *Alaria esculenta* or Atlantic wakame and *Saccharina latissima* or Kombu, are particularly interesting for the European food market. The French, UK, German and Spanish markets comprise about 80% of European revenues for seaweed and these are the markets that we will look to in an effort to establish demand for produce. The European market for sea vegetables is growing by about 7-10% per annum, with the retail market and food processors becoming more important.

Abalone, urchins and scallops

Market demand for these high value shellfish products remains strong with attendant high prices. However, significant technological barriers remain to be overcome within the production processes so as to allow for economically viable production at a commercial scale.

Integrated Multi-Trophic Aquaculture (IMTA)

Another opportunity for output growth would be the addition of mutually compatible species to an existing consent to create a virtuous multi-species output (IMTA) from a particular site. Examples of this would be the inclusion of seaweeds and or sea-urchins on to the existing consents for rope mussel farmers. In that scenario, the existing infrastructure already installed by the operator can be positively leveraged to yield more efficiencies and improve competitiveness and ultimately profitability. The development of trials in this regard is proposed.

Optimisation of Licensed Capacity

Given the expense, uncertainty and time taken to obtain an aquaculture licence, it makes sense to optimise the use of existing licensed capacity.

This optimisation could take a number of forms. At its most simplistic, it could be a case of an unused or underutilised licensed site being sold or sub-let to a better resourced or more ambitious operator. This scenario is currently playing out in the farmed oyster sector in Ireland, as improved product prices have driven an increase in willingness to invest.

Whilst market forces can go so far, it is important that such developments do not occur in isolation of consideration of their possible impacts on existing operators in close proximity. The development of a practical site productivity analysis, along with a tool for measuring productivity and determining the constraints associated with any particular site or group of sites in an area, is proposed. Otherwise, overstocking may occur and in the case of bivalves this may lead to local food shortages for the stock, with a consequent reduction in growth rate and productivity for those operators situated furthest from the 'new' water on each tidal cycle.

Supporting Actions

The following actions are proposed to support the aquaculture industry in achieving the growth potential indentified across a range of species above. In addition, the supporting actions detailed in Chapter 5, together with other non-financial measures

detailed elsewhere in this Plan, will also contribute to fostering a business and regulatory environment that promotes sustainable growth of the aquaculture industry.

Build Capacity and Scale in the industry

A commercial Aquaculture Development Scheme will be implemented through the Seafood Development Programme 2014-2020, co-funded by the Exchequer and European Maritime and Fisheries Fund. This scheme will support capital investment by aquaculture enterprises, mostly SMEs, to sustainably grow production and value, to reduce the impact of aquaculture on the environment and to improve safety and working conditions in aquaculture sites.

Dedicated Supports to New Entrants to the Sector

New entrants to the aquaculture sector can aid in increasing the output of the sector and can bring innovative practices and new ideas from other sectors. However, new entrants also have particular needs for dedicated support, given their lack of industry experience. Additionally, there are specific regulatory requirements which apply to new entrants under the European Maritime and Fisheries Fund Regulation, which do not face existing operators seeking State supports.

It is proposed to establish dedicated supports through the Seafood Development Programme 2014-2020, co-funded by the Exchequer and European Maritime and Fisheries Fund, to assist new entrants.

Promote Organic Aquaculture Practices and Certification

A large proportion of the aquaculture industry is already engaged in organic aquaculture production. Organic certification brings significant competitive advantage and is increasingly essential in some markets.

It is proposed to initiate a support scheme through the Seafood Development Programme 2014-2020, co-funded by the Exchequer and European Maritime and Fisheries Fund, to encourage conventional producers to move to organic production and to participate in EU Eco-management and audit schemes (EMAS).

Aid Shellfish Producers affected by major Biotoxin Episodes

Suspension for public health reasons of harvesting of shellfish during periods of raised biotoxin levels can in some cases lead to lost production and ensuing trading difficulties. Harvesting suspensions for extended periods can be compounded by stock exceeding market size, becoming fouled with marine organisms and losses of stock from over-capacity on long lines.

It is proposed to establish through the Seafood Development Programme 2014-2020, co-funded by the Exchequer and European Maritime and Fisheries Fund, a limited scheme of aid to shellfish producers affected by major biotoxin episodes to recover from prolonged harvesting suspensions so as to preserve productive capacity and employment. It is proposed that aid will be granted only where a harvesting suspension persists for more than 4 months. Aid will be prioritised for operators affected by the longest suspensions and will be limited to a maximum total aid to all farmers of €500,000 per year. Individual beneficiary limits may be implemented to ensure a fair distribution of funds. Individual beneficiaries will be limited to one aid payment over the period of the Programme.

Chapter 5
Knowledge, Innovation & Technology

Vision for 2020

"A more competitive, technically efficient and innovative aquaculture sector."

Actions to achieve the vision

Aquaculture is relatively new form of food production and as such the technologies and state of knowledge is evolving rapidly. It is important that the Irish sector stays abreast of the latest developments and invests appropriately into research and development to maintain and improve competitiveness and environmental sustainability.

The following actions are proposed to be undertaken in order to progress towards the vision outlined above. These actions may be undertaken by the State, by private actors, or a combination as appropriate, and some may be financially supported through the Seafood Development Programme, co-funded by the Exchequer and European Maritime and Fisheries Fund.

Action 5	***Foster knowledge, innovation and technology transfer.***
Action 6	***Enhance the skills base to foster a knowledge economy.***
Action 7	***Provision of expert advice to improve environmental and business performance and enhanced strategic planning by aquaculture enterprises.***
Action 8	***Support best husbandry and disease management practice.***
Action 9	***Applied research and collaborations between industry, scientific and development bodies.***
Action 10	***Development of commercial scale growing systems for novel species.***

National Situation

The small scale and fragmentary nature of the Irish aquaculture industry means that there are difficulties in driving competiveness, especially in trying to supply products into large-scale commodity markets. Conversely, the advantage of this has meant that

the Irish industry focuses on high-value, niche products to remain viable. The constant demand for innovation and development of new and improved products puts a heavy burden on small businesses. Therefore research and development institutions and their links with industry are vital to the success and on-going sustainability of the sector.

Existing R&D support

The primary government agency responsible for commercial fisheries and aquaculture development in Ireland is An Bord Iascaigh Mhara (BIM). Údarás na Gaeltachta also has a role in the development of aquaculture in the Gaeltacht regions. BIM presently operates a number of aquaculture grant schemes which are designed to modernise the sector, improve efficiencies and develop a sustainable aquaculture industry. All schemes are aimed at aquaculture operators who are in the SME sector. Additionally BIM provides expert and hands-on technical support to the aquaculture sector in the form of technology transfer, advisory workshops and training services.

The Marine Institute is the national agency responsible for Marine Research, Technology Development and Innovation (RTDI) and supports the marine, fisheries and aquaculture sectors. The Marine Institute is mandated to undertake, to coordinate, to promote and to assist in marine research and development in accordance with the Marine Institute Act 1991. The Institute acts as the implementing body, on behalf of its parent department DAFM, for dedicated marine research funding. The Institute tracks and provides notification of research funding opportunities from agencies including, but not limited to:

- Science Foundation Ireland;
- Irish Research Council;
- Enterprise Ireland;
- Environmental Protection Agency;
- Sustainable Energy Authority of Ireland;
- Geological Survey Ireland;
- InterTrade Ireland.

Nationally, there are additional support bases of research providers including Universities, Institutes of Technology and a number of private research units supporting the research needs of Irish aquaculture. These include Aqua TT Ltd, University College Cork (Coastal and Marine Resource Centre/Aquaculture and Fisheries Development Centre/Zoology Ecology and Plant Science), National University of Ireland Galway

(Martin Ryan Institute), Trinity College Dublin, Dundalk Institute of Technology, Institute of Technology Sligo, Cork Institute of Technology and Daithi O'Murchu Marine Research Station/Indigo Rock Research Station.

Other research providers to the Irish aquaculture sector, some of which are also project participants as SME's, are - Cartron Point Shellfish Ltd, Clew Bay Marine Forum, Clew Bay Oyster Group, Atlantic Shellfish Ltd, Teagasc, Athlone Institute of Technology, University of Limerick, Galway Mayo Institute of Technology, Queen's University Belfast/ Portaferry Marine Laboratory, University of Ulster, University College Dublin and Dublin City University.

Specific sector knowledge and innovation requirements

Rope Grown Mussels

A major constraining factor for the rope mussel sector is the ongoing difficulty with managing food safety because of the incidence of naturally occurring biotoxins. A reliable, rapid, locally based approach to complement the existing State service is urgently required to assist operators to manage risk in this regard.

Product innovation around the shucked mussel meat market, which has been neglected in recent years due to extremely low prices for product from Chile, may also hold promise for Irish producers. Should Chilean imports to Europe continue to decrease as more of their production is diverted to what is for them a more attractive US market, there may be an opportunity to develop some upmarket organic mussel meat products as a salad or meal ingredient.

Bottom Grown Mussels

A key area of knowledge and innovation advances for the bottom grown mussel sector will be the development of large scale, commercially viable techniques and technologies for the artificial collection of mussel seed to augment the unreliable wild fisheries supply. This will be achieved through studies to improve the state of knowledge regarding the dynamics of mussel larvae in the Irish water column and the development of a low cost, biodegradable, efficient settlement substrate which can be re-laid on to the licensed aquaculture sites.

Ireland is one of several countries interested in developing artificial collection systems for mussel seed. On that basis, technology transfer projects will be used to assist in accelerating progress in this regard.

There is significant potential to improve yield if natural predators can be more effectively controlled on the growing sites. Applied research into this area will be prioritised.

Oysters

Over the past decade, there have been a number of unusual mortality events directly affecting the Pacific oyster sector. Since 2009, mortality in oyster spat has been ranging from 30% up to 80%, linked directly to the Ostreid Herpes virus OsHv1µvar. This virus has affected oyster producers all over Europe. It is essential that resources are put into generating best practice guides for reducing the effect of the virus on stocks and into developing resistance in oyster stocks through a national hatchery breeding programme.

More recently, since 2013 exceptional mortality events in juvenile and adult oysters have been linked to *Vibrio aesturianus*. Again, further work is needed to understand this pathogen in terms of its carriers, its ability to survive in a dormant state in unfavourable conditions, the development of best practise for producers to reduce the impact of the pathogen on stocks and the potential for developing treatments for affected stocks.

In 2007, producers along the entire Western coastline, from Cork to Donegal, suffered mortalities in juvenile and adult oysters due to a *Karenia mikimotoi* bloom. Mortality rates were as high as 80% for many farmers. The same occurred in 2011, although this time affecting areas from North Clare up to North Donegal. Again, mortalities were as high as 80% in adult stocks. Further work is needed on predictive modelling of algal blooms to enable the development of early warning systems for producers, so that where possible, stocks can be moved in advance of any algal bloom hitting the coastline.

There is great potential for developing hatchery and nursery capacity in Ireland. Research into energy and cost saving green technologies is vital to ensure profitability and sustainability.

Salmon

Particularly in the freshwater phase, additional applied R&D is required to improve the performance of RAS in terms of:

- Reduced freshwater usage;
- Improved stock survival, growth rates and animal welfare;
- More effective treatment of return water in terms of key enrichment parameters;
- Ensuring that future technical developments in RAS continue to conform to the requirements of organic certification.

In terms of large scale production of salmon from saltwater RAS, continued applied research is required to improve system performance in terms of:

- Reduction of energy usage in water pumping and treatment;
- Improvement of system reliability so as to avoid catastrophic stock losses;
- More effective treatment of return water in terms of key enrichment parameters;
- Improvements to animal welfare standards and disease management in the context of high stocking densities.

With regard to the expansion the sector in offshore locations, applied research is required to:

- Develop of technical standards for cage design and other site infrastructure;
- Knowledge transfer and collaboration with other suitable aquaculture countries with a view to developing techniques and technologies to allow for production in locations which are currently too exposed for currently available growing systems.

Research into diseases and parasites

Diseases pose a threat to aquaculture on a number of levels. Animal health and welfare is seriously affected by any disease outbreak. Most recently Amoebic Gill Disease (AGD) has emerged as a serious health challenge to Irish salmon farms. Some initial research has been carried out (Rodger & Mitchell, 2013) but further investigation into the epidemiology, environmental and genetic factors and best practices for treatment is ongoing.

AGD, algal blooms and jelly fish swarms have caused significant mortalities and problems for the marine salmon industry. Sea lice infections in sites from Galway up to Donegal have further complicated issues with treatments being required on already stressed fish. Though the use of fresh water has been successful in treating AGD this still has significant economic and logistical implications for the industry. The use of cleaner fish such as wrasse for the removal of sea lice has been successful on some sites and this should to be expanded. The evaluation of other potential cleaner species, such as lumpfish, also needs to be trialled. Work is being undertaken on obtaining and holding cleaner fish by using newly developed hides and by potentially developing a hatchery for lumpfish in association with research institutes. Improved vaccination and treatments for other diseases such as Pancreatic Disease also need to be developed.

Further development and delivery of training courses on fish health and welfare will also be undertaken.

Trout

The actions set out in the freshwater salmon section above can also be applied to the freshwater trout sector. In addition, certification to an eco-standard or a special animal welfare standard could be developed to differentiate the product and thus create a unique point of sale. It also may achieve a higher price and allow the sector compete in the export market.

Novel Species

BIM is currently undertaking a feasibility study to assess the potential of inland cutaway peat bogs for aquaculture diversification. Initial results are promising, particularly the potential to develop split-pond production. BIM will continue to explore the feasibility of this method, incorporating multi-trophic aquaculture. The focus of research must be on developing sustainable ecosystem based production models for freshwater fish. In tandem with this, BIM has commenced a fish breeding project aimed at developing perch strains which show potential for faster growth rate, improved fillet yield and disease resistance.

Seaweed

The red seaweeds, *Palmaria palmata* or Dulse and *Porphyra umbilicalis* or Nori, are technically challenging to manipulate in terms of life cycle management in the marine hatchery. Actions to develop this sector will be undertaken collaboratively by industry and the development agencies.

Abalone and sea urchins

Hatchery techniques for abalone and sea urchins have a strong reliance on microalgal cultivation as a food source for juveniles. There is, therefore, a specialist body of expertise required in this area when engaging in these activities and it is expected that further developments will take place in this sector, as well as the mainstream element of the business.

For both abalone and sea urchins, trials involving broodstock selection and enhancement need to be carried out, and this may involve the transfer of brood animals from overseas.

There is also likely to be considerable work performed in the area of microalgal diets, including selection of strains and appropriate culture methods.

Integrated Multi-Trophic Aquaculture

There are currently a small number of land based facilities in Ireland with multiple species on their aquaculture licences. This presents a great opportunity for incubation units, with the possibility of additional species being added as developments or market opportunities arise. It also opens the door to integrated multi-trophic aquaculture within those situations and could ultimately lead to developments in IMTA in sea-based culture systems utilising a multitude of species.

Supporting Actions

The following actions are proposed to support the aquaculture industry in taking maximum advantage of scientific and technological developments to foster innovation and better manage challenges such as fish diseases. In addition, the supporting actions detailed in Chapter 4, together with other non-financial measures detailed elsewhere in this Plan, will also contribute to fostering a culture within the aquaculture industry of knowledge and innovation.

Foster Knowledge, Innovation and Technology Transfer

Within the aquaculture sector most companies do not have the individual capacity and capital to innovate and develop new techniques and species. It is proposed to initiate a support scheme through the Seafood Development Programme 2014-2020, co-funded by the Exchequer and European Maritime and Fisheries Fund, to support:

- Development of technical, scientific or organisational knowledge in aquaculture farms, which, in particular, reduces the impact on the environment, reduces dependence on fish meal and oil, fosters a sustainable use of resources in aquaculture, improves animal welfare or facilitates new sustainable production methods;
- Development or introduction in the market new aquaculture species with good market potential, new or substantially improved products, new or improved processes, new or improved management and organisation systems;
- Exploration of the technical or economic feasibility of innovative products or processes.

The main objective of the scheme will be the provision of support to strengthen technological development, innovation and knowledge transfer within the Irish aquaculture sector.

Enhance the Skills Base to Foster a Knowledge Economy

Developing and enhancing the skills complement throughout the aquaculture sector is essential to increasing profitability and sustainability in the sector. The development of knowledge-based enterprises is fundamental to the success of the aquaculture industry and their ability to attract inward investment and grow a sustainable business. Networking and exchange of best practice across the sector aids the industry to become more robust in its environmental compliance and can lead to co-ordination and co-operation between operators for the good of all.

A Training and Networking Scheme is proposed to be implemented through the Seafood Development Programme 2014-2020, co-funded by the Exchequer and European Maritime and Fisheries Fund, with the objective of development of professional training, new professional skills, lifelong learning and the dissemination of scientific and technical knowledge and innovative practices. This can be achieved by:

- Upskilling at production level through business training and mentoring programmes;
- Boosting industry management / competence through Placement Programmes and exchange of best practice;
- Embedding conservation / environmental technology in formal training courses for all industry sectors;
- Embedding a culture of food safety in the aquaculture sector;
- Networking and new professional skills development.

Provision of expert advice to improve environmental and business performance and enhanced strategic planning by aquaculture enterprises

The aquaculture sector is characterised by SMEs, with limited capacity for strategic business planning. An increasingly complex regulatory system, especially in relation to environmental requirements and animal health and public health legislation adds additional challenges for these SME enterprises.

A Business, Planning and Environmental Advisory Services scheme is proposed to be implemented through the Seafood Development Programme 2014-2020, co-funded by

the Exchequer and European Maritime and Fisheries Fund, in order to improve performance and competitiveness and to reduce the environmental impact of operations. The advisory services may include:

- Marketing and business strategies;
- Management needs to comply with Union and National environmental legislation and maritime spatial planning requirements;
- Health and safety standards;
- Environmental Impact Assessments.

Support Best husbandry and Disease Management Practice

Animal health and welfare are crucial to the sustainability of aquaculture businesses. Disease and parasites on stock can seriously damage the economic viability of the farm, in addition to having a deleterious effect on animal health and welfare. Best practice in production techniques, along with good biosecurity measures, can in some cases mitigate these effects without the use of veterinary medicines. However, the aquaculture sector is characterised by SMEs, with limited capacity to unilaterally develop new practices or to maintain knowledge of emerging best practice in the industry.

The management of veterinary medicine use in Ireland is further limited by what is allowed under organic management regulation, as over 80% of Irish farmed salmon are certified organic. The development of sustainable, low-impact and low cost alternatives to conventional veterinary medicines is essential given the reliance on organic markets for Irish aquaculture products.

It is proposed to develop a support scheme through the Seafood Development Programme 2014-2020, co-funded by the Exchequer and European Maritime and Fisheries Fund, to aid in the investigation of alternatives to medicines, studies into best practice techniques and knowledge transfer.

Applied research and collaborations between industry, scientific and development bodies

Working with technical and research institutions will allow innovative products and investment in innovative technology and trialling such technology under commercial conditions to improve performance and competitiveness, whilst also assisting measures to improve long term environmental sustainability.

Development of commercial scale growing systems for novel species

Projects to develop the appropriate techniques and technologies from pilot through to commercial scale production will be prioritised under the plan along with training, networking and international technology transfer for novel species.

Chapter 6

Chapter 6
Ensuring Sustainability

Vision for 2020

"An aquaculture industry that develops in harmony with nature, and with the confidence of stakeholders".

Actions to achieve the vision

The following actions are proposed to be undertaken in order to progress towards the vision outlined above. These actions may be undertaken by the State, by private actors, or a combination as appropriate, and some may be financially supported through the Seafood Development Programme, co-funded by the Exchequer and European Maritime and Fisheries Fund.

Action 11	***Application of Guiding Principles for the Sustainable Development of Aquaculture.***
Action 12	***Application of scale limits and phasing in relation to the development of individual offshore salmon farms.***
Action 13	***Development of an industry Code of Practice for Invasive Alien Species.***
Action 14	***Continuation of Invasive Species Ireland Project in relation to aquaculture.***
Action 15	***Quantify the environmental contribution of aquaculture.***
Action 16	***Ensure that aquaculture monitoring is consistent with the requirements of the Marine Strategy Framework Directive.***

Guiding Principles for the Sustainable Development of Aquaculture

The following six high-level principles, recommended by the Marine Institute, are intended to provide a broad direction to guide the ongoing development of sustainable aquaculture in Ireland and instil confidence in all stakeholders in the commitment to appropriate development of the industry.

Principle 1 - Responsible Planning

Responsible planning ensures that the overall development of aquaculture and the siting of individual farms are compatible with other uses and the responsible management of the marine environment. Such an approach, within a wider marine spatial planning framework, ensures a comprehensive consideration of constraints and synergies, and appropriate siting of fish farms, and reduces the uncertainty and administrative burden for developers.

Principle 2 - Ecosystem Protection

Licensing and ongoing regulation of aquaculture operations ensures compatibility with the goal of maintaining healthy, productive and resilient marine ecosystems. This ensures that we maintain good water quality and healthy populations of wild species, prevent escapes and accidental discharges into the environment, and avoid harmful interactions with wild fish stocks, protected habitats and species.

Principle 3 - Science-based Approach

Planning, licensing and regulation of the sector are founded on the best available, impartial and objective science, as delivered by the national and international science community. This provides the highest level of confidence in the decision-making process and allows for the adoption of a risk and evidence-based approach to determining monitoring requirements that are subject to continuous improvement.

Principle 4 - Compliance

Planning, licensing and regulation of the sector ensures full compliance with relevant European and National legislation, including SEA and EIA legislation, nature conservation legislation (Birds and Habitats Directives), and legislation seeking to achieve and maintain good environmental status of coastal and marine waters (Water Framework Directive, Marine Strategy Framework Directive).

Principle 5 - Openness, Transparency and Accountability

Openness, transparency and accountability are core considerations in the licensing and regulatory framework for aquaculture. Seeking public and local knowledge inputs during the process increases confidence in the decision-making process. Likewise, accountability and openness on the part of the industry will help to educate stakeholders on the social and economic benefits of the industry and ensure an accurate understanding of its potential environmental interactions.

Principle 6 - Industry Best Practice

Aquaculture operators should strive to adopt, maintain and improve best practice in all aspects of farm operations, including fish health and welfare, feed utilisation and sustainability, use of medication, abstraction of water, and cage design and maintenance. Additionally, industry should be supported / encouraged to implement Codes of Best Practice and independent certification schemes.

Scaling and Phasing of the Development of Offshore Salmon Farms

The future growth of salmon farming is limited by spatial and environmental constraints in inshore bays. The use of larger, more exposed, offshore sites is increasingly a feature of the development of the sector globally and the environmental benefits of such sites, compared to inshore sites, are clear.

Environmental impacts are predicted to decrease in offshore sites, where stronger currents and greater depths increase the dispersal of waste products and interactions with wild fish are lessened. In addition, competition for space with other users is likely to be less of an issue in sites further removed from the coast.

Despite these potential benefits, no assumptions can be made as to the suitability of locations and individual sites for salmon farms, which can only be considered following rigorous assessment of potential environmental interactions.

Any consideration of the scaling and phasing of individual farms should seek to build regulatory confidence. A key factor in determining the scale of potential developments using ecosystem-based management is the concept of *carrying capacity*, which considers environmental limits aimed at avoiding 'unacceptable change' to the natural ecosystems.

In general terms, carrying capacity for any sector can be defined as the level of resource use both by humans or animals that can be sustained over the long term by the natural regenerative power of the environment.

In considering the appropriate scaling and phasing of individual offshore salmon farms, it is useful to consider international experiences.

- In Norway, where annual production is in the order of 1.2 million tonnes, the maximum allowable biomass per licence is 780 tonnes (except in two counties, where the maximum allowable is 900 tonnes). Farms typically hold several licences for a single location, with the largest farms licensed for just over 7,000 tonnes (maximum allowable biomass).
- Scotland categorises sea lochs using predictive modelling to estimate nutrient enrichment and benthic impacts and sets total biomass limits for individual lochs. Individual licences are in a range of up to 2,600 tonnes (peak biomass).
- In British Columbia, the largest individual farms have a peak biomass of approximately 5,200 tonnes.
- The largest site in Ireland is licensed for a biomass of just under 3,200 tonnes.

It is not possible, however, to make direct comparisons either on a regional or individual site basis. For example, many of the Scottish sea lochs are relatively small, well-defined waterbodies that would not be considered offshore.

Scale limits and phasing

Taking consideration of the above, the following scale limits and phasing, as recommended by the Marine Institute, will be applied in relation to the development of individual offshore salmon farms.

1. Licences for individual sites should be issued on the basis of approval for an initial maximum allowable biomass and, where sought, a provision for a gradual, phased build-up.

2. An appropriate maximum for new individual offshore salmon farms is considered to be 5,000 tonnes (peak biomass). The allowable peak biomass will be site specific and will rely upon a full assessment of environmental considerations, e.g. site characteristics, carrying capacity and separation distance from adjacent operations.

3. Following establishment of a farm, permission for additional tonnage beyond the initial licensed peak biomass may be sought, subject to a total maximum of 7,000 tonnes (peak biomass). Such a request could be considered subject to the following:

    (a) The EIS accompanying the licence application shall include all of the relevant information to describe the physical characteristics of the project, the production processes, expected residues and emissions and the likely significant effects of the proposed project through the various phases;

    (b) The phasing and timing for permission to scale-up beyond the initial allowable biomass should be set at the licensing stage, taking into consideration, for example, site characteristics, stocking strategies and production cycle issues;

    (c) Approval to increase the capacity above the initial allowable biomass should only be considered following a rigorous assessment of monitoring outcomes;

    (d) Monitoring requirements should be included as a licence condition.

The thresholds outlined above (2 and 3) shall be reviewed on a regular basis.

Biodiversity and Sustainable Development

Ireland's marine and terrestrial environment supports a wide variety of species and habitats, many of which are of international importance. While many species are doing well in conservation terms, there are a significant number of habitats and species that are not and which are under threat from unsustainable activities. Progress has been made in the designation of EU-protected areas in Ireland, and Ireland's second National Biodiversity Plan (2011–2016) includes a programme of measures aimed at meeting Ireland's biodiversity obligations including a commitment to halt biodiversity loss by 2020. Protection of biodiversity within and outside protected areas is therefore necessary and requires greater integration of biodiversity concerns in sectoral policy development and implementation, at local and national levels.

Sustainable development means meeting current needs without compromising the ability of future generations to meet their own needs. This encompasses economic, social and environmental factors to provide viable livelihoods for current and future populations.

Actions concerning biodiversity

(A) Continuation of Invasive Species Ireland Project in relation to Aquaculture

Control of invasive species is a major challenge, and involves cross-sectoral and cross-border co-operation by a range of responsible bodies and sectoral interests. In response to this issue, a joint approach was undertaken by the relevant Departments in Ireland and Northern Ireland to establish the Invasive Species Ireland project. This project acts as a co-ordination mechanism and provides advice and resources for stakeholders, in addition to carrying out risk assessment, policy development, education and awareness activities, research and development of invasive alien species action plans.

Both BIM and the Marine Institute have worked closely with Invasive Species Ireland and participate in its marine working groups

The Invasive Species Ireland project is currently on hold but BIM continues to liaise with interested parties in the UK via a project called Marine Pathways.

Invasive Species Ireland can act as a co-ordination mechanism and provide advice and resources for stakeholders, in addition to carrying out risk

assessment, policy development, education and awareness activities and research and development of invasive species action plans.

(B) Development of an industry Code of Practice for Invasive Alien Species

Non-indigenous Species (NIS) is an important component of the Marine Strategy Framework Directive and is one of the 11 descriptors upon which Good Environmental Status Targets are based. The recently published Article 19 report states: "The majority of the known initial introductions of NIS to Irish waters have occurred via shipping (commercial and recreational) or through aquaculture."

The project actions include research into prevention and control of NIS, promoting opportunities for the aquaculture sector to learn about and take appropriate action to reduce the risks of invasive species introduction and spread, of species both impacting upon and impacted by existing and new operations in line with MSFD targets.

(C) Quantify the Environmental contribution of Aquaculture

In the National Biodiversity Plan there are objectives and targets related to raising awareness and appreciation of biodiversity and ecosystem services and to conserve and restore these in the wider countryside. One of the targets is to optimise use of opportunities under agricultural, rural development and forest policy to benefit biodiversity.

Although these objectives and targets are primarily concerned with agriculture and forestry, the overall themes are cross-cutting over other sectors, including aquaculture.

The recent trend towards development of Integrated Multi-Trophic Aquaculture, combining fed fish with extractive aquaculture (seaweed and shellfish), appears to be a promising approach to reduce environmental impacts and make farms more profitable through the provision of secondary crops.

Climate Change and biodiversity are inextricably linked. Climate change may be a driver for loss of biodiversity, conversely biodiversity may support the reduction of negative effects of climate change.

Shellfish and seaweed production may contribute, albeit marginally, to control of carbon emissions through carbon sequestration in shell production and seaweed photosynthesis and therefore assist in climate change mitigation. Life cycle analysis is required to confirm the tangible benefits of this.

(D) Ensure that aquaculture monitoring is consistent with the requirements of the Marine Strategy Framework Directive

The marine environment forms the largest part of Ireland's territory, encompassing an area ten times greater than the country's land area. The Marine Strategy Framework Directive (MSFD) establishes a framework within which Member States shall take the necessary measures to achieve or maintain good environmental status (GES) in the marine environment by 2020. Ireland has undertaken the Initial Assessment stage, which was submitted to the European Commission in 2013. The current on-going work is the development of a monitoring programme and Programmes of Measures. Aquaculture monitoring must be consistent with MSFD requirements and be reflected in MSFD assessment and reporting.

The three main pressures exerted on the environment as a result of the activities associated with aquaculture are the introduction of non-indigenous species (NIS), physical loss of habitat and nutrient and organic enrichment. [14]

The SWOT analysis in Chapter 2 identifies several areas of consistency with progress to achieve GES. [15]

Non-Indigenous Species: Monitoring programme with risk assessment by NPWS for pathways and vectors. SWOT identifies reliance on foreign seed. This could be a vector for NIS.

Sea bed integrity: Generally considered good for Ireland. The use of licensing and consents infrastructure could be used to determine pressure footprints and inform management action.

[14] Ireland's Marine Strategy Framework Directive Article 19 Report Initial Assessment, GES and Targets and Indicators
October 2013

[15] Marine Strategy Framework Directive Article 11 Monitoring Programmes Public Consultation Document
July 2014

Eutrophication: This is both an effect by aquaculture and also an effect on aquaculture. The main activities contributing to eutrophication in Ireland's Marine Waters are agriculture, wastewater treatment and discharges from unsewered areas and industry. Eutrophication can have large effects on aquaculture in the form of toxic algal blooms and reduction of oxygen in the water.

Climate Change

Climate change impacts on the marine environment (e.g. rising sea temperatures and increases frequency/intensity of winter storms) and increased ocean acidification present a number of challenges for the global and Irish aquaculture industry. These challenges are set out below.

The timing (short, medium or long-term) and scale of these impacts is difficult to predict and may be of limited significance over the life-span of this plan.

From a Marine perspective

- Sea level rise leading to problems with site suitability, access and general site management
- Increase in storm frequency and intensity leading to structural damage, associated financial losses and burdens, also potential escapes of farmed fish and its consequences for biodiversity
- Increase in water temperature leading to -
    - Changes in seasonality, resulting in changes in typical growth patterns, affecting timing of spawning and harvesting
    - New/different disease challenges
    - Expansion in range of alien invasive species
- Increased frequency/severity of harmful algal bloom events as a result of changes in ocean and coastal stratification and increasing temperatures

From a freshwater perspective

- Increase in storm frequency and intensity - increased flood risk
- Changes in seasonality

- Freshwater availability

In contrast, increased water temperature may also result in benefits for the Irish aquaculture industry, e.g. faster growth rates, resulting in decreased costs and conditions more conducive to the growth of new species.

Actions under Chapter 5 concerning Knowledge Innovation and Technology, supported by funding under the proposed Seafood Development Programme, may be relevant to climate change adaptation by the aquaculture sector, e.g. study, development and trialling of cages that are adapted to withstand greater storm intensity, or studies concerning impacts of raised water temperature on fish health etc.

Chapter 7
Co-ordinated Spatial Planning

Vision for 2020

"Aquaculture incorporated into an effective and equitable marine spatial planning system".

Actions to achieve the vision

The following actions are proposed to be undertaken in order to progress towards the vision outlined above. These actions may be undertaken by the State, by private actors, or a combination as appropriate, and some may be financially supported through the Seafood Development Programme, co-funded by the Exchequer and European Maritime and Fisheries Fund.

Action 17	***Develop opportunities and constraints mapping for aquaculture taking specific account of environmental issues, Natura 2000 sites and inshore fisheries.***
Action 18	***Identify marine tourism opportunities from aquaculture.***
Action 19	***Study on integrated multi-trophic aquaculture and possible synergies with offshore wind farms or other marine renewable energy.***
Action 20	***Study on how aquaculture contributes to communities in rural areas.***

Marine Spatial Planning

The European Marine Spatial Planning (MSP) Directive (2014/89/EU) seeks to establish a framework for maritime spatial planning aimed at promoting the sustainable growth of maritime economies, the sustainable development of marine areas and the sustainable use of marine resources. It aims to ensure that growth of marine and coastal activities, as well as the use of resources at sea and on coasts, remain sustainable.

The National Context

Co-ordinated Spatial Planning is more relevant than ever before given the increasing demands on the coastal resource. Emerging growth areas such as offshore energy added to increasing demand from existing sectors and acknowledging the need to protect the environment means that planning is essential. Utilising marine resources efficiently requires careful planning to ensure Ireland manages human use of the marine environment sustainably and that different demands and uses are appropriately sited within Ireland's waters and along its coastline.

Existing Framework for Maritime Spatial Planning in Ireland

Currently, the majority of planning, licensing and regulation in the marine environment is carried out on a sectoral and demand-driven basis. Strategic Environmental Assessment, Environmental Impact Assessment and Appropriate Assessment are applicable cross-sectorally and are undertaken in accordance regulatory requirements.

Marine spatial planning and management of land-sea interactions involve a strategic, forward looking planning approach. It requires stakeholder involvement at an early stage of plan making. It analyses and plans best use of the seas and where and when human activity should take place.

Ecosystem-based, marine spatial planning focuses on marine spaces in which the boundaries are ecologically meaningful and ensures integration with coastal and inland areas. *Harnessing Our Ocean Wealth (HOOW)*, Ireland's integrated marine plan, acknowledges this and establishes a roadmap for the Government's vision, high-level goals and integrated actions across policy, governance and business to enable our marine potential to be realised. Implementation of this Plan will see Ireland evolve an integrated system of policy and programme planning for our marine affairs.

Under Key Action No. 2 of *Harnessing Our Ocean Wealth* an Enablers Task Force was convened to make recommendations on the establishment of an appropriate MSP framework for Ireland, taking into account:

- Emerging EU policy in relation to maritime spatial planning;
- The need for any further legislative changes that may be required to support a national maritime spatial planning framework;
- International best practice on developing integrated marine planning and licensing – benchmarking Ireland's marine regulatory framework; and

- A national maritime spatial planning capacity and responsibility for data coordination and exchange.

Implementation of the recommendations arising from this work is currently being considered by Government in accordance with the European MSP Directive.

The Aquaculture Perspective

From an Aquaculture perspective, Co-ordinated Local Aquaculture Management Systems (CLAMS) is a long established voluntary process which enables co-ordination among existing aquaculture operators and this process will undoubtedly provide important bottom-up information for policy and strategy formation

In order to inform the MSP process and ensure aquaculture spatial needs are properly considered in developing marine spatial plans, a constraints and opportunities mapping project for aquaculture will be carried out.

Marine Spatial Planning & Aquaculture

Food security is an important policy objective and aquaculture makes an important and growing contribution to this [globally]. Aquaculture is an important, and in coming years a potentially more significant, contributor to employment and economic activity in coastal communities. These factors will be important considerations in the development of integrated marine plans.

The majority of marine aquaculture is currently related to Atlantic salmon and shellfish. The farming of seaweed as a food or fuel is a growing part of this sector, including as a part of polyculture processes such as sea fish production. The majority (>85%) of existing marine based finfish aquaculture activity has organic certification. Ireland is the largest producer of organic farmed salmon in the EU, and in the world. Shellfish production is evenly spread throughout Ireland and is a potentially expanding activity. Trends in the industry are closely tied in with changes in wild fisheries, the availability of investment, and site availability. More intensive types of aquaculture can use space and resources more efficiently if they are carefully planned and managed. The overall outlook is dependent on site availability and environmental carrying capacity. Future development of high-energy sites for finfish production could lead to large scale offshore production.

Potential impacts

Increased aquaculture production could help to contribute to increased food security and local production as a means of securing future supply in a way which is carbon efficient and fits local economies. Finfish aquaculture can alleviate fishing pressure on some wild stocks, while providing additional nutrients for shellfish production when well sited. Reduction of pollution of shellfish waters will help provide a sustainable base for development of the inshore aquaculture sector, as well as reducing public health risks. The health benefits of fish consumption remain clear, with increased consumption in the Irish population advised.

Actions proposed to support integration of aquaculture into marine spatial planning framework

(A) Develop opportunities and constraints mapping for aquaculture

These constraints and opportunities may be economic, social and environmental in nature. The mapping study will assess the spatial constraints and opportunities and should provide maps showing specific areas suitable for specific aquaculture activities and areas where there are constraints to specific aquaculture activities. These may be identified as anticipated benefits, including the contribution that the proposals would make to policy objectives, or anticipated adverse effects.

(B) Identify marine tourism opportunities from aquaculture

Aquaculture presents significant opportunities for marine tourism that can supplement farmers' income. The coastal nature of aquaculture complements the tourism products promoted through the Wild Atlantic Way strategy. Aquaculture tourism also offers the opportunity to improve public knowledge of the industry. A study will be initiated to identify marine tourism opportunities for the aquaculture sector and to provide guidance to farmers wishing to become involved.

The synergies of aquaculture and tourism have been evident in Ireland with the longest running seafood festival The Galway Oyster Festival one example of this point. BIM are delighted to be a sponsor once again for the 2015 Festival. One of the main attractions for visitors has been the experience to taste Irish farmed oysters from numerous bays around the country highlighting the diversity in tastes so much sought after by tourists looking for a unique taste experience.
More recently BIM working in conjunction with the Failte Ireland have further capitalised on the synergy of tourism and aquaculture. The recent success of the Taste

of the Atlantic –A Seafood Journey is comprised mainly of experiences with aquaculture producers. http://www.wildatlanticway.com/stories/food/bay-coast-seafood-trail/ This includes a chance to visit mussel and oyster farms. In addition to this tourists can also learn about the production of Irish organic salmon and experience the smoking of this much sought after product. While this initiative began in 2015 already the feedback from both producers and tourists has been extremely positive and plans to extend the Trail all along the Wild Atlantic Way are already in progress.

Further evidence of the vital link between aquaculture and tourism is from local community festivals based around aquaculture products for example The Connemara Mussel Festival, The Carlingford Oyster Festival and The Clarenbridge Oyster Festival to name but a few. Coupled with this more and more aquaculture producers are providing tours of their facilities coupled with a tasting of the product due to the demand from tourists.

(C) Conduct studies on how aquaculture contributes to communities in rural areas [to inform decision-making and trade-off considerations]

These studies would outline how aquaculture contributes to the societal benefits in the marine area, including the sustainable use of marine resources to address local social and economic issues, including:

- How properly planned aquaculture developments in the marine area can provide environmental and social benefits as well as drive economic development, provide opportunities for investment, employment and generate export and tax revenues.
- To provide data and information and methodology to assess the economic and social influences and benefits of aquaculture activities to inform decision making and trade off decisions.

(D) Study on integrated multi-trophic aquaculture (IMTA) and possible synergies with offshore wind farms or other marine renewables

A significant part of the renewable energy required to meet low carbon energy targets and objectives will come from marine sources. Offshore wind is expected to provide the largest single renewable electricity contribution as we move towards 2020 and beyond. Wave and tidal stream technologies also have significant potential in the medium to long-term. A study or studies into possible synergies between these renewables and aquaculture activities would yield valuable planning information.

In addition, it will be important to explore what role IMTA could play in Ireland. If, as anticipated, the farming of seaweed becomes more established and prevalent then a study or studies into possible mutually beneficial interactions between seaweed aquaculture and other aquaculture forms would be most beneficial.

Chapter 8
Aquaculture Licensing

Vision for 2020

"A streamlined and efficient licensing system that provides greater business certainty to applicants, and transparency to the general public."

Actions to achieve the vision

The following actions are proposed to be undertaken in order to progress towards the vision outlined above. These actions may be undertaken by the State, by private actors, or a combination as appropriate, and some may be financially supported through the Seafood Development Programme, co-funded by the Exchequer and European Maritime and Fisheries Fund.

Action 21	***Progressively remove the current aquaculture licensing backlog.***
Action 22	***Review and revision of the aquaculture licensing process, including the applicable legal framework.***
Action 23	***In the context of a reviewed process and revised legal framework, consider the phased introduction of appropriate timescales for licence determination.***
Action 24	***Develop a data management and information system, with online aquaculture licence application and tracking functionality, and spatial mapping of aquaculture sites.***

Overview of current legal framework for licensing of aquaculture

The main piece of aquaculture licensing legislation is the Fisheries (Amendment) Act of 1997.

Other key legislation includes

- Sections 2,3 and 4 of the Fisheries and Foreshore (Amendment) Act 1998, No. 54
- Section 101 of the Sea-Fisheries and Maritime Jurisdiction Act 2006, No. 8
- Aquaculture (Licence Application) Regulations, 1998 S.I. NO. 236 of 1998, as amended by S.I. No. 145 of 2001 and S.I. No. 197 of 2006 and S.I. No. 301 of 2012 and S.I. No 410 of 2012.

Aquaculture licensing in Ireland is administered by the Aquaculture Foreshore Management Division of the Department of Agriculture, Food and the Marine on behalf of the Minister.

In conjunction with the Fisheries Amendment Act, the Foreshore Act of 1933 is also required for the licensing of aquaculture sites in Ireland and allows the Minister to grant leases/ licences and regulates the placement of structures on the foreshore associated with the carrying out of licensed aquaculture.

The Foreshore Acts 1933 - 2011 require that a lease or licence must be obtained from the Minister for Agriculture, Food and the Marine for works undertaken on the foreshore which are deemed to be:

- any function in relation to a fishery harbour centre;
- any function in respect of—

    (i) an activity which is wholly or primarily for the use, development or support of aquaculture, or

    (ii) an activity which is wholly or primarily for the use, development or support of sea-fishing including the processing and sale of sea-fish and manufacture of products derived from sea-fish.

The foreshore is classed as the land and seabed between the high water of ordinary or medium tides (shown HWM on Ordnance Survey maps) and the twelve mile limit (12 nautical miles equals approximately 22.24 kilometres).

The Foreshore Acts 1933 to 2011 include the following.

- Foreshore Act 1933
- Foreshore (Amendment) Act 1992.
- Section 5 of the Fisheries and Foreshore (Amendment) Act 1998
- Fisheries (Amendment) Act 2003 (Part 5)
- Maritime Safety Act 2005 No. 11 (Part 6)
- Foyle and Carlingford Fisheries Act 2007
- Foreshore and Dumping at Sea (Amendment) Act 2009
- Foreshore (Amendment) Act 2011

These pieces of legislation form the legal basis for licensing marine aquaculture. For freshwater aquaculture, the foreshore act is replaced by the Planning and Development Act of 2000 for land-based operations.

The appeals procedure of aquaculture licensing is handled by the independent Aquaculture Licences Appeals Board, the legal basis for which is included in the Fisheries (Amendment) Act 1997. Customers, the public or environmental organisations aggrieved by a decision of the Minister for Agriculture, Food and the Marine on an aquaculture licence application, or by the revocation or amendment of an aquaculture licence, may make an appeal within one month of publication of the decision.

The procedural steps relating to aquaculture licensing, including public and statutory consultation, are set out in the Aquaculture (Licence Application) Regulations, 1998 (S.I. No. 236 of 1998). Notice of aquaculture licence applications are published in a newspaper circulating in the vicinity of the proposed aquaculture. This notice specifies where the documentation relating to the application may be inspected. A person may make written submissions or observations within a prescribed time period (as set out in the Statutory Instrument). In addition, aquaculture licence applications are sent to statutory consultees (as prescribed in regulation 10 of S.I. No. 236 of 1998).

Habitats and Birds Directives

Appropriate Assessment (AA) is a legal requirement under Article 6 of Council Directive 92/43/EEC of 21 May 1992 on the Conservation of Natural Habitats and of Wild Fauna and Flora (Habitats Directive) and of Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the Conservation of Wild Birds (Birds Directive). The obligations under the Directives are transposed into Irish law primarily through the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 of 2011). The Regulations require that the Minister as the licensing authority for aquaculture satisfy himself before making a licence determination that the proposed activities will not adversely affect the integrity of the designated area, by reference to its Conservation Objectives. AA thus forms an integral part of the decision-making process for aquaculture licensing. The AA process requires very considerable data on protected habitats and species within the designated area.

In December 2007, the Court of Justice of the European Union[16] delivered judgment on Ireland's implementation of the Birds Directive in case C418/04. The Judgment referred to six separate complaints, with one relating to aquaculture. The Court found that Ireland did not meet the required standard regarding the level of protection being

[16] Previously referred to as the European Court of Justice

achieved in SPAs or in areas that should be designated as SPAs, as set out in Article 4 of the Birds Directive or Article 6 of the Habitats Directive, in particular by failing to take all reasonable measures, including targeted action to prevent their deterioration, and by not requiring appropriate assessment for certain types of activities including aquaculture.

Since 2009, Ireland has been addressing the judgement as a whole through a *Programme of Measures* (POM) published by the Minister for Arts, Heritage and the Gaeltacht. As part of that POM, in relation to Natura 2000 areas relevant to aquaculture, the Minister for Agriculture, Food and the Marine, together with the Minister for Arts, Heritage and the Gaeltacht and the Marine Institute, has engaged in a comprehensive multi-annual work programme. All of the baseline data on habitats and species for these areas has been acquired, allowing for Conservation Objectives to be set by the Minister for Arts, Heritage and the Gaeltacht. In addition, targeted research (e.g. specific activity-species-habitat interaction studies) to support the AA process has been commissioned. The POM, and in particular the work carried out in relation to aquaculture, has entailed a very significant financial, administrative and scientific investment by the State in resolving the CJEU judgement in case C418/04.

During the course of the POM work programme, the ability of the Minister for Agriculture Food and the Marine to process aquaculture license determinations was significantly curtailed by law. However, following the above investment of resources, the Minister is now in a position to progress licence determinations in full compliance with the 2011 Regulations. Licence determinations for Natura 2000 areas are being progressed by the Minister on a bay-by-bay basis. By mid October 2015, 13 bay level appropriate assessments had been carried out. In a number of instances these have triggered the need to commission additional surveys to complete the knowledge-base.

In tandem with the ongoing availability of further completed Appropriate Assessments, this will facilitate the processing of aquaculture licenses currently on hand. The tables below show the number of licence applications determined by the Minister over the period 2007-2014. It can be seen that as the AA process becomes more streamlined, the number of licence determinations is increasing significantly year on year. Completion of bay-level appropriate assessment reports by the Marine Institute is targeted for 2016.

The publication by the Marine Institute of the AA report does not, in itself, conclude the overall AA Process. This process can only be considered closed following the approval by the Minister of an “Appropriate Assessment Conclusion Statement” (a statement by the Minister that the proposed aquaculture licensing conforms with the relevant EU Directives.)

	2007	2008	2009	2010	2011	2012	2013	2014	Total
Applications Received	57	24	106	106	123	62	99	140	717
Licences Issued	11	2	4	3	6	16	108	94	244
Licences Refused	1	1	0	0	0	0	0	2	4

Present average application process period

The average timeframe for processing each particular application varies depending on location, species, scale and intensity of production, statutory status of sites, potential visual impact etc. Other factors include consideration of any submissions or observations raised during the public consultation period.

The table below sets out in detail the steps in the licence consideration process, including the AA Process. The table also provides indicative timelines for those actions under the full or partial control of the Minister, including, but not limited to, issues arising as part of the public and statutory consultation process. Definitive timelines are not possible under the constraints of current legislation, multiple external inputs to the process and limited staffing resources both within the Department and available to other parties providing essential inputs.

STEPS	DESCRIPTION OF PROCESS	INDICATIVE TIMELINES
Step 1	Aquaculture licence application received and dated	
Step 2	The application form is checked to determine if the proposed area is located within a 'Natura 2000' site - if so, an Appropriate Assessment needs to be carried out	
Step 3	Appropriate Assessment carried out, which involves: • Detailed analysis of raw data collected (this is substantially complete in all bays) • The setting of Conservation Objectives by the National Parks and Wildlife Service (NPWS) • Preparation of shape files by DAFM and BIM (including profiling of aquaculture activity in the relevant Natura site) to allow the Marine Institute to spatially overlap the aquaculture activity over the protected habitats in the	

	Natura site • Appropriate Assessment carried out by the Marine Institute • Broad agreement between the Marine Institute and NPWS on the outcomes of the Appropriate Assessment	
Step 4	DAFM meets with its scientific and technical advisors to discuss the findings of the Appropriate Assessment, with particular reference to ensuring scientific agreement and translating the findings into practical licensing decisions - this can include an informal meeting with NPWS (who are also Statutory Consultees)	
Step 5	If DAFM has a serviceable Appropriate Assessment, it can proceed to carry out Environmental Impact Assessment (EIA) pre-screening on all licence applications to ensure compliance with EU Environmental Directives	4 weeks minimum
Step 6	Submission to Minister on requirement for Environmental Impact Statement (EIS) for each application	2-3 weeks
Step 7	Submission of set of policy recommendations for entire bay or Natura site for Ministerial approval	1 week
Step 8	All applications accompanied by the Appropriate Assessment and EIA pre-screening (or EIS) are sent to Statutory Consultees (this includes NPWS, An Taisce, County Councils, Department of Environment etc)	9 weeks (includes 6 week statutory consultation period)
Step 9	All applications accompanied by the Appropriate Assessment and EIA pre-screening (or EIS) are sent to Public consultation - allowing members of the public to comment	Runs parallel to Step 8
Step10	All information received is evaluated by DAFM. An Appropriate Assessment Conclusion Statement is finalised indicating how the bay will be licensed in accordance with Natura requirements. Individual recommendations are prepared and sent for Ministerial approval	3-6 weeks depending on the size of the bay

Step 11	Ministerial Decision to either grant or refuse the application	1-2 weeks
Step 12	Publication of Ministerial Decision and the reasons for such determinations are placed on DAFM website	1 week
Step 13	Decision may be appealed to the Aquaculture Licences Appeals Board (ALAB) - the independent appeals body	4 weeks

It will be seen from the above table that a period of time in the order of 30 weeks is required to finalise licence determinations, after publication of each Appropriate Assessment Report.

In addition to the above constraints, enhanced requirements from other authorising agencies have emerged, for example in the case of underwater archaeology. The requirements set down by the Minister for Arts, Heritage and the Gaeltacht in respect of underwater archaeology reflect applicable legislation. However, they will impact the timelines indicated above. It is not possible at this stage to quantify this pending the completion of initial archaeological surveys currently underway in respect of Dungarvan Bay.

Based on the information currently available to the Minister, the expected outturn for 2015 in respect of licence determinations is in the order of 120. This estimation is the subject of an ongoing review for the reasons outlined above.

Enhanced regulatory monitoring

A dedicated Monitoring and Compliance Unit has been established within the DAFM to strengthen the adherence to the terms and conditions of all aquaculture licences. The Unit brings greater coherence to the existing monitoring system leading to enhanced monitoring and regulatory standards, practices and procedures. A structure for the systematic audit of licence conditions has been put in place. This is a very substantial enhancement of the existing regulatory procedure and supplements all other inspections of sites.

The Unit avails of services provided by representatives of DAFM, MI, Engineering Division (DAFM), SFPA, MSO and BIM as necessary.

The areas targeted for audit include the following:-

Site

- Navigational marking
- Location (within licenced boundaries)
- Cleanliness/redundant structures
- Access routes
- Planning permissions (if appropriate)

Structures

- Type of structure
- Alignment
- Moorings (if appropriate)
- Spacing

Stocking and Records

- Species and source
- Stocking density
- Stock movements
- Fish health
- Predator control
- Chemical usage
- Disposal of mortalities
- Fallowing
- Escapes

Environmental Monitoring

- Water quality
- Effluent discharge (if appropriate)
- Chemical discharge
- Benthic monitoring
- Waste management
- Emergency action plan

Licence Fees

Details of the present licence fees are set out in Appendix 3.

Actions proposed

(A) Progressively remove the current aquaculture licensing backlog.

Implementation of a more streamlined process, within a revised legal framework, should allow for the phased introduction of significantly reduced timescales for licence determination. While the overall process will continue to need to reflect the engineering, scientific, environmental, legal and public policy aspects of all applications, the incremental availability and ultimate completion in 2016 by the Marine Institute of Appropriate Assessments will facilitate the processing of aquaculture licence applications currently on hand. As the Appropriate Assessment process becomes more refined, the number of licence determinations should increase significantly year on year.

(B) Review and revision of the aquaculture licensing process, including the applicable legal framework.

(C) In the context of a reviewed process and revised legal framework, consider the phased introduction of appropriate timescales for licence determination.

A full review of the procedures and processes involved in the consideration of aquaculture licence applications including, of necessity, the legislative framework is proposed. Implementation of a more streamlined process, within a revised legal framework, together with completion of appropriate assessment, will allow for the phased introduction of appropriate timescales for licence determination.

(D) Develop a data management and information system, with online aquaculture licence application and tracking functionality, and spatial mapping of aquaculture sites

The development of a data management and online system for aquaculture licence application and tracking is envisaged. The system envisaged will also provide a management tool for aquaculture licence processing, reporting and file sharing. The system will provide a mechanism for reducing the administrative burden for both the applicant and the administrators. The key features and benefits of the system would be as follows:

- Real time reporting and monitoring of the aquaculture industry;
- Potential to improve processing efficiency by the introduction of Registered Aquaculture Agents to assist clients to prepare aquaculture licence applications to the required standard of completeness and accuracy;
- A standardised reporting and input process to the aquaculture licensing process from internal and external consultees;
- Improved efficiencies in processing time of applications such as instant on-screen accessibility and two-way electronic delivery of internal, statutory and public consultation material;
- Public Viewer will deliver transparency for the aquaculture industry and the public;
- Enhanced efficiencies, arising from improved levels of reliability and predictability with consequent cost reduction to applicants, DAFM and other agencies by the use of a standardised paperless system.
- Secure web based system with controlled levels of access (DAFM, agency and public) managed by DAFM.
- Improved efficiency in information accuracy and decision-making by central file sharing and single on-screen viewer.

The system will reduce the administrative burden for the applicant, the administrators, and wider stakeholders.

Appendix 1
Licence Fees

The cost of obtaining and maintaining an aquaculture licence varies with the type of aquaculture proposed.

Aquaculture Application Fees

New licence shellfish, plants or food	New licence finfish	Renewal /review shellfish, plants or food	Renewal/review finfish
€95.23	€634.87	€63.49	€190.46

Licence class	Method of calculation	Fee
Intensive shellfish culture or culture of aquatic plants or aquatic fish food	Up to 2 hectares	€82.53
	Each additional hectare	€40.63
Extensive shellfish culture or culture of aquatic plants or aquatic fish food	Up to 2 hectares	€82.53
	Each additional hectare up to 20	€40.63
	Each additional hectare above 20	€1.27
Finfish culture	Up to 100 tonnes (per tonne)	€6.35
	Each additional tonne	€15.24

Other indirect costs associated with acquiring an aquaculture licence include:

- Banking:-business plan etc.;
- EIA report (where applicable);
- Planning permission (land-based applications);
- Water discharge licence (land-based applications);
- Water and other analysis report;
- Notices in newspapers;
- Engineering drawings, consultant and/ or legal professional fees.

The above costs can vary collectively from €1000 for an on growing shellfish licence applicant up to €100,000 for a marine on growing finfish applicant who is required to commission an EIA.

Appendix 2
Best Practices in Irish Aquaculture

Co-ordinated Local Aquaculture Management Systems (CLAMS)

The unique Co-ordinated Local Aquaculture Management Systems process is a nationwide initiative to manage the development of aquaculture in bays and inshore waters throughout Ireland at a local level. In each case, the plan fully integrates aquaculture interests with relevant national policies, as well as Single Bay Management (SBM) practices, which were initially introduced by salmon farmers to co-operatively tackle a range of issues, and have now been extended to:

- All aquaculture species;
- The interests of other groups using the bays and inshore waters;
- Integrated Coastal Zone Management (I.C.Z.M.) plans;
- County Development plans.

The process has been widely adopted in bays and inshore waters where fish farming is practiced around the Irish coast, as a further proactive step by fish and shellfish farmers, to encourage public consultation on their current operations and their future plans.

The logical management approach is a locally based and all-embracing system designed to maximise production and environmental management through the integration of production goals with minimal conflict with other resource users. Ireland is leading the way in the development of such a unique and progressive approach to bay/inshore waters management.

This is a constantly evolving process in which a co-ordinated strategy is developed and implemented for the allocation of environmental, socio-cultural and institutional resources to achieve conservation and sustainable multiple use of the coast.

Because CLAMS is designed to treat each bay/region as a separate entity, the process involves an individual plan being drawn up for each area. This management plan lays out clearly what fish and shellfish farmers are currently doing in the bay, how they operate and what their future plans are. The plan involves a long consultative process with many interested parties in the relevant area and includes:

- A detailed description of the bay/area in terms of physical characteristics, history, aquaculture operations, future potential, problems etc.;
- The integration of a series of codes of practice for current aquaculture operations and translation of those national codes to the specific circumstances of each bay or coastal region;
- The expansion of the concept of S.B.M. to species other than salmon;
- The formation of a development plan for aquaculture in the bay;
- The compilation of information on other activities in the bay;
- The establishment of a local and national communication network with 'bottom up' and 'top down' dialogue capacity.

CLAMS groups have been set up and are active in the following areas.

- Killmacanogue
- Killary Harbour
- Roaringwater Bay
- Clew Bay
- Ardgroom
- North Shannon
- Dungarvan
- South Shannon
- Bannow Bay
- Kilkieran Bay
- Castlemaine Harbour
- Donegal Bay
- Trawbega Bay
- Mulroy Bay
- Lough Swilly
- Larne
- Carlingford Lough
- Belfast Lough
- Strangford Lough

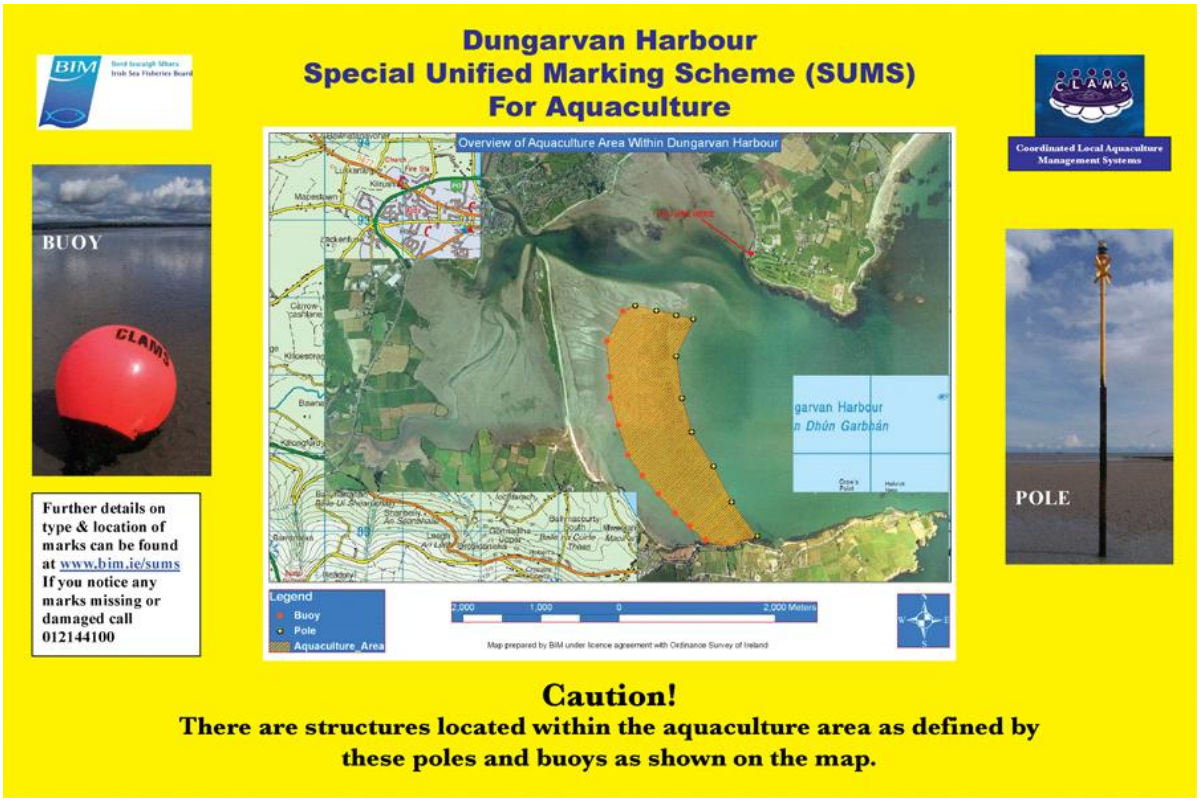
Within these groups, the Regional Officers co-ordinate and manage projects including:

- Navigation Plans
- Deployment of navigation markers
- Beach and pier clean-ups
- Schools Projects
- Re-alignment and rationalisation of mussel lines
- Oyster trestle recycling

Special Unified Marking Schemes (SUMS)

Group marking of aquaculture sites in an area to provide a more harmonised approach to site marking and allow for reduced visual impact and clearer navigation for other users of the marine environment. Licensed sites have to be marked under law as they could be a hazard to bay users. Previously all sites required marks on the corners. This has meant that some aquaculture areas have multiple sites marked. SUMS is designed to be cheaper and easier to maintain for the aquaculture producers whilst also providing a safer marine environment for other users.

An example of a SUMS project in action is Dungarvan Bay. There are 45 aquaculture sites in Dungarvan Bay. If each site was marked at the 4 corners with a marker pole or buoy this would mean180 separate marks. The farmers and BIM designed a plan in agreement with Commissioners of Irish Lights, the Marine Safety Office and Department of Agriculture Engineers to mark collectively sites. There are now 21 marker poles and buoys along with public awareness signs at slipways around the bay. This means that the sites are now safely marked for both the farmers and other users of the bay.



Dungarvan Harbour Public Awareness Sign

ECOPACT

ECOPACT is an initiative designed to ensure the widespread introduction of environmental management systems (EMS) throughout the Irish aquaculture industry. This in turn promotes responsible and sustainable development of fish and shellfish farming.

ECOPACT helps industry to work to the highest standards and to produce a top quality product in a viable and efficient manner. It covers every aspect of aquaculture, from husbandry, to maintenance, and the interaction of farm related activities with the surrounding environment.

BIM has developed the ECOPACT document to provide a solid basis for Irish fish and shellfish farmers to set up their own individually tailored, highly effective EMS. This is a framework that helps companies to manage their operations with a reduced impact on the environment. BIM is helping companies to develop a plan listing the environmental issues to be covered, together with targets for action, details of management actions to achieve those targets, and setting out how performance will be monitored and evaluated.

As well as detailing the procedures for setting up an EMS, this document includes a comprehensive series of annexes including pictures and ecological descriptions for species Ireland has protected under the EU Birds and Habitats Directive. These act as a useful aid to identification.

The acceptance of ECOPACT by the Irish industry represents a powerful commitment to environmentally sustainable operations, to a standard well beyond simple compliance with legal requirements. Currently there are over 50 aquaculture businesses with ECOPACT environmental management systems in place.

ECOPACT also allows farmers to feed into the Origin Green programme run by Bord Bia, which provides a wider recognition of the sustainability credentials of the participants.

National Sea Lice Monitoring Programme

The ecto-parasite sea louse, a tiny crustacean, is an economically significant pest of the marine farmed salmon industry worldwide. In Ireland, a mandatory national sea lice monitoring and control regime, which features so-called 'treatment-trigger-levels', has been put in place, which aims to keep the level of infestation on marine salmon farms as low as possible.

The control of sea lice has been afforded to high priority by the State since 1991 and Irish salmon farms are the subject of rigorous and transparent inspection regime carried out by the Marine Institute on behalf of the Government. This monitoring programme is backed up by mandatory licensing requirements imposed on marine fin-fish farmers through a protocol on management and control. In May 2008, the Department of Agriculture, Fisheries and Food published A strategy for improved pest control on Irish salmon farms, outlining a new National Sea Lice Monitoring Plan for the control of sea lice in Ireland.

The purposes of the national sea lice monitoring programme is:

- To provide an objective measurement of infestation levels on farms;
- To investigate the nature of infestations;
- To provide management information to drive the implementation of control and management strategies;
- To facilitate further development and refinement of the control and management strategies.

Monitoring and Control Strategy

The sea lice monitoring and control strategy has five principal components:

1. Separation of generations;
2. Annual fallowing of sites;
3. Early harvest of two-sea-winter fish;
4. Targeted treatment regimes, including synchronous treatments;
5. Agreed husbandry practices.

Together, these components work to reduce the development of infestation and to ensure the most effective treatment of developing infestations. They minimize lice levels whilst controlling reliance on, and reducing use of, veterinary medicines. The separation of generations and the annual fallowing prevent the vertical transmission of infestations from one generation to the next, thus retarding the development of infestations. The early harvest of two sea winter fish removes a potential reservoir of lice infestation and the agreed practices and targeted treatments enhance the efficacy of treatment regimes. One important aspect of targeted treatments is the carrying out of autumn/ winter treatments to reduce lice burdens to as close to zero as practicable on all fish, which are to be over-wintered. This is fundamental to avoiding zero/ near zero egg bearing lice in spring. The agreed husbandry practices cover a range of related fish health, quality and environmental issues in addition to those specifically related to lice control.

Trigger Levels for Treatment

Treatment triggers during the spring period (March to May) are set close to zero (0.5 egg bearing females per females per fish). Timing of treatments is also informed by the numbers of mobile lice on the fish. Where numbers of mobile lice are high, treatments are triggered even in the absence of egg bearing females. Outside of the critical spring period, a level of 2.0 egg bearing lice per fish acts as a trigger for treatments. This is only relaxed where fish are under harvest or with the agreement of the Department of Agriculture, Food & Marine (DAFM) or its agent, the Marine Institute.

Synchronous Sea Lice Treatment and Control in Bays

Sea lice management is dependent on the availability of adequate sites and the separation of generations. All fish farms operating in a particular bay undertake appropriate synchronous sea lice treatment and control strategies through the Single

Bay Management/CLAMS (Coordinated Local Aquaculture Management System) process. Close co-operation between the industry and government is essential to maximise the benefits of strategic sea lice management.

Training

All farm staff should receive introductory training in fish health and welfare. All staff should stay informed of emerging fish health and welfare issues and should be encouraged to attend fish health meetings and workshop.