

# Marine Scotland

An Assessment of the Benefits to Scotland of Aquaculture



marinescotland

# An Assessment of the Benefits to Scotland of Aquaculture



**Drafted by**

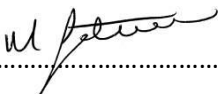
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## Glossary

BTA	British Trout Association
CSR	Corporate Social Responsibility
DEFRA	Department for the Environment, Food and Rural Affairs
EBM	Ecosystem Based Management
FAO	Food and Agriculture Organisation of the United Nations
FCR	Food Conversion Ratio
FSA	Food Standards Agency
FTE	Full Time Employee
GHG	Green House Gas
GVA	Gross Value Added
HIE	Highlands and Islands Enterprise
HUFA	Highly Unsaturated Fatty Acids
IEL	Imani Enterprise Ltd
IMTA	Integrated Multi-Trophic Aquaculture
JNCC	Joint Nature Conservation Committee
LCA	Life Cycle Assessment
MPS	Marine Policy Statement
MPA	Marine Protected Area
MSP	Marine Spatial Planning
MSFD	Marine Strategy Framework Directive
MSA	Market Systems Approach
MGSA	Ministerial Group for Sustainable Aquaculture
MSC	Most Significant Change
NAFC	NAFC Marine Centre (Shetland)
NMP	National Marine Plan
SRSL	SAMS Research Services Ltd
SARF	Scottish Aquaculture Research Forum
SAMS	Scottish Association for Marine Science
SNH	Scottish Natural Heritage
SSC	Scottish Salmon Company
SSPO	Scottish Salmon Producers' Organisation
SSF	Scottish Sea Farms
SSMG	Scottish Shellfish Marketing Group
SSMEI	Scottish Sustainable Marine Environment Initiative
SLA	Sustainable Livelihoods Approach
CEFAS	The Centre for Environment, Fisheries and Aquaculture Science
UHI	University of the Highlands and Islands
VCA	Value Chain Analysis
WFD	Water Framework Directive



## Acknowledgements

Imani and SRSL would like to take this opportunity to thank the many people who have contributed to this report. The input from stakeholders throughout the aquaculture industry and across Scotland has been fantastic through the extensive consultation process and we are very grateful to all those who have kindly given their time as well as information for use in this study. It is impossible to thank all those involved, particularly the members of the public who were consulted during surveys, however we want to note our thanks here to those who have the opportunity to read the resulting outputs. Our apologies to those we were not able to meet as part of the research process.

Many thanks to Marine Scotland and Highlands and Islands Enterprise for commissioning this piece of work and for their interest in assessing how this industry is benefitting the people of Scotland, both now and into the future.



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## 1. RESEARCH SUMMARY

### 1.1. INTRODUCTION AND METHODOLOGY

Scottish aquaculture production is a pillar of rural industry in Scotland, and provides considerable benefit for fragile economic areas. Further, through its supply chain providing demand for feed, research, engineering, and downstream logistics and processing opportunities, it provides employment and revenue for a diverse range of sectors *throughout* Scotland. This assessment, commissioned by Marine Scotland and Highlands and Islands Enterprise between July-December 2013, describes these benefits through the industry's economic contribution including social, environmental, human, financial and physical capital.

Analysis was split into four work packages: a macro-level industry assessment; a Market Systems Approach analysing the whole market; a Sustainable Livelihoods Approach using a combination of interviews and questionnaires to investigate sustainability and benefits to communities; and a Value Matrix to summarise all available benefits provided by the aquaculture industry.

### 1.2. RESULTS

Results based on 2012 outputs suggest that:

- The aquaculture industry:
  - From **direct production** alone, contributes turnover for Scotland of at least £550m, with a GVA (primarily the added value of salaries and profit) of £165.8m, and over 2,800 jobs: though its wealth generation goes far beyond this value.
  - Across the **Scottish supply chain** stemming from Scottish aquaculture sites, it generates over 4,800 jobs in total, £800m in revenue and £270m of added value across all suppliers, farm production, processing and into retail.
  - Generates for the **UK economy** at least £1bn in turnover across the UK, including Grimsby processing and national retailing.
  - Taking into account the **catalytic effect of that added income across the economy**, it is estimated to contribute as much as £1.4bn turnover and 8,000 jobs to Scotland, and £1.8bn turnover and 8,800 jobs to the whole UK.
- Economic geography is a key concept which frames the impact of aquaculture in Scotland; although aquaculture provides sustainable employment and income generation in remote areas that may otherwise lack alternative economic options, it also has a substantial impact on jobs in other parts of Scotland such as the Central Belt and this 'other half' remains largely unrecognised.
- In terms of the benefits of aquaculture to Scottish communities, human capital in terms of participation in employment, as well as the skills and experience which provide 'employment security' was found to be most important, with financial benefit in terms of income to local ancillary businesses (particularly transport and tourism) the second most important. Negative opinions were generally low and most often related to environmental impact.
- Stakeholders and the public largely believed that growth of the aquaculture sector would be beneficial to Scotland as long as that growth was an organic process. Should the industry achieve the 2020 targets (set out in the Scottish Marine Plan consultation) to increase marine finfish production sustainably to 210,000 tonnes and shellfish to 13,000 tonnes, the



industry and supply chain could directly be worth over £1.1 billion with a GVA of £345m, and provide 7,000 jobs for Scotland.

### 1.2.1. TOWARDS 2020: POTENTIAL GAINS

Should Scotland achieve its aspirations in growth towards 2020, the economic value based on current projections would be as follows:

MARINE FINFISH		SHELLFISH	
2012 <sup>i</sup>		2012	
Production	164,380	Production	6,525
Turnover (production only)	£550m	Turnover (production only)	£8.7m
Employment (production only)	1,118	Employment (production only)	358
Turnover across Scottish supply chain including processing and other suppliers	Over £800m	Turnover across Scottish supply chain including processing and other suppliers	£20m
Employment across Scottish supply chain	Over 4,000 employees	Employment across Scottish supply chain	Over 500 employees
GVA across Scottish supply chain	£265m	GVA across Scottish supply chain	Over £5m
2020 PROJECTION		2020 PROJECTION	
Production Target	210,000	Production Target	13,000
Turnover (production only)	£771m	Turnover (production only)	£17.3m
Employment (production only)	1,447	Employment (production only)	713
Turnover across Scottish supply chain including processing and other suppliers	Est. £1.1bn	Turnover across Scottish supply chain including processing and other suppliers	£40m
Employment across Scottish supply chain	Over 7,000 employees	Employment across Scottish supply chain	~1,000 employees
GVA across Scottish supply chain	£345m	GVA across Scottish supply chain	£10-15m
<b>Full Benefit by 2020 of Scottish Aquaculture including growth stimulated in the wider economy (estimated):</b> To Scotland: est. £2bn, over 10,000 jobs (full and part time) To UK: est. 2.5bn, over 11,000 jobs (full and part time)			

<sup>i</sup> Finfish production tonnage and production-only employment includes (in addition to salmon) rainbow trout produced in the marine environment (2,076t) plus small volumes of halibut and sea trout.



The *intensity of benefit* for many rural areas, particularly in pockets of Argyll and the North Isles of Shetland, should be acknowledged. Instead of fearing for their economic and social future, populations in these fragile areas are now driving economic activity in towns such as Lerwick and Lochgilphead. Nevertheless, this intensity brings its own risk when aquaculture is one of the few industries reaching into remote areas. Fragile urban areas, like post-industrial Lanarkshire area near the motorway network also host major processor and distributors.

The *causality* between Scottish aquaculture production, and the Scottish location of other industries in large sections of the supply chain, is notably clear-cut. There is a geographic requirement about many of the activities in a way that multiplies the benefit of aquaculture. Because of this, only by looking across the whole value chain can we see the true benefits to Scotland of aquaculture production.

Salmon producing companies, both large and small, have a positive impact on Scotland's economy. The industry also has benefits, with largely positive feedback from members of the public, in terms of social, financial, human and physical capital as reported in this study. Negative impacts were raised in all geographical locations in relation to environmental capital, with specific reference to sea lice and visual amenity; however in many of these cases it was not considered the most significant change. Scottish Salmon Producers Organisation (SSPO) and individual firms should continue to confidently promote a flourishing industry. The call to grow volumes is compelling for Scottish policy-makers, but multinational companies have to balance the interests of their Scottish operations alongside production in other countries. As a result there is a rationale for Scottish policy-makers to be more pro-active in the promotion of 'Brand Scotland', consenting of sites, stimulating technological development for more exposed sites, and exploring better finance options for smaller companies. By reducing the cost of securing viable sites, while maintaining Scotland's impressive reputation for quality and standards, Scotland can provide a win-win for both multinational salmon companies and Scottish economic interest. It would be healthy for the Scottish industry if Scottish-owned companies could invest in and operate farms divested under competition regulations, achieved through competitive finance and more innovative local ownership models.

In comparison to salmon, mussels and other shellfish provide a lower cost of entry for owner-producers and are generally considered to be of lower impact environmentally. The processing of shellfish is almost wholly owned by the farmers both in the integrated Loch Fyne Oysters model, and the predominant Scottish Shellfish Marketing Group (SSMG) cooperative model. The latter has proven resilient to mussel supply challenges and is growing in value, though it requires West Coast Scotland and Shetland producers to be balanced in scale: to that end, more West Coast mussel production would be desirable. There are also opportunities on the horizon for Integrated Multi-Trophic Aquaculture (IMTA), particularly around seaweed production. Despite being at an experimental scale further support to develop sustainable methods of production and diversification will improve the reputation of the industry in light of environmental impact and provide opportunities for diversification.

The barriers to proposed Scottish aquaculture growth can be overcome, and the will and justification from local communities is evident. If realised, such growth will contribute to the Scottish goals of solidarity, stable population and the creation of economic value in fragile and economically disadvantaged communities.



### 1.3. CHAPTER SYNOPSES

The following section provides a brief synopsis of each of the key chapters in this report.

#### 1.3.1. SECTION 5: ECONOMIC ANALYSIS

The Scottish economy should be viewed as ‘twin-engined’ whereby the now-traditional financial services sector is joined by ‘natural resource-based’ output (such as salmon, whisky, energy, oil): the latter should be viewed as a driver of economic growth and one with particularly promising prospects for the 21<sup>st</sup> Century. This engine of the economy relies on and propagates intellectual capital as well as physical outputs: ‘experience is exportable’, noted one supplier. Scottish Government objectives for sustainable economic growth are suitable for development in that they capture social and environmental consequences, and risk factors, as well as financial indicators.

Discussion is given regarding the whole aquaculture value chain: the GVA of aquaculture *production* must be set in context of other direct and indirect economic activity that is *attributable to the Scottishness of aquaculture production*, i.e. would or could fall away without that production being in Scotland. Looking across the value chain and considering case study examples from Shetland where multipliers and accounts are well-documented, it is clear that considerable (likely a majority of) value is found in provision of inputs and further down the value chain, not in the actual farming itself, which is the anchor activity but not the largest part of the benefit to Scotland.

#### 1.3.2. SECTION 6: ENVIRONMENT & CARBON FOOTPRINT

The environmental impact section provides contextual background to the complex relationship between the aquaculture sector and the environment in which it operates. The impacts of aquaculture production are discussed at a local benthic and disease level, but also considering climate and carbon footprint measures. At a local level, it appears that significant improvements have been made to minimising the impact of salmon production. For shellfish, the impact is perceived to be minimal and it is a highly efficient sector.

In the context of the carbon footprint of production, research indicates that salmon is considerably more efficient than some meat types, and favourably comparable with chicken production. This could be even further improved by substituting some carbon-intensive feed ingredients.

#### 1.3.3. SECTION 7: SUSTAINABLE LIVELIHOODS ASSESSMENT (SLA)

The Sustainable Livelihoods Assessment (SLA) methodology considers the holistic impact of aquaculture production on the fabric and well-being of communities in Argyll, Skye, Western Isles and Shetland Islands, including: human capital, financial capital, environmental (or natural) capital, social capital and physical capital. The findings provide rich detail in direct viewpoints from participants (quotes, analysis of the industry) and highlight the prime driver for many, that of employment and income as drivers that help maintain community structures, from schools to ferry services, to youth employment.

These findings are, in other sections, set in the context of mitigating vulnerability for communities (i.e. de-risking their economic outlook, protecting services) and policy frameworks.



#### **1.3.4. SECTION 8: ECONOMIC GEOGRAPHY**

Geography plays a pivotal role in understanding the whole value chain for aquaculture. While the scale of the industry hangs on the ability of sites to meet production targets in rural areas, many of the supply chain industries are in post-industrial Lanarkshire, West Lothian, Aberdeenshire, Fife and Grangemouth. When the *attribution* of these activities is properly accredited to Scottish (rather than generic) aquaculture production, there is an evident picture that production in the Highlands is a driver for economic activity in non-Highlands areas in Scotland (largely Central Belt and East Coast). It is essential to have a good understanding of these geographical relationships in order to reconfigure Scottish attitudes when looking at ‘where our money will come from?’ in future years.

Industry concentration and ownership can strongly influence where the value of production lies, and it is noted that Scotland’s high value niche in the salmon market (and indeed the shellfish market) provides an advantage, but it is constrained by supply limitations. From the point of view of a multinational owner that has a portfolio of production across multiple countries, this is a manageable problem, but it suggests that from a Scottish development point of view there are missed opportunities in achieving scale, since there are indications of unrealised demand (even in the UK) that is currently being met by competitor countries.

#### **1.3.5. SECTION 9: SUB-REGIONAL CASE STUDIES**

Case study summaries are presented from Skye, Western Isles, Shetland and Argyll. While often data at regional level can be limited, primary interviews and some datasets give a useful indication of how aquaculture contributes to those local regions. It is noted that in some cases, beneficiaries can be many miles inland from a fish cage, or may be in relatively unrelated supplier industries, and/or viewing aquaculture as only one part of an integrated sub-regional economy.

#### **1.3.6. SECTION 10: INDUSTRY VALUE CHAIN**

The industry incorporates inter alia: research, feed and smolt supplies as upstream activities, and transport, processing and retail as downstream activities. These are explicitly mapped out with examples and estimates of scale. Within this section export volumes are evaluated and supply limitations are discussed in order to detail the ‘bigger picture’ in relation to the aquaculture value chains. Indicative salmon and mussel value chains are included with diagrammatic representation of how these sectors look in the Scottish context.

#### **1.3.7. SECTION 11: COMPARATIVE INDUSTRIES**

Aquaculture is compared with other relevant rural industries, and its potential interaction with them. It is noted that aquaculture is a very young industry in comparison, and has some direct relevance for tourism, energy and fisheries among others. The Norwegian aquaculture industry is described in both scale and its competition in supplying the salmon market globally and within the UK.



### **1.3.8. SECTION 12: DISCUSSION – PROSPECTS FOR GROWTH**

Within this section the barriers to growth are identified and discussed, namely:

- 1) Consenting of sites
- 2) Technological barriers that are being overcome between now and 2020
- 3) Fish health & public health factors which could adversely affect a smooth and consistent growth of the industry.

Global growth projections show strong potential for the future of the industry; industry targets ('2020 targets') are deemed feasible if barriers are overcome. Most industry players seek a gradualist approach based on steady increase, however there is evidence that advances in developing more exposed / high energy sites would be desirable, and this requires a step-change in attitudes towards development.

### **1.3.9. SECTION 13: KEY FINDINGS**

Section 13 of this report outlines the key benefits to Scotland of aquaculture and growth in aquaculture, as highlighted at the beginning of this Research Summary. The section also identifies the key findings of the study in further detail, as follows:

- Quality and high value is Scottish aquaculture's trump card: but current volumes are more limited than they need be for every party concerned.
- Demand for Scottish salmon is potentially much larger than at present both in export and domestic markets, particularly at a more competitive price than is currently created by high compliance and volume-constrained supply conditions. However, constrained supply could lead to Scottish product being increasingly displaced by Norwegian product, rather than vice versa, leading Scotland into a high value but smaller niche than could ultimately be realised.
- The incentive to promote Scottish salmon over other countries' product is likely to be stronger for Scottish policy-makers and Scottish-owned companies than it is for multinational companies. This gives a good rationale for promoting Scottish production (including that of multinationals) through Scotland Food and Drink and industry bodies such as SSPO and SSMG.
- Large firms in aquaculture (mainly in salmon) have sought to professionalise an industry that was in the past beset by bankruptcies, disease events and standards that would no longer be acceptable and would harm industry growth. Their contribution should be recognised alongside the recognition that the market is highly concentrated in ownership, and is now subject to divestment requirements under EU rules.
- The requirement to divest farms in rationalisation during takeovers between large firms should be seen as an opportunity to be creative with ownership models.
- Many of the remaining small salmon-producing companies, mussel farmers and successful food processors are hampered by the cost of entry into high investment expansion: risk-mitigation or better finance options are required if they are to remain successful and sustainable in competing with larger companies.
- There is a 'perception gap' between policy-makers and the public, possibly arising from the hard economic realities since 2008: though a diverse range of opinions were voiced, there is a degree of consensus that aquaculture production has brought highly valued human and



financial capital to Highland and Island communities, and towns in the Central Belt. Environmental management has improved over the same period.

- Funding options: IMTA and more exposed and high energy production sites as emerging strategic areas should be explored with supporting catalytic investment / soft loans or other R&D funding, and prioritised in the same way that technological development is in, for example, marine renewable energy.
- Streamlining the planning and consenting process is urgently required in both finfish and shellfish, without weakening Scotland's value proposition. A pro-active approach to consenting is appropriate and should be pursued by all actors.
- Recognise the value across the supply chain that is brought into Scotland: feed supply, equipment, transport, logistics, and processing not only contribute through other sectoral GVAs directly dependent on aquaculture production, but are knitted into the Highland and non-Highland economic regions.
- Recognise the value of investment brought to the Scottish industry through multinational financing and management, and learn from it: scope investment models where national wealth (through e.g. oil funds or an investment fund) can be reinvested in sectors such as aquaculture.
- Support more community engagement as 'core business', not just as CSR policy. There are established outgrower models (Bound Skerries) and new community engagement models (Colonsay, Barra) which could be developed into a coherent system for accelerated planning and community benefit / ownership structures.
- Fragile areas remain fragile, even when aquaculture production has provided essential income streams over 2 decades and looks set to provide further benefits in future.
- Increase value addition in Scotland for both improvements in Scottish health objectives and to improve acceptance of aquaculture production across the Highlands and Islands region. Ultimately this relies on increased volume which can supply the processors.
- Learn from Shetland's industry forum discussions to allow ferries to meet industry as well as social needs: in the long term this will improve the financial viability and position of public transport services.
- New export markets are hard to predict and growing from small volumes: but indications are that domestic and international demand could be multiples higher than at present.
- Skills and research exports e.g. Fusion Marine, Kames, Institute of Aquaculture, AutoDEPOMOD software: Scotland needs to market its intellectual capital – this is confirmed by Stirling's MSc programme being largely international students coming here to learn.

### **1.3.10. SECTION 14: POLICY IMPLICATIONS**

A number of recommendations are proposed at the local (council) policy level, the national policy level and the European Union (EU) policy level. At the local level, it is proposed that there should be a focus upon 'skills challenges', particularly for remote island communities. At the national level, there are a number of initiatives which will be influential in steering sustainable aquaculture such as the Ministerial Group for Sustainable Aquaculture (MGSA) and its working groups, for example the Interactions Working Group which will facilitate ongoing discussion between farmed and wild fish sectors, and the National regional marine plans – all of which have policy challenges and opportunities. Finally, many of the concerns at the EU level echo concerns facing Scottish





aquaculture but the European Commission Blue Growth Agenda represents a considerable opportunity for the Scottish aquaculture sector with a drive to increase sustainable production.

#### 1.4. SUMMARY VALUE MATRIX

The benefits of aquaculture production to Scotland can be summarised below:

Benefit	Type / Magnitude of Value
Value of Scottish Aquaculture to Scotland <sup>ii</sup>	<ul style="list-style-type: none"> <li>Minimum <b>£800m across supply chain</b> <ul style="list-style-type: none"> <li><i>Generates £1.4bn in activity across the wider economy</i></li> </ul> </li> <li>Employment across the supply chain: <b>4,800 jobs</b><sup>iii</sup> <ul style="list-style-type: none"> <li><i>Generates 8,000 across the whole Scottish economy</i></li> </ul> </li> <li>GVA across the supply chain: <b>£270m</b></li> </ul>
Value of Scottish aquaculture ( <i>in production only</i> ) to Scotland <sup>iv</sup>	<ul style="list-style-type: none"> <li>Minimum <b>£550m</b></li> <li><b>2,700</b> direct jobs</li> <li>GVA of <b>£166m</b> (adj.)</li> </ul>
Value of Scottish Aquaculture to UK	<ul style="list-style-type: none"> <li><b>£1.8bn</b> in production, supplies and induced economic activity</li> <li><b>8,800 jobs</b> in production, supplies and induced economic activity</li> </ul>
Aquaculture exports	<ul style="list-style-type: none"> <li>Minimum <b>£470m</b></li> <li>Plus min. <b>£30m</b> from other industries in supply chain (e.g. feed exports to Norway and Ireland made possible by Scottish aquaculture-driven volume production)</li> </ul>
National Economic and Social Objectives	<p>Meeting Scottish Government objectives:</p> <ul style="list-style-type: none"> <li>New industries for existing low income areas such as Lanarkshire ('solidarity')</li> <li>A key industry for Scotland's wider Food and Drink strategy</li> <li>Tourism: aquaculture can be positive for tourism and create a 'living landscape', strong potential for aquaculture and tourism sectors to grow in parallel</li> </ul>
Scottish Government Environmental Objectives	<ul style="list-style-type: none"> <li>Recognised as having a robust regulatory regime and some of the highest environmental standards worldwide. Scottish aquaculture can further support Scottish Government in assisting a transition to a low carbon economy, cutting the carbon footprint of meat by up to 90% per portion.</li> </ul>
Strategic Development	<ul style="list-style-type: none"> <li>Scotland has a high-value industry for 'Brand Scotland' which has one of the strongest growth opportunities in the 21st Century. Global demand could rise to multiples of current production.</li> </ul>
Public / Wider Economic Benefit	<ul style="list-style-type: none"> <li>Aquaculture helps maintain the economic and social fabric of the Highlands and Islands area, maintaining rural populations.</li> </ul>
Value for the Highlands and Islands Region	<ul style="list-style-type: none"> <li>Minimum <b>2,800 jobs</b> across the supply chain, est. <b>4,700 jobs</b> generated across the wider HIE economy</li> <li>Production GVA of approx. <b>£150m</b></li> </ul>

<sup>ii</sup> Values have been included only when attributable to Scottish aquaculture production rather than other income sources (e.g. processing non-Scottish product).

<sup>iii</sup> Employment figures include both FTE and part time jobs, since they are both considered suitable for different types of employees under a sustainable livelihoods model and not judged purely on financial income to the household.

<sup>iv</sup> Equivalent to 'farm-gate' though may include a variety of transport and processing arrangements depending on customer contract and company integration.



Benefit	Type / Magnitude of Value
	<ul style="list-style-type: none"> <li>Salaries: over <b>£60m</b></li> <li>Total aquaculture turnover of est. <b>£450m</b></li> <li>Highland and Island industry driving growth across Scotland.</li> <li>Provides high intensity benefit to 'fragile areas', providing youth employment and skills training.</li> <li>Strengthens the economic case for public service provision (education, ferry services) for remote populations (social and physical capital)</li> </ul>
Value to the Central Belt and North East	<ul style="list-style-type: none"> <li>Number of jobs challenging to estimate, but likely over <b>1,400</b></li> <li>Over <b>£450m</b> in turnover</li> <li>GVA of min. <b>£150m</b></li> <li>Central Belt and North East benefit from the Highlands and Islands farm production – this is a departure from the narrative that the Central Belt drives rural Scotland, and should aid Scotland's economic strategy of cohesion and solidarity.</li> </ul>



## 2. LITERATURE REVIEW: STATE OF THE AQUACULTURE INDUSTRY

The aquaculture industry is receiving increased attention in Scotland in relation to its ability to provide investment opportunities, job creation and skills development, particularly in rural communities. To this end Scottish Government supports aspirational industry growth targets for finfish and shellfish for 2020. In order to highlight the context in which this report is situated, a brief summary of the main findings to date are covered in this section. Some of the ways aquaculture has been analysed can be telling in itself: many sources compile aquaculture and fisheries data together, reflecting both the historical dominance of caught fish in comparison to fish farming and the ongoing convergent processing and supply chains.

Globally, Scottish production is at a small scale but is under close scrutiny and analysis relative to the colossal Asian volumes, since Scottish aquaculture is subject to high expectations regarding environmental, planning and quality standards. This scrutiny gives us detailed information on a rapidly evolving industry. Even information gathered in recent years cannot fully reflect the opportunities and challenges of the years between now and 2020.

### 2.1. PRODUCTION

Aquaculture is the driver of global fish production with supply from capture fisheries stagnant. In fact, aquaculture's contribution to global food fish supply for human consumption has risen from 9% to 47% from 1980 to 2010<sup>1</sup>. In Scotland, aquaculture takes place on 971 sites<sup>2</sup> which supply over 170,000 tonnes of salmon, mussels, trout and other species to market annually<sup>3</sup>. The total aquaculture industry output has an estimated farm-gate value of over £550 million<sup>4</sup>.

Farmed Atlantic salmon currently dominates the Scottish aquaculture industry with most recent figures suggesting that the produce at retail is worth in excess of £1 billion annually<sup>5</sup> (this is revised upwards in the following analysis). Scotland is currently the third largest producer of Atlantic salmon globally. A summary of the industry is given by recent Scottish Government data<sup>6</sup> which states that the industry is set to maintain its current position because production has been following an upward trajectory in recent years with 162,223 tonnes supplied in 2012, constituting a 2.7% rise from 158,018 tonnes in 2011. It should be noted that the total tonnage of salmon varies between total live weight and the weight of a salmon once it is harvested and is 'head-on-gutted'. This accounts for some variations in figures between industry figures and farm surveys. More broadly, the total volume equated to a 17,341t increase on the average annual production for the 2002-2011 period. Increased production has been achieved alongside systematic consolidation because since 2004 the number of companies in operation has decreased dramatically from 48 to 28 and the number of active sites has reduced by 42%. In 2012, 98% of production was generated by 8 companies. The production gains have in some studies<sup>7</sup> been attributed to technological improvements over the past 20 years.

In 2012, rainbow trout production<sup>8</sup> increased to 5,670t on 48 sites, up 22.8% from the previous year but down 949t from the previous 10 year average. Other finfish species that have been produced in recent years are brown/sea trout, halibut, wrasse, cod and arctic charr. However the figures for production of such fish are small (110t in 2013).

Scotland produces a variety of farmed shellfish species including pacific oysters, native oysters, king and queen scallops and mussels<sup>9</sup> which collectively have a farm-gate value of £8.7 million<sup>10</sup>, and a



post-processing value we estimated as close to £17million. Mussels are the dominant farmed shellfish species and output for the table has grown over the past 10 years from 3,632t in 2003 to 6,277t in 2012 with 69% of the 2012 output from farms on the Shetland Isles<sup>11</sup>. Pacific oysters are also produced on a large scale (2,706,000 in 2012) but in terms of global and EU production, Scotland is only a small contributor<sup>12</sup>. The industry is more traditionally structured than the finfish sector. Farms are more likely to be locally owned and hence they potentially give local people a more direct ownership stake in the industry, though its ‘cottage industry’ structure may limit the investment, wage and scale benefits in comparison to ‘large salmon’<sup>13</sup>.

## 2.2. MARKETS AND POTENTIAL EXPANSION

Demand for aquaculture produce, both globally and in the UK, is a relevant point for discussion when considering the Scottish industry and its potential expansion. The UK is very reliant on seafood imports to satisfy domestic demand (Figure 1) and hence there is an opportunity for the UK to pursue a market strategy of import substitution<sup>14</sup> as well as export-oriented growth. Note that this should not imply protectionism of any kind, but that domestic market share is being lost. The viability of this approach, i.e. making gains both domestically and internationally is significantly constrained by supply capacity and costs, making it (under the status quo) an ‘either-or’ decision.

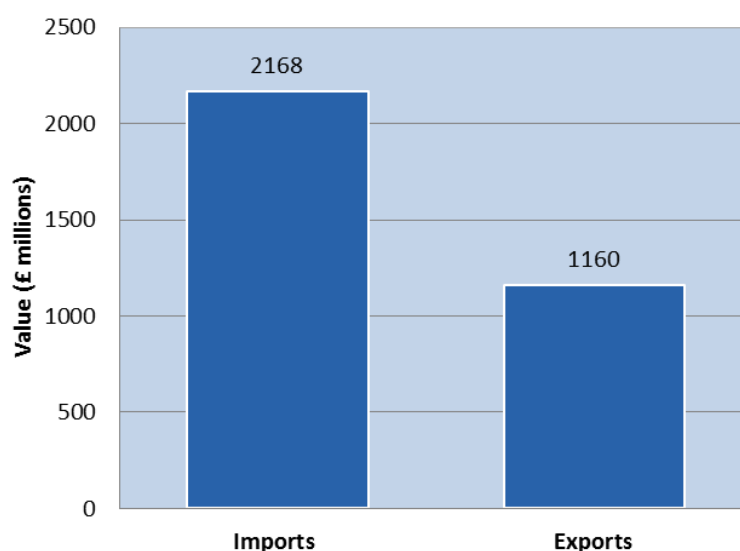


FIGURE 1: TRADE BALANCE FOR SEAFOOD IN UK, 2009. SOURCED FROM LEVERCLIFF (2011)

A reduction in supply of Atlantic salmon from Chile, the second largest producer of Atlantic Salmon, over recent years has resulted in an undersupply of produce to the market<sup>15</sup>. This has maintained an opportunity to avoid excessive price competition and a gap for Scottish producers to fill both in the internal and the external market<sup>16</sup>. Exports of salmon out of the UK in 2012 reached a total volume of 103,592 tonnes at a value of £464 million<sup>17</sup>. This equates to the majority of earnings from UK aquaculture exports and 34% of total UK seafood export earnings<sup>18</sup>. The USA, France, Irish Republic, China and Poland make up the top five destinations for salmon<sup>19</sup>. Markets such as China have provided new export opportunities because there has been a sharp increase in seafood consumption, particularly of luxury goods like smoked salmon<sup>20</sup>.

Similarly, Scottish shellfish commands a premium in the vast (>0.5 million t) European market for mussels, already well supplied by European mainland producers. However a recent surge in Chilean imports to meet supply deficits may reduce opportunities for Scottish producers<sup>21</sup>. Currently UK



consumption of mussels is about 0.3kg per capita compared to 2kg in France and 4-5kg in Belgium which suggests that there is room for expansion in domestic consumption<sup>22</sup>. This may explain the success of retailers' campaigns for mussels such as Sainsbury's recent "Switch the Fish" campaign in partnership with the Scottish Shellfish Marketing Group (SSMG)<sup>23</sup>. Producing cooked convenience goods could be one way of accessing the domestic market more effectively<sup>24</sup>. Whilst there are fairly restricted opportunities for development of new inshore and offshore sites due to a combination of environmental and economic barriers, some research has shown that there is scope for growth in the industry via increased efficiency in utilising the capacity of existing sites. For example, in 2008 the average production on existing sites was only 9t/200m longline which was poor in comparison to the typical industry yields of 40t/line, thereby suggesting there are potential gains to be made<sup>25</sup>. However, development of production capabilities would likely cause a decrease in the sale price for producers and hence efficiency gains (and increased marketing effort) will be required for producers to remain profitable<sup>26</sup>.

Despite the fact that trout is a healthy and affordable species, demand for trout in the UK is struggling due to competition from salmon. However, Levercliff market analysis states that trout could potentially be used to supply 2.1% of the chilled fish market in the UK which would amount to an estimated £10.5 million in sales of value added produce. To achieve this, the Scottish producers need to invest in marketing to endorse the provenance and quality of Scottish trout<sup>27</sup>.

### **2.3. INDIRECT BENEFITS**

The potential unseen, or indirect, economic impacts of fish farming activity in Scotland encompasses a broad range of factors. For example, there are the benefits that fish farming companies bring if they utilise the goods and services provided by local companies in carrying out their routine operations. For instance, once farmed, salmon distribution is predominantly managed via a network of refrigerated trucks and the ferry services to and from the islands<sup>28</sup>. The Scottish Salmon Company claims to have spent £1.2 million in this way on their operations on the Western Isles in 2011 alone<sup>29</sup>. SSPO states that overall expenditure on suppliers and services for the salmon industry in 2011 was £435.7 million<sup>30</sup>.

The hope is that in the same way that the Chilean salmon farming industry has been praised for reducing the poverty levels in the affected communities<sup>31</sup>, the Scottish aquaculture industry can also provide improved living standards for the Scottish population. In Chile, some of the attributed benefits have been brought about by the industry's expenditure on goods and services in the local area. For example, egg producers, feed manufacturers and service providers have developed in the region which has provided additional jobs for young professionals in a rural community<sup>32</sup>.

A further indirect advantage of aquaculture to the Scottish economy is that it encourages the development of associated local industries. For example, there is some evidence that tourism businesses can benefit from the presence of a fish farm because it may provide a good point of interest for wildlife tours and supply local high quality produce<sup>33</sup>.

The indirect benefits of aquaculture are largely unreported in the literature, but are an important focus of this study, both in terms of the economics and value chains (Sections 5, 8 and 10) and through the Sustainable Livelihoods Approach (Section 6).



## 2.4. AQUACULTURE IN THE COMMUNITY

The importance of engaging with local communities has been recognised by many of the aquaculture companies operating in Scotland. The majority are engaging with communities by default through employment and maintaining operations within fragile rural areas, which subsequently benefit the local community through shops, schools and other services which can survive as a result of a strengthened economy and local population. However, a number of specific Corporate Social Responsibility (CSR) schemes have been established in order to engage with communities, with a few examples given below – this is by no means an exhaustive list, but serves to illustrate some examples:

Scottish Sea Farms have a ‘Heart of the Community’ grant programme<sup>34</sup>, which provides financial grants for community development projects which would deliver “lasting change”. Grants are offered through the criteria of: Health and health promotion, Education with schools and for life-long learning, Personal development that leads to enhancement of the community, Community projects that benefit the majority.



Marine Harvest have company-wide quality control system, QMarine<sup>35</sup>, which includes guidelines on how the company invests and engages with local communities in areas surrounding its operational units. As well as local community support through sponsorship and funding, Marine Harvest are best recognised for their support of the Shinty league - 2013 was the 25th anniversary of this sponsorship arrangement.



Meridian<sup>36</sup> (now sold to Marine Harvest) also have an active CSR policy including sponsorship of local school and charitable activities and donating to Gaelic and traditional music initiatives.

Loch Fyne Oysters are another independent organisation who place strong emphasis on commitment to sustainability and people. Their commitment is highlighted through their Gaelic philosophy of ‘Nach Urramach an Cuan’ (How worthy of honour is the sea), which encapsulates respect for animals, people and ecology<sup>37</sup>. The Loch Fyne Marine Trust is the arm through which the funds from a levy on Loch Fyne Home Delivery sales are distributed to work to relieve poverty, enhance education attainment and the protection of the environment in Scotland (particularly in the local area)<sup>38</sup>.

CSR is integrated into the operational side of the Scottish Salmon Company through their Pride, Passion, Provenance scheme (Pride of the Company, Passion of the People, Provenance of the Product)<sup>39</sup>. The scheme acknowledges the importance of social sustainability and the importance it plays in the sustainability of the business, particularly in rural communities where they operate. Specific examples of this investment include the ‘Healthy Living Initiative’ and the ‘Gaelic plan’ for the company in the coming years.



Loch Duart Salmon is an example of a smaller company that takes pride in its commitments to remain small and independent. As a result they have a slightly different approach to the large-scale corporate CSR branding: they invest directly in local communities through employment and are also investing in projects in developing countries through partners such as HIK Abalone Farm (Pty) Ltd in South Africa and in Mozambique<sup>40</sup>.



## 2.5. INTERNATIONAL COMPETITIVENESS

Scotland's aquaculture industry is founded on continuing demonstration of *quality differentiation and good practice* with regards to farm handling techniques and sustainability<sup>41</sup>. It is these elements that allow for the provenance of Scottish aquaculture to translate into increased sales and revenue from retailers in the UK and elsewhere<sup>42</sup>. Whilst the industry used funding post the 2003 price drop for marketing purposes<sup>43</sup>, it has not tended to independently conduct marketing campaigns which would allow for it to fully capitalise on the added value associated with its Scottish origins. Furthermore there is little promotion of Scottish seafood products (including farmed salmon) in the supermarket when compared to other products such as meat and vegetables<sup>44</sup>. This may be a function of industry ownership structures, where valuing Scottish salmon above that from other sources is welcome at a national company level, but may be strategically limiting for a Norwegian owner seeking to promote multiple sources of salmon production.

Scotland in production terms is languishing behind competitors that are cheaper and growing far more rapidly: Norway, the salmon industry leader, is growing annually by approximately the total present Scottish production (Figure 2). Some suggest this is because funding availability has allowed them to be the frontrunner in the industry in terms of technical developments since the early 1980s and they have also developed advanced infrastructure<sup>45</sup>. Chilean salmon production has seen a significant rise over the past 20 years so that it has become one of Chile's main export industries and a major contributor to regional development<sup>46</sup>. It has achieved this through effectively adopting new technologies, capitalising on its low labour and feed costs and strategic investment<sup>47</sup>, though its recent disease events have demonstrated the necessity for managing risk more effectively.

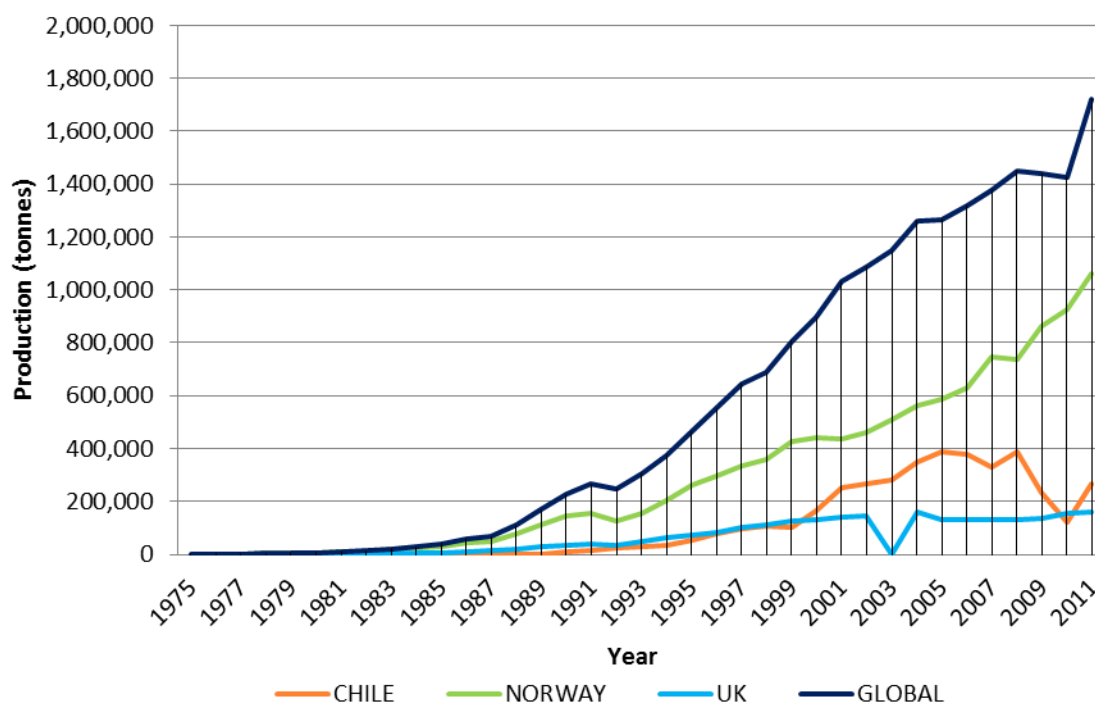


FIGURE 2: TOTAL SALMON PRODUCTION (SOURCED FROM FAO FISHSTAT)

The different salmon producing countries have approached regulation of the industry in differing ways and Scottish producers could be seen to be at a disadvantage because of the high





environmental monitoring and reporting requirements<sup>48</sup> and the uncertainty and delay associated with the planning procedure<sup>49</sup>. Poseidon (2008)<sup>50</sup> makes a clear comparison on this issue, saying:

*“In Norway, the periodic issue of production licences sends a clear and simple message: we wish to expand steadily and sustainably. Although there may still be uncertainties associated with specific sites there is a general presumption that development will take place. This contrasts with Scotland where there is no such presumption, and there is often a negative reaction to further development, especially amongst the local population. There is a real need to create a more positive development and investment climate if the Scottish industry is to expand sustainably.”*

Scottish producers may also face higher costs in terms of expenditure on medicines, feed and smolts, and in being unable to exploit economies of scale in the same way due to reduced site capacity on average<sup>51</sup>.

Taking mussel production as an alternative example, currently production is relatively expensive in comparison to elsewhere in Europe due to slow biological growth, use of more costly production methods and higher wages<sup>52</sup>. Furthermore, whilst production of mussels has shown the strongest growth in comparison to other shellfish, recent production figures could have been higher had the industry not been affected by environmental variations such as spat settlement patterns<sup>53</sup>. To improve competitiveness, cost reductions are required and these could be achieved using newer technologies or increasing cooperation so that sites share expensive equipment<sup>54</sup>.

## **2.6. EMPLOYMENT**

The Scottish aquaculture industry has often been highlighted for its ability to improve job prospects for employees at a range of skills levels in vulnerable remote communities which are otherwise challenged in terms of business development opportunities and hence are at risk of suffering from population decline<sup>55</sup>. For instance, in 2010-2011 aquaculture was known to employ 3.3% of the population on Shetland (350 people) directly, almost double that of the agriculture industry<sup>56</sup>. Furthermore, other related industries also employed a high volume of people, for example, fish processing provided 260 jobs and marine engineering employed 441<sup>57</sup>. The industry has contributed to the stabilisation of productivity and living standards at 70-80% of the Scottish average in some otherwise marginal communities, and alongside some other industries, such as agriculture and energy generation, has helped to counteract population decline in fragile and remote areas<sup>58</sup>.

Scottish Government farm production surveys show that 1,898 people were employed in 2011/12 across finfish and shellfish species, including smolt production. This is equivalent to roughly half the number provided by the fishing industry and 2.5% of those provided by the energy sector<sup>59</sup>. To give an indication of how this breaks down by species, the total number of staff employed solely in salmon production in 2012 was 1,059, representing an increase of just under 5% on 2011<sup>60</sup>, with the number in shellfish farming rising by 4% across the year to 358 in 2012<sup>61</sup> (and the remainder being rainbow trout, other finfish and shellfish. The proportion of staff that were employed fulltime in 2012 varied between 89%, 74% and 48% for salmon, rainbow trout and shellfish respectively<sup>62</sup>. Significantly, the SSPO figure totalling 2,200 employees among members includes management, administration and some processing: this is considered a better figure on which to base the direct employment impact not just ‘on-farm’ but including ancillary staff necessary to generate farm production.



## 2.7. PUBLIC PERCEPTION

A study in 2009 found that public attitudes in Scotland towards salmon farming development are formed by combining the value that individuals attach to the economic benefits of industry development (e.g. job creation) with the perceived negative impacts on other factors such as the environment<sup>63</sup>. This finding has been echoed in other countries, for example a study focusing on perceptions of the aquaculture industry in the UK, Germany and Norway stated:

*"[Aquaculture] is presented as a complex activity comprising health, environmental, economic and socio-organizational dimensions. Of those, only economic themes are more often framed in terms of benefit rather than risk. As such aquaculture has an overall negative representation in the media."*<sup>64</sup>

The aquaculture industry has faced criticisms in academic journals and in the media in relation to its environmental impact primarily on account of: impact of escaped salmon from fish farms on the health of wild salmon<sup>65 66</sup>, the adverse effects of the chemicals used to control the spread of disease and sea lice and impacts of such problems on the wellbeing of the fish themselves<sup>67 68</sup>, the carbon footprint of the fish farming activities<sup>69 70 71</sup>, and the quality of feed alternatives given the limited supply of fishmeal and fish oil<sup>72 73</sup>. Whilst the industry must take responsibility for the negative impacts that it has on the environment, some have argued that the industry has failed to communicate with consumers to the same level that critics have, and hence consumers have not been presented with a balanced picture. Indeed a report commissioned by Marine Scotland noted that:

*"Retailers tended to feel that the industry is not good at communicating, with either the retailers themselves or more widely to consumers and the general public. Some felt the industry is vulnerable to attack in the media and does not do enough to prepare for or respond to attack."*<sup>74</sup>

Whether consumers have responded to the increased information on potential environmental concerns by purchasing less Scottish farmed fish is an important question to ask in response to these issues. Consumer research suggests that there has been a recent shift in consumer preferences so that the majority of UK customers are more concerned about the quality, source and sustainability of the goods that they buy<sup>75 76</sup>. These "greener" consumers, who may have concerns about the environmental performance of salmon farms, have in some cases been proven to be less likely to purchase salmon<sup>77 78</sup> or more likely to purchase wild rather than farmed fish<sup>79</sup>. Alternatively, as research from Canada has shown, some environmentally conscious consumers would be willing to pay more for seafood products that are farmed using more sustainable methods such as Integrated Multi-Trophic Aquaculture (IMTA)<sup>80</sup>. However, in other cases, such as on the issue of feed sustainability, consumers have been shown to be less concerned by the environmental issues. For instance, plant materials as substitutes are acceptable for the majority of consumers so long as the quality and health benefits of the end product are not impacted<sup>81</sup>. Public perceptions of the environmental performance of aquaculture are likely to have some impact on the industry's development plans and so must be better understood.

In a similar way, the media in some countries has been found to unfairly over-dramatise the negative health risks for consumption of farmed fish without highlighting the many positive health benefits that are associated with eating fish<sup>82</sup>. Therefore they could be criticised for not presenting the public



with a balanced overview and the public could have a negative overall perception of the impact of fish farming on individuals' health.

A final criticism that the aquaculture has faced is that it has an adverse effect on the tourism industry. This is because some are concerned that the negative visual impact of fish farms on the natural scenery is detrimental to the further development of the tourism industry in coastal regions. Some studies have provided support for this concern: for instance a study that focused on the Outer Hebrides, Shetland and Oban and Mull found that approximately half of the visitors interviewed said that future expansion of fish farms would negatively impact their willingness to revisit the area<sup>83</sup>. However, results have been mixed, for instance in one case the tourists interviewed showed an appreciation of the importance of the industry to the area from an economic perspective and stated that, on the whole, they do not perceive fish farms to be visually negative or off-putting<sup>84</sup>.

The picture of public perceptions from the literature suggests that in some cases, people have been subjected to unbalanced arguments in the media about the risks associated with the aquaculture industry. Improved communication about the available scientific data could in these instances prove useful and would be to the benefit of the aquaculture industry overall<sup>85</sup>.

## 2.8. SWOT ANALYSIS: AQUACULTURE INDUSTRY

A summary of the literature review findings is given in the below SWOT analysis developed by Levercliff (2011)<sup>86</sup>.

STRENGTHS	WEAKNESSES
<ul style="list-style-type: none"><li>• Scotland has the most developed aquaculture sector within the UK</li><li>• Well regulated industry –responded well to salmon anaemia outbreak</li><li>• Scotland has a strong association with Seafood</li><li>• Excellent water quality Vs. the rest of the UK – a large number of 'A' classified waters</li><li>• A leading producer of salmon in the EU</li><li>• A leading producer of trout in the UK</li><li>• A leading supplier of sustainable and good quality shellfish</li></ul>	<ul style="list-style-type: none"><li>• Poor perception of aquaculture within the press and among key opinion formers – specifically salmon</li><li>• Poor economies of scale in relation to other international countries – especially shellfish</li><li>• Lack of availability of finance for sectors dominated by smaller companies</li><li>• Colder waters which contribute to slow growth</li><li>• Not all sectors are as technologically advanced as salmon</li><li>• Lack of investment in consumer marketing</li></ul>
OPPORTUNITIES	THREATS
<ul style="list-style-type: none"><li>• There is strong demand for certain species produced in Scotland</li><li>• Ability to get live and fresh fish to the consumer within 24 hours of capture/harvest within the UK and support high quality of raw material with quality assurance measures</li><li>• Potential to add further value to seafood production</li><li>• Increased desire for locally produced products from consumers and increased focus on regional sourcing by major retailers and foodservice operators</li></ul>	<ul style="list-style-type: none"><li>• Failure to continue to improve the sustainability of production going forward</li><li>• Cheaper imports</li><li>• Quality perception of wild fish</li><li>• Quality perception of farmed fish from other countries – specifically Ireland</li><li>• A Stagnant economy</li></ul>

FIGURE 3: SWOT ANALYSIS OF THE SCOTTISH AQUACULTURE INDUSTRY



### 3. EXISTING POLICY

#### 3.1. CURRENT SCOTTISH AQUACULTURE POLICY

Current Scottish aquaculture policy is based upon 'A Fresh Start: The renewed strategic framework for Scottish Aquaculture' (2009)<sup>87</sup>, largely guided by the Scottish Government's Economic Strategy<sup>88</sup>. Within this document a number of challenges were identified which underpin the sustainable growth of an industry which is recognised as providing significant socio-economic benefits particularly to rural communities. 'A Fresh Start' is a statement of intent for a renewed aquaculture framework based on six themes: healthier fish and shellfish, improved systems for licensing aquaculture developments, improved containment, better marketing and improved image, improved access to finance, and a Shellfish Forum. Through these key themes, it is hoped that a long-term future for the industry will be secured by e.g. the adoption of disease and parasite-control strategies as well as causing minimal impact on the environment; locating sites in the least adverse locations in terms of impacts on marine and freshwater users; and by promoting a positive image of the industry and focusing on the Scottish 'quality' product. Furthermore, the policy also highlights the importance of a greater focus on education, training and making the best use of research and development as well as new technologies.

Scottish Government continues to be supportive of growing a competitive and sustainable aquaculture sector in Scotland. The latest in a series of reforms is the Aquaculture and Fisheries (Scotland) Act that commenced in September 2013 to ensure farmed and wild fisheries – and their interactions– continue to be managed effectively. The Act legislates that farmers within farm management areas must be party to a fish farm management agreement that regulates fish management, movement, parasites and fallowing arrangements. It also reforms arrangements concerning the protection of shellfish waters and the management of wild capture fisheries.

Building upon the existing regulatory framework, a recent development A Ministerial Group for Sustainable Aquaculture (MGSA)<sup>89</sup> chaired by the Minister of Environment and Climate Change and comprising industry and other stakeholders was established in May 2013 to facilitate industry to achieve their 2020 sustainable growth targets – with due regard to the marine environment - (marine finfish production sustainably to 210,000 tonnes and shellfish, particularly mussels, to 13,000 tonnes by 2020 as set out in the Scottish Marine Plan consultation in 2013) through seven focused working groups.

MGSA is chaired by the Minister of Environment and Climate Change with membership comprising, government, industry, wild fish interests, environment NGOs and regulatory bodies; and progressed through seven working groups:

- Science & Research Working Group - will produce a draft national aquaculture research strategy defining medium (5 years) to long term (20 years) vision and research requirements by Spring 2014.
- Containment Working Group – will deliver a Scottish Technical Standard for fish farm equipment and associated guidance including training requirements by 2015.
- Wellboats Working Group - is developing standards for wellboats in relation to tracking position, valve status and filtration to remove sea lice.
- Interactions Working Group - established against a background of some debate between interested parties as to the best way to address a number of interaction related issues.



Currently considering how best to progress a number of workstreams , with an initial focus on improving dialogue at a local level.

- Farmed Fish Health & Welfare Working Group will develop standards of best practice for the use of wrasse; introduce thresholds for mortality reporting in freshwater finfish production; see a disease prioritisation exercise conducted for trout farming, and review mortality disposal.
- Shellfish Working Group - building on the work of the Shellfish Forum to identify and resolve key bottlenecks to delivery of the shellfish industry's 2020 sustainable growth target and beyond.
- Capacity Working Group – is developing a programme to identify and resolve constraints on growth, including infrastructure bottlenecks, spatial issues, business and investor confidence and community engagement, to deliver the right sites in the right places through transparent, streamlined and proportionate regulation and processes.

Scotland is also in the process of developing a Seaweed Policy Statement, currently under consultation, with the potential for seaweed cultivation to be made a licensable marine activity<sup>90</sup>.

### **3.2. THE EXISTING LEGISLATIVE FRAMEWORK**

Aquaculture policy is spread across a number of institutions in Scotland and is extensive in scope. To date, aquaculture in Scotland has been highly regulated but legislation has been fragmented and generally suffers from a lack of integration both within and external to the sector.

A number of bodies are responsible for aquaculture in Scotland. In terms of planning for development Marine Scotland, the Crown Estate, the Scottish Environment Protection Agency (SEPA) and local planning authorities are involved, largely during the consenting process. Scottish Natural Heritage (SNH) must also be consulted before consents are granted. The Fish Health Inspectorate (Marine Scotland), SEPA, the Health and Safety Executive, the Food Standards Agency (FSA) and local authorities are involved in the operational aspect of aquaculture.

The authorisation for aquaculture must be obtained from a number of organisations. The *Crown Estate Act 1961* requires that anyone wishing to establish a marine fish farm/shellfish farm must apply for a lease of the seabed and the foreshore. Planning permission for new farms, or modifications to existing ones, must be made to the relevant local planning authority under the *Town and Country Planning (Scotland) Act 1997 (amended by the Planning etc. (Scotland) Act 2006)*. The Act is the principal legislation covering the planning system in Scotland. The *Town and Country Planning (Marine Fish Farming) (Scotland) Regulations 2007* and the *Town and Country Planning (Marine Fish Farming) (Scotland) Amendment Regulations 2012* lay down specific assessment criteria for aquaculture. Any activity which is liable to cause pollution of or have any significant adverse impact on the water environment also requires authorisation from SEPA under the *Water Environment (Controlled Activities) (Scotland) Regulations 2011*. Last but not least, all businesses keeping aquatic animals must be registered under the *Aquatic Animal Health (Scotland) Regulations 2009 (amended 2011)* the aim of which is to encourage bio-security, harmonised trade rules and effective disease control measures.

The majority of operational legislation is fragmented across different management approaches. Effluent discharges and disposals of pesticides into the water environment, are regulated under the *Water Environment (Controlled Activities) (Scotland) Regulations 2011*, and a discharge licence required. Pollution caused by specific dangerous substances discharged into the aquatic



environment is dealt with by the *Surface Waters (Dangerous Substances) (Classification) Regulations 1992* (transposing Council Directive 76/464/EEC). This requires the Scottish Environment Protection Agency (SEPA) to monitor water quality in the vicinity of discharges.

The *Aquatic Animal Health (Scotland) Regulations 2009 (amended 2011)* require all businesses keeping aquatic animals to be registered. These Regulations implement Council Directive 2006/88 on animal health requirements for aquaculture animals to prevent and control certain diseases, making it an offence to place any aquaculture species on the market unless it is clinically healthy. Furthermore, the *Aquatic Animal Health (Miscellaneous modifications) (Scotland) Regulations 2011* amends the above regulation and imposes obligations on the operators of businesses and processing establishments to compile records, notify the competent authority regarding escapes of fish, and recover fish using best practice methods. Two key authorities are responsible for fish movement and disease control in Scotland: the Fish Health Directorate and the Food Standards Agency (FSA).

Medicines for animal use are subject to a system of licencing laid down in a multitude of EU regulations which is implemented through the *Veterinary Medicines Regulations 2011 (amended 2012)*. Specifically, this regulates the supply and possession of veterinary medicinal products and requires records to be kept. The Veterinary Medicines Directorate within the Department for Environment, Food and Rural Affairs (DEFRA) is the responsible authority, although the Fish Health Inspectorate carries out inspections of fish and shellfish farms for medicine residues.

Manufacture, distribution and use of feed, including the substances and products used in manufacturing feed is addressed at the UK and EU levels. The principle regulations are the *Animal Feed (Scotland) Regulations 2010* which implement EU Directive 767/2009 which cover the marketing, labelling, composition of animal feeding stuffs and authorised additives that may be incorporated into animal feed. Medicated feeding stuffs are regulated at UK level through the *Medicines (Medicated Animal Feeding Stuffs) Regulations 1992 (amended 1997)*. These govern the preparation, placing on the market and the use of medicated feeding stuffs. Responsibility for the regulation and use of animal feeding stuffs in Scotland rests with the Food Standards Agency Scotland (FSAS).

The *Aquaculture and Fisheries (Scotland) Act 2007* introduced regulations affecting a number of legislative areas relating to aquaculture operation including controlling parasites on fish/shellfish farms, prevention of escapes and the containment and treating of disease.

The *Aquaculture and Fisheries (Scotland) Act 2013* will make further provisions about some operational aspects of aquaculture including a legal requirement for fish farms within a Farm Management Area to operate under Farm Management Agreements or Farm Management Statements which are agreements between two or more persons fish farming within a management area and must cover arrangements for fish health management, management of parasites, movement of live fish on and off of the farms, harvesting of fish and fallowing of farms.

### **3.3. WIDER POLICY AFFECTING SCOTTISH AQUACULTURE**

#### **3.3.1. MARINE PLANNING IN SCOTLAND**

There have been important reforms to marine planning in the Scottish and UK context. The concept of Marine Spatial Planning (MSP) has evolved over the past decade with significant input from marine resource users including the aquaculture sector. The concepts surrounding MSP were





debated initially through the AGMACS (Advisory Group on the Marine and Coastal Sciences), and later the Marine Strategy Forum and, experimentally, the SSMEI (Scottish Sustainable Marine Environment Initiative) that established 5 pilot schemes (Clyde, Solway, Sound of Mull, Shetland, Berwick). The discussions resulted in considerable learning and contributed to the enshrinement in law of a Scottish marine planning process through the *UK Marine and Coastal Act 2009* and the *Marine (Scotland) Act 2010*. These recent legislative reforms put in place a framework for planning to occur and a process for decision making and consultation – they do not provide detailed guidance on how plans should be made and their content. Therefore marine planning in Scotland, despite its importance for the aquaculture sector, faces a number of uncertainties in terms of the exact structure of the process and the ramifications for the sector.

The current approach to marine planning in the UK and Scotland identifies three tiers of strategic relevance. The **Marine Policy Statement (MPS)** is an agreement between all UK Administrations and establishes a common vision for UK seas: clean, healthy, safe, productive and biologically diverse. The MPS was jointly adopted by all UK administrations with the purpose of ensuring a consistent UK vision and policy context for marine planning including the delivery of the EU Marine Strategy Framework Directive. The MPS articulates a series of high level principles (High Level Marine Objectives) for marine planning and all plans developed in the UK must be in accordance with these principles. It also specifies coherence between existing UK plans, for example between cross border regions.

In Scotland the **National Marine Plan** sets out objectives and policies for the sustainable use of Scotland's marine environment out to 200 nautical miles. The *Marine (Scotland) Act 2010* empowers the NMP to manage maritime activity out to 12 nautical miles while the *UK Marine and Coastal Act 2009* extends coverage to the limits of the exclusive economic zone (200 nautical miles). The NMP espouses the principle of sustainability as its primary goal where pressures on ecosystems do not cause a reduction in goods and services; where the pressure of human activities does not compromise capacity of marine ecosystems to respond to human induced changes; and where activities are kept within levels compatible with the achievement of good environmental status under the MSFD.

The policy objectives contained within the plan will need to be incorporated into the decision making framework of relevant authorities. Both the Scottish and UK Acts specify that public authorities must take authorisation or enforcement decisions in accordance with the NMP unless relevant considerations indicate otherwise. Authorities must also refer to the Plan in taking other decisions if they impact on the marine area. In the context of aquaculture this will set the context for future development consents for finfish, shellfish and potential algae farms as existing planning legislation has been amended to direct relevant authorities to take into account the objectives of the NMP when developing planning instruments.





The (draft) NMP has a chapter dedicated to the aquaculture sector and updates many of the themes expressed in the 2009 'New Start' policy, adding additional detail to reflect the current policy climate. These objectives are summarised in Box 1 below.

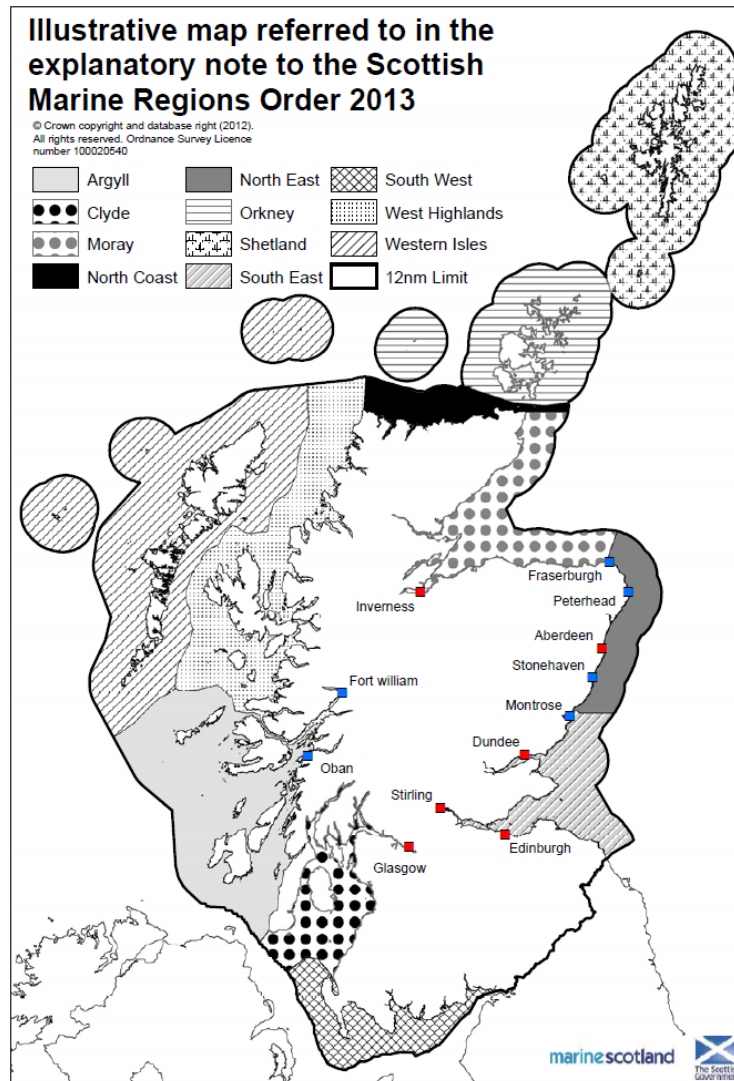
**BOX 1. NMP OBJECTIVES FOR AQUACULTURE**

- Ensure an appropriate and proportionate regulatory framework within which the industry can achieve sustainable growth targets.
- Support the industry and other stakeholders to increase sustainable production by 2020 (from a 2011/2012 baseline) of:
  - marine finfish to 210,000 t (159,269 t in 2011);
  - domestic juvenile salmon production to satisfy the salmon sector growth aspirations;
  - shellfish, especially mussels, to 13,000 t (6525 t in 2012).
- Secure quality employment and sustainable economic activity in remote and rural communities.
- Improve business confidence and industry investment by identifying areas where sustainable aquaculture growth is optimal.
- Maximise benefits to Scotland from the Scottish aquaculture value chain.
- The oyster sector should ensure security of supply through, for example, the development of a biosecure hatchery facility for Pacific oysters.

**Particular focus is given to:**

- pursuing prospects and opportunities for growth of the trout and shellfish sectors;
- supporting diversification to other species such as halibut production;
- developing seaweed production for a variety of products as well as in integrated multi-trophic aquaculture systems where the by-products from one species are recycled to become inputs for another.

The NMP and the broad national objectives for aquaculture will need to be operationalised at the regional scale by the development of **Regional Marine Plans**, legislated under the *Marine (Scotland) Act* and spatially designated by secondary legislation (Figure 4 below). Within these regions, RMPs will be developed by Marine Planning Partnerships to take account of local circumstances but must be developed in alignment with the National Marine Plan and will be subject to public consultation and adoption by Scottish Ministers.



**FIGURE 4: PROPOSED MARINE REGIONS UNDER THE SCOTTISH MARINE REGIONS ORDER 2013.**

Six regional plans will potentially guide aquaculture on the West Coast, Outer Hebrides and Northern Islands of Scotland. Ensuring consistency of regulation and management is a considerable challenge. Plans will be phased in at different times around Scotland with an indicative view that this will entail 2 plans per annum subject to resources. There is currently a lack of clear or specific guidance as to what the plans will entail: from setup, institutional rules, extent of spatial zoning, regulatory impact and monitoring and enforcement. Taking the previous SSMEI pilots and a recent Scottish Coastal Forum paper on institutional design into account, an educated guess into the impacts of regional plans for aquaculture can be observed including:

- An overall objective to increase aquaculture production in key sectors (salmon, mussels) within the carrying capacity of regional coastal systems;
- Further development and diversification of the sector including new species (seaweeds, halibut) and development of polyculture through expansion of IMTA;
- Spatial zoning of preferred sites for aquaculture and regulation of interaction and integration with other sectors including fisheries, recreation, tourism and conservation;
- Moving offshore into larger production units that minimise impacts on coastal systems;
- Further incorporation of landscape and seascape issues into aquaculture planning;



- Location of aquaculture sites within and adjacent to marine conservation designations, in particular Nature Conservation MPAs under the *Marine (Scotland) Act* and consequent planning and management implications.

### **3.3.2. SCOTTISH NATURE CONSERVATION MPAs**

The emergence of Nature Conservation MPAs under the Marine (Scotland) Act 2010 complements an existing suite of EU designations from the Habitats and Birds Directives (Special Areas of Conservation and Specially Protected Areas) to form an ecologically coherent network at the Scottish and UK scale. The process of designation has evolved over a number of years, in particular the five stakeholder workshops delivered across 2011/ 12 to determine the spatial extent and characteristics of the proposed MPA network. The project is led by Marine Scotland in partnership with, Scottish Natural Heritage (SNH), the Joint Nature Conservation Committee (JNCC), Historic Scotland, the Scottish Environment Protection Agency (SEPA) and Marine Scotland Science.

In December 2012 proposals for a network of MPAs surrounding Scotland were reported to the Scottish Parliament. The report from Marine Scotland<sup>91</sup> outlined advice on the selection of proposed MPA sites for Scotland, reporting on the progress of the two year process to design an MPA network. The boundaries of the proposed MPAs were submitted to public consultation in 2013 as a part of the 'triple policy' consultation that delivered the draft NMP, Wind, Wave and Tidal Plan and the MPA Overview. The consultation closed in October 2013 and the final decision on the shape of the network is expected in early 2014.

There are currently 37 proposed Nature Conservation MPA sites, including 4 locations to be further assessed, in addition to the stock of existing European and UK sites (e.g. 46 existing SACs with marine components). A further two Demonstration and Research MPAs are being reviewed. The new Nature Conservation MPAs, if designated, would represent 12% area coverage of Scotland's seas, increasing the overall spatial protection to 20% for a range of identified 'priority marine features'. There are a number of overlaps in the west and north with existing or potential farming sites. Where farming can potentially impact a feature of conservation significance – a priority marine feature – intervention in the form of management will likely be required. MPAs will be managed to achieve their conservation objectives, using the principle of sustainable use. This means that only activities that present a risk of hindering the achievement of the conservation objectives will have specific management measures implemented. The MPA proposal<sup>92</sup> highlights that over a period of 20 years in the 'intermediate' or most likely scenario an aggregated impact of £ 0.61 million would be expected – a relatively minor impact on the industry in Scotland over time. Table 1 highlights MPAs on the West Coast, protected features and the likelihood of management interaction. Note the final designation of site is subject to ministerial approval in 2014.



**TABLE 1. MPAS ON THE WEST COAST**

Site	Features Protected	Likelihood of Management Intervention
Clyde Sea sill (CSS)	Biodiversity: Black guillemot, fronts, and circalittoral and coarse sediment communities.	Unlikely
Fetlar to Haroldswick (FSS)	Biodiversity: Black guillemot, circalittoral sand and coarse sediment communities, horse mussel beds, kelp and seaweed communities on sublittoral sediments, maerl beds, and shallow tide-swept coarse sands with burrowing bivalves.	Likely
Loch Creran (LCR)	Flame Shell Beds.	Likely
Lochs Duich, Long and Alsh (DLA)	Burrowed mud and flame shell beds.	Likely
Loch Sunart (LSU)	Flame shell beds, northern feather star aggregations on mixed substrata and serpulid aggregations.	Likely
Loch Sunart to the Sound of Jura (SJU)	Common Skate.	Unlikely
Loch Sween (LSW)	Burrowed mud, maerl beds, native oysters, and sublittoral mud and mixed sediment communities.	Likely
North West Sea Lochs and Summer Isles (NWS)	Burrowed mud, circalittoral muddy sand communities, flame shell beds, kelp and seaweed communities on sublittoral sediments, maerl beds, maerl or coarse shell gravel with burrowing sea cucumbers, and northern feather star aggregations on mixed substrata.	Likely
Small Isles (SMI)	Black guillemot, burrowed mud, circalittoral sand and mud communities, fan mussel aggregations, horse mussel beds, northern feather star aggregations on mixed substrata, northern sea fan and sponge communities, shelf deeps, and white cluster anemones.	Likely
South Arran (ARR)	Burrowed mud, herring spawning grounds, kelp and seaweed communities on sublittoral sediments, maerl beds, maerl or coarse shell gravel with burrowing sea cucumbers, ocean quahog, seagrass beds, and shallow tide-swept coarse sands with burrowing bivalves.	Likely
Upper Loch Fyne and Loch Goil (LFG)	Burrowed mud, flame shell beds, horse mussel beds, ocean quahog, and sublittoral mud and mixed sediment communities.	Likely
Wyre and Rousay Sounds	Kelp and seaweed communities on sublittoral sediment, and maerl beds.	Likely



## 4. METHODOLOGY

### 4.1. INTRODUCTION

An industry's nominal value is that which it adds to its inputs: giving the Gross Value Added (or GVA) of the industry. However, this study has looked to understand the full value of aquaculture production in Scotland, including the value of associated economic, environmental and social impacts that are intrinsically dependent on the act of producing aquaculture products in Scotland.

The contribution of aquaculture to Scotland has been modelled using a '**Market Systems Approach**' (MSA)<sup>v</sup>: that is, seeing Scottish aquaculture within the international market, and subject to a range of institutions, the wider business operating environment, membership associations and infrastructure (with a particular focus on supply chains).

This study also considers export earnings and the level of foreign direct investment (and associated loss of direct profit) from the concentration of foreign ownership. However, the starting assumption of this analysis in looking at market concentration (and resulting loss of Scottish ownership) is that foreign, particularly Norwegian, companies have fulfilled a role that Scotland has, for reasons to be examined, failed to achieve.

For some products, the value chain by no means needs to be based in a particular place, but in the case of salmon and mussels in particular, the whole industry edifice largely depends (for price and marketing reasons) on parts of the value chain being geographically specific. Further, many of those parts of the chain which are not strictly geographically fixed (like high-value processing) remain in Scotland because of the human capital (skills, know-how, image, reputation etc.) The approach has therefore been widened to properly account for the directly associated aquaculture industry production; including fish feed supply, research and intellectual capital.

The **economic output** and contribution of the industry remains important in day-to-day company and industry-level decision-making. These have been analysed at regional and national levels, and the GVA of the industry in basic terms has been assessed using the 'Production Approach'.

Further, this study has taken a '**Sustainable Livelihoods Approach**' (SLA) where sustainability observes the rule that people are endowed with capabilities that allow them to make 'a good life': human capital, financial capital, physical capital, social capital and environmental capital', i.e. they have resources and skills at their disposal that characterise their wealth and livelihoods, not just a snapshot of one's bank account. For example, skills in marine engineering and veterinary practice should be considered a high value asset even if one was moving between jobs and has no immediate income; similarly a clean environment or access to broadband.

The project includes extensive qualitative and quantitative primary data collection through interviews and surveys as well as secondary data analysis. A thorough approach has been taken to ensure extensive consultation, inclusive of as many areas within the aquaculture industry as possible. The specific details of each interviewee have remained confidential, however some information in relation to sector and regional location has been included to provide relevant context. The benefits of the aquaculture industry to Scotland are considered through macro-analysis by

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<sup>v</sup> This approach builds on M4P methodology and in the Scottish context can be described as 'making markets work for people'.



modelling the community and regional impacts and therefore recognising the geographic diversity of the aquaculture sector.

## 4.2. METHODOLOGY

The methodology undertaken for this assignment was broken down into the four work packages as identified in Figure 5. The macro-level economic analysis was done through desk-based research and clarified through industry interviews both in person and via telephone and email. Value chain and SLA work was conducted through collection of primary data in two work streams – one meeting representatives from throughout value chains and a second undertaking regional and sub-regional interviews and surveys to gather community-level data. All of this information has then been combined using the value chain approach in order to achieve the final value matrix and policy recommendations.

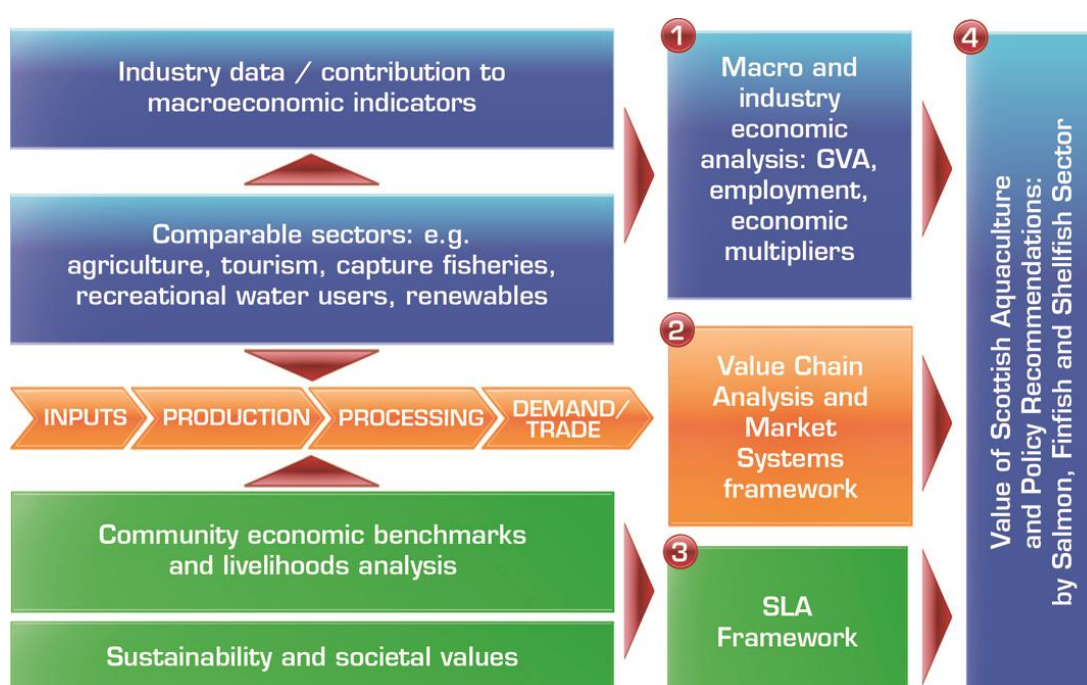


FIGURE 5: PROJECT ANALYTICAL FRAMEWORK (IEL, 2013)

**Macro-Level economics:** Macroeconomic industry assessment including quantitative analysis, industry and regional multipliers and linkages to other industries in the value chain.

① Reference to national, international and industry aquaculture statistics (e.g. Scottish Government statistics and FAO FishStat), national economic strategies, Companies House submitted accounts and direct interviews.

**Aquaculture Value Chain:** A Market Systems Approach analysing the whole market rather than just farm production, including supply chain mapping and interviews, geographic modelling, assessment of industry growth prospects and impact at scale.

②

**Communities and Sustainability:** A Sustainable Livelihoods Approach including in-depth regional interviews and surveys at chosen locations as detailed below.

③

**Value Matrix of Results:** A summary encapsulating all available benefits emanating from the aquaculture industry with reference to accompanying policy recommendations

④





As the Scottish Government's pre-consultation draft marine plan states that there should be a presumption against salmonid development on Scotland's North and East Coasts, the study has focused on four distinct regions, namely the Shetland Isles, Western Isles, Highlands and Argyll and Bute with focal points being Lerwick, Stornoway, Portree, and Lochgilphead.

The project was designed to include cross-cutting themes such as youth employment, community and regional development, sustainable and resilient growth and Global market linkages. A key focus has been placed on the HIE region in keeping with the HIE Operating Plan and reviewing how the aquaculture activities and outputs in the region fit within the picture of the wider Scottish economy.

### **4.3. FROM VALUE CHAIN TO SUSTAINABILITY**

The heart of the impact in relation to benefits of aquaculture and growth in aquaculture to Scotland relates to the communities who contribute to and benefit from the industry, from job creation in fragile rural communities through to manufacture of fish feed in the Central Belt. Whichever segment of the industry value chain is being considered, there is ultimately a corresponding community within Scotland that stands to benefit. The project has therefore sought to identify these communities provide an assessment of what benefits are felt and to what extent.

The methodology employed in this report seeks to ground the financial outputs from aquaculture production within the real-life context of the broader value chain, the affected rural communities and the other integrated industries.

#### **BOX 2. A PRACTICAL EXAMPLE**

Availability of housing stock has been a pivotal issue in the securing of fish farm sites with island communities. A large salmon company representative noted that in his experience in Canada, he saw temporary accommodation provided within the fish farm setup for accessibility and to minimise the physical impact of the farm: whereas the opposite may be true in West Coast island communities, where permanent housing is seen as key to the overall proposition. The desire is to *have positive impact* and legacy, not zero impact!

For aquaculture, taking account of the wider impact is critical to the *feasibility* of production growth, because how production affects a local population's financial, social, physical, environmental and human assets will translate into whether production is appropriate in a loch or region. This standpoint has meant that in respect of the local economy and population of the East Coast of Scotland, a precautionary approach has been taken against fish farming to manage risk to those diverse assets. However, while there have been studies estimating the impact on angling should there be any disease interaction with farmed fish<sup>93</sup>, the rationale of closing off the whole East Coast should be reviewed regularly because of the evolution in risks and site approaches in the industry: these developments could change the asset and risk profile for the region, making fish farming more favourable.





#### 4.4. SUSTAINABLE LIVELIHOODS APPROACH

The use of SLA techniques is often considered to be standard practice in International Development, however, there are many elements of it that are transferrable to the Scottish context, as undertaken for this study.

Contextualising a sustainable livelihoods model is essential: for example, a community or individual may experience an improvement in welfare due to improved human capital (e.g. skills), or social capital (e.g. support for community projects, family remaining in the local area) or financial capital (e.g. increased wealth through paid employment) but those improvements or impacts may be vulnerable to change or dependent on one company's decisions, or changes to an industry's policy framework. This is the case for aquaculture's impact on local communities in the Highland and Island 'fragile areas'. A suitable account of sustainability therefore takes into account the vulnerability and policy frameworks around people's livelihoods and strives for the most beneficial and (ideally) resilient current status and future for communities.

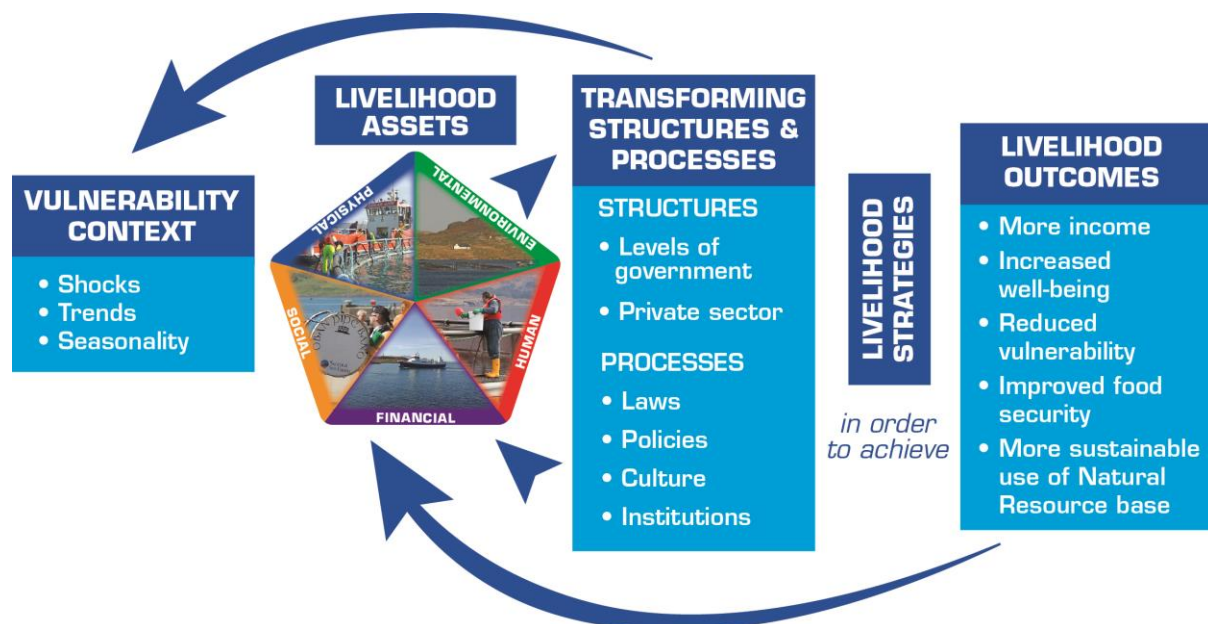


FIGURE 6: SUSTAINABLE LIVELIHOODS ASSESSMENT FRAMEWORK<sup>94</sup>

Taking a livelihoods approach provides alternative ways of thinking about the objectives, scope and priorities for developing an industry within a community context – essentially it puts people and their priorities at the centre of development<sup>95</sup>. People are given the opportunity to improve their well-being, avoid economic and environmental vulnerability, and face a viable future livelihood. This approach requires looking beyond raw economic GVA data and identifies what health, social, risk-avoidance and environmental factors are also to be considered. Even food security (usually relevant for poorer societies than Scotland) is relevant in understanding the challenges of low carbon, affordable and predictable provision of protein when fish stocks are under pressure and agricultural meat production faces higher ratios of feed conversion. A variety of research areas, primary case studies and local consultations provide evidence for these factors as appropriate.



There are 5 types of capital or livelihoods assets to consider within the SLA methodology:

- **Human** i.e. employment / skills / education / health. *Note - Employment is often included in financial capital, however in this instance the consideration was the opportunity to participate in the workforce as opposed to level of financial remuneration*
- **Social** i.e. family / community life
- **Financial** i.e. income / earnings for business
- **Environmental** i.e. land / water / wildlife / biodiversity
- **Physical** i.e. infrastructure / shelter / water / energy / communication

In each of the four case studies a mixed methods approach was taken using in-depth qualitative interviews with key stakeholders and a larger survey with the general public. At the end of each survey the individuals were asked what they perceived to be the Most Significant Change (MSC) that has been brought about by aquaculture in Scotland - the results have been included in tabular and graphical form. The MSC discussion has been related back to the key types of capital and how each was rated by public opinion.

Future growth has also been included in the SLA approach here in terms of public opinion on the future of both fin fish and shell fish aquaculture in Scotland.

Although section 6 places emphasis on the asset pentagon and discussion of each type of capital, it is important to note that the overall SLA approach, as shown in Figure 6, has been considered throughout the design and implementation of the project. The **vulnerability context** is a key consideration when working with fragile communities and so is important when looking specifically at the benefits of aquaculture to rural areas. Issues such as disease and changes in ownership / foreign investment in Scotland are considered to be 'shocks' and are discussed throughout this report. The **transforming structures** of Scottish Government and the Private Sector have a great impact on the impacts of the aquaculture industry to Scotland and so have received specific focus here, with **transforming processes** and associated recommendations a key output for the report.

As discussed earlier, the importance of considering the SLA approach should not be underestimated when examining the benefits of aquaculture and the growth of the aquaculture industry in Scotland. The **livelihoods outcomes** as illustrated in Figure 6: Sustainable livelihoods assessment framework have therefore been considered when suggesting recommendations at the end of this report. The growth of the aquaculture industry in Scotland should be undertaken with community-level engagement throughout, including each aspect of the asset pentagon. When assessed in conjunction with the macroeconomic figures, such as GVA, it is then possible to build a more thorough picture of the benefits to Scotland and how these benefits can grow as the industry expands in line with the 2020 targets.



## 5. ECONOMIC ANALYSIS

This section will present the economic impact of the aquaculture industry in the wider Scottish economic context.

The significance of its economic impact is illustrated by reference to in-depth regional accounts from Shetland as a micro-economy (importing and exporting) within Scotland, and as a significant proportion of Scotland's aquaculture output in its own right.

### 5.1. SCOTTISH INDUSTRIAL CONTEXT

The aquaculture industry in Scotland remains, in comparison to similar agricultural activities, a very new way of producing food and income: it is an 'infant' at only 40 years old, and is maturing, improving and developing at rapid pace. Indeed, at the heart of this report is the examination of the degree to which aquaculture has become part of our way of making a living as a country, but also our view of our landscape and culture. The Highlands and Islands region of Scotland, in particular, has a population base, landscape, economy and cultural demographic all based on the immense historical changes in agricultural production in the 18th and 19th Centuries; and its relatively sparse population, wild and beautiful countryside has attracted other industries such as tourism as a result.

In the 21<sup>st</sup> Century, Scotland has tended to see its economy as primarily driven by the engine of the urban Central Belt (and Aberdeen, though it is largely servicing a natural resource, oil), with the spillover benefits accruing to more rural areas: this analogy is borrowed from the parallel of London driving the wider UK economy as a whole. But this is increasingly in error: **Scotland should more appropriately be seen as having a twin-engined economy**, driven by:



FIGURE 7. AQUACULTURE EMPLOYMENT IN SCOTLAND. IMAGES COURTESY OF IEL AND FUSION MARINE

1) **natural resource-based wealth creation** (oil, renewable energy, whisky, hydro, agriculture, high-value foods such as seafood, tourism, golf etc.); and

2) **high-skilled financial services and research based industries** commonly clustered in and around urban centres (this 'engine' currently remains the majority income generation for Scotland)

The first of these engines, natural resource-based wealth creation, is predicated on an economics of abundance i.e. an intelligent balance in exploiting Scotland's natural resource base will allow it to maintain and improve its standards of living in the face of the risks of climate change and international competition.

It is viewing Scotland's economy and well-being through this lens that we have examined the benefits of the aquaculture industry.



Aquaculture production accounts for a Scottish industry value contribution of an estimated £800 million, and at least 4,800 jobs, to Scotland's economy. This includes, inter alia, those engaged directly in production, supply of Scottish goods and services to producer companies (e.g. equipment and feed suppliers), the proportion of processors whose jobs are attributable to Scottish aquaculture production (i.e. excluding processing of Norwegian or non-aquaculture product). Should the industry achieve its sustainable growth targets of an increase in finfish production (mainly through growth in salmon production) to 210,000 tonnes and shellfish to 13,000 tonnes by 2020, it could have a direct turnover of around £1.2 billion, which includes the activities of aquaculture farmers, managers, logistics, equipment manufacture, agro-processing, and other input suppliers in that year: as much as £1.5 billion in Scotland (and over £2bn across the UK) in total turnover through retail and hospitality to the consumer's plate.

The 'prize' is therefore enticing when one views the whole value chain dependent on Scottish salmon production. The contention of this report is that current production figures tend to undervalue the total contribution of aquaculture, since they do not adequately value the Scottish-based production of peripheral industries *that would not accrue to Scotland without the presence of a significant, sustainable and growing aquaculture production base*. For example, fish feed supply is widely considered to be up to 60% of the cost of production (depending on the buyer requirements), most of which is produced by Scottish-based companies. The job and value creation in this sector would not be viable without the presence of Scottish-based production even when considering that the industry exports 10% of total production to Ireland and Norway. Nevertheless, the feed industry does import the vast majority of its feed and this is likely to be the largest 'leakage' of value in the whole supply chain (estimated £200m<sup>96</sup>). Looking across the turnover of production we can identify jobs and industries which exist specifically to service Scottish aquaculture, and therefore should be fully accounted for in taking a strategic view of the value of the industry. Their GVA (buried, as it were, within aquaculture production turnover, or downstream of that turnover altogether) should be acknowledged for effective policymaking.

By calculating the GVA of those firms (excluding inputs such as imported primary commodities) we can also see that they contribute a sizable portion of investment of the industry in Scotland: not only that, based as some of them are in the Central Belt, we can see the rural aquaculture industry as a driver for investment in Bathgate and Grangemouth as much as serving the Highlands and Islands area. The same argument can be applied for the aquaculture bioscience, breeding and international research conducted by institutions that contribute to Scotland's education and life sciences sectors.

Salmon production is illustrated through industry figures collated by the Scottish Salmon Producers' Organisation (SSPO). The figures cover what is thought to be 98% of total salmon production (pre-processing), covering the largest producers, though the figure also covers indirectly some smaller community- and SME-sized companies that grow salmon on contract for the larger firms.

The SSPO data shows a member employment figure of 2,200 (this is higher than the Scottish Government figure of 1,059 for salmon employment because it includes smolt production, marketing, logistics, management and other staff, not just farm-based workers) and a total 'economic contribution' of gross pay of nearly £62m. We consider this to be a fairer reckoning and is based on primary industry data.



## **5.2. SCOTTISH GOVERNMENT ECONOMIC OBJECTIVES**

This assessment will consider how the aquaculture industry contributes to traditional economic indicators such as income and employment, but also its worth in meeting other thematic objectives in the Scottish Government economic strategy. For example, economic *participation* in the labour force), 'cohesion', and solidarity are cited as objectives; not only in rural areas (where Highlands and Islands add the maintaining of population as an additional aim) but in post-industrial Lanarkshire, Glasgow, across the Central Belt (including Grangemouth) and fish processors in Fraserburgh. Aquaculture creates Scotland-wide economic opportunities, and many of sections of the supply chain (such as distribution and feed) are effective when close to transport infrastructure rather than near where the fish are produced in remote areas. Further, while much of the feed supply for aquaculture is imported, even the estimated 10% of volume sourced in Scotland (including wheat and beans) may total between £20-25m for Scottish agriculture.

Downstream in the supply chain, smoked salmon (and to a lesser extent shellfish) are a strong pillar of 'Brand Scotland' in promoting the Scottish Food and drink industry, which is valued at £13.1bn<sup>97</sup>, with salmon alone generating at least £464m<sup>98</sup> in export revenue.

As the scope of the impact broadens out from established economic indicators, many of the Scottish Government's social and even environmental objectives are met (e.g. section 6 notes that salmon production has a relatively low carbon footprint compared with other types of meat production).

There is evidence that the links between youth employment in rural communities and aquaculture remain strong, both on a direct and indirect level. In addition to employment and income generation, in some cases this has maintained families in rural areas, keeping school numbers viable and providing an employment route for school leavers. Aquaculture companies, to varying degrees of formality, visit schools to teach children about enterprise since they are the only clear commercial industry in some areas. The Seafood in Schools programme (or similar) should be maintained to support greater understanding of the industry and its potential health, economic and environmental benefits. More analysis of such benefits can be found in section 6 on sustainable livelihoods.

## **5.3. STIMULATING THE ECONOMY THROUGH PRODUCTIVITY GROWTH**

While the drive to scale within the aquaculture industry, particularly salmon farming, has tended to reduce employment at a farm level, it has been concurrent with improved productivity over 10 years (though it has levelled off over the past 5 years see below). Further, achieving scale for better management, and mitigation of risks per individual site, is seen as positive beyond the farm production level, and in turn positive for long term productivity growth. Even in the past 5 years, it is argued, the industry's methods have improved, not least in reducing waste in the provision of feed. This is largely cost-driven but has had a beneficial effect on the environmental impact of waste damaging the benthic environment, at least per unit of production.

For salmon, productivity per production staff member has fluctuated, but the trend is one of improvement over 10 years. However, at around 153 tonnes of output per person in 2012 it is up only slightly from a previous peak of 151 tonnes per person in 2006, and fell as low as 135.5 tonnes in 2008.<sup>99</sup> The most productive farm was sized between 1,000 and 2,000 tonnes (producing 213 tonnes per person), not those exceeding 2,000 tonnes (almost all the sites in 2012 were in this category).





At a company level (rather than farm level) the Levercliff SWOT analysis (Figure 3) notes that a lack of finance options for smaller producers remains a problem, and this was confirmed in discussions with all but the main 3-4 Norwegian-owned salmon producers.

By region, Shetland is by far the most productive at 211 tonnes per person, almost double that of the South West of Scotland.<sup>100</sup>

In shellfish, employment increased by 4% while production fell significantly (by 10% for mussels, Pacific oysters by 14%), suggesting a fall in productivity per worker.<sup>101</sup> However it is anticipated that the long term prospects for shellfish employment remain positive.

From a value chain perspective, the relative merits of productivity in production are only half the story, and must be balanced with the potential gains in other sectors such as processing and marketing, since there may be a wider opportunity cost and risks in long term performance of the production sector. Increased mechanisation in farms may increase productivity per person but displace farm workers, while keeping processing of Scottish salmon competitive through lower per unit prices. In this case, even if there is a reduction in the number of direct farm jobs as there has been over the past 10 years, the benefits to Scotland through improved quality, management and efficiency of production have been found in maintaining a competitive (if still high) price, and by creating product for high-value processing and marketing. The industry's ability, then, to unlock this downstream productivity means that a loss of jobs at the farm level could be regained at the processing level: some of these gains can be seen in the growth in processing jobs proposed in Rosyth. Ideally, more (appropriate) volume in production will provide long term sustainable growth for both fish farmers and the rest of the supply chain: both can deliver both high quality and accessible jobs in Scotland.

A lack of technological development outside of the salmon industry, and considerable challenges for new technological development within salmon cage design for more exposed sites, are also potential limitations in achieving economic growth, since labour productivity is arguably less of a constraint than regulations implemented for other reasons. The Scottish Government should consider how the research and development support provided to the marine renewable energy industry (including joint company projects for meeting shared needs) could be applied to stimulate investment in the aquaculture industry: this could facilitate growth in productivity per employee, which in turn will provide economic growth and improved competitiveness. A more competitive price for output should create new markets not just for aquaculture product, but for the value-added Scottish industries such as smokeries, ready meals and tourism retail (and realise potential demand from English processors, too). These are areas where productivity gains should also be possible.

However, it remains that the Scottish Government objectives including transition to a low carbon economy, appear highly complementary to the objectives of the aquaculture industry (for wider discussion of carbon footprint, see section 6) and the main facilitation roles it can play are through ensuring policy is as pro-active and pre-emptive as possible to identify viable sites (i.e. not simply deregulating and compromising on quality assurance), and through support on financing for smaller companies which cannot compete in growth planning compared to large Norwegian companies which can provide inter-company investment packages. It should be stressed again that the latter should be welcomed and supported, but should equally be subject to competition from smaller



producers. This should favour the larger companies too, since they are now facing competition requirements to divest sites to smaller firms as they consolidate in the market even further.

#### 5.4. DIRECT AND INDIRECT ECONOMIC IMPACT

The Gross Value Added of an industry is the value within that industrial segment of economic activity: it can be derived via a production method or an income method, but both seek to quantify the financial value that is added to inputs that come *into* that industry. For example, in the case of aquaculture production, if e.g. 45% of the cost of total production is in the feed supply, then that 45% of the value of the industry is sitting elsewhere in another industry, and not in the farming itself. Therefore to establish the simple value-added by the aquaculture production industry, it is relevant to exclude 45% of the turnover figure<sup>vi</sup>, and similarly for all other inputs from other suppliers. Measuring the GVA of aquaculture production alone is useful for comparison with other industries, demonstrating the *direct* employment and income impact of growth in an industry, and for aggregation to give a picture of the Scottish economy. (On this measure, the GVA is around 20% of revenue in a poor year, and as high as 30% or more in a more representative one: and salaries are between 10 and 15% of total turnover, depending on the company structure and activities.) *However, for the purposes of this report, it is relevant to look beyond just the GVA of production, and look to the GVA of associated and dependent industries. Focusing solely on farm production value does not give a full or accurate account of the indirect benefits on the industrial activity of suppliers within a value chain, from inputs through to downstream outputs. These are arguably as important, not least because they contain a large variety of economic activity that is quite different from aquaculture in geography, skills required and resultant employment.*

Aquaculture production may be described as an *anchor industry*, creating demand for engineering, agricultural products, transport, construction and public services. As such it influences the shape of the Scottish economy, particularly in areas where production is highly concentrated. The business generated can be seen as a benefit created by the Scottish aquaculture production *if that business activity is dependent on the 'Scottishness' of the salmon*, either for logistical, skills or provenance/marketing reasons. Some of the processing activity generated in Grimsby, for example, is not solely dependent on the Scottishness of the salmon, and there is a degree of substitutability with salmon product from other sources. Where that company can do without Scottish production, the latter cannot 'take the credit' for that value creation. However, in the vast majority of the supply chain in Scotland, there *is* a clear attribution of that business activity depending on the product provenance being Scottish, for reasons of geography and cost (feed, distribution, diving services) or marketing (smokeries). The consequences and benefits of this 'attribution of impact' and developed below, and the exercise is interpretive based on industry interviews and value chain / market analysis.

A whole-value-chain approach gives a better account of such economic benefits, with the input activities being captured largely in the final turnover of production, and downstream processing and

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<sup>vi</sup> HMRC defines turnover as 'the amount derived from the provisions of goods or services within the company's ordinary activities after deduction of trade discounts, VAT and other relevant taxes [...] Furthermore some companies may describe their turnover as, say, income but in essence that income will normally be similar to or the same as the sums that would constitute turnover as defined in the Companies Act.' Available: <http://www.hmrc.gov.uk/manuals/saogmanual/saog11232.htm>





retail activity being additional to that. While inputs should not be aggregated with production turnover (i.e. they should not be 'double-counted'), in line with GVA methodology, we can identify and aggregate employment figures across the value chain.

The total income of aquaculture production (in 2012, some £537m<sup>102</sup> for salmon production, up to £8.7m<sup>103</sup> for shellfish) will therefore include the economic value (bought in goods and services by the producer companies) of, *inter alia*:

- Research & Development
- Light engineering
- Feed supplies (*here there is a lower than expected impact due to the majority of feed being imported, and as such is largely a 'throughput' with relatively low GVA and indirect economic value per £*)
- Barges, boats, well boats and some intra-company transport
- Harvest station (*where salmon are slaughtered before processing*)

Some of these indirect sources of employment and value involve skilled manufacturing, management and research activities which have a strongly positive spillover effect in their local areas, creating a further induced effect of increased income circulating in unrelated sectors such as retail and housing.

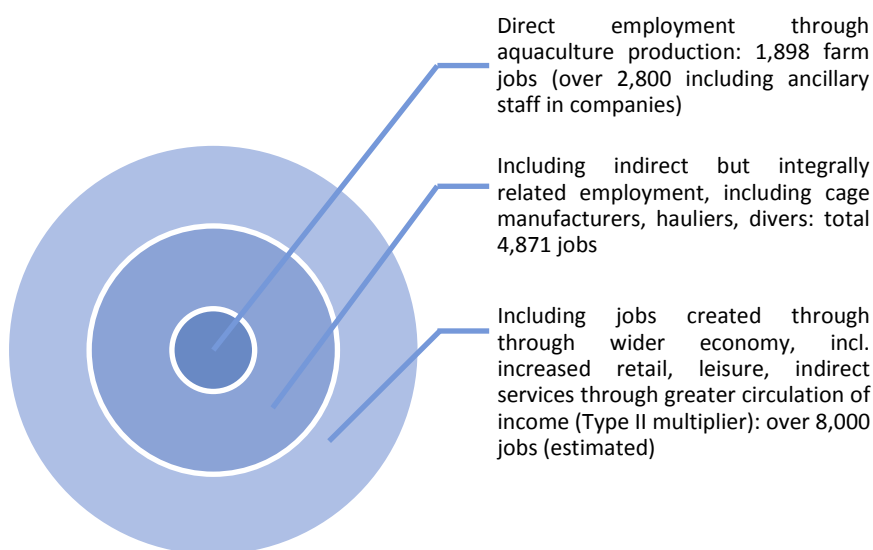


FIGURE 8: DIRECT AND INDIRECT MEASURES ACROSS SCOTLAND

While the 'induced multiplier effect' of wealth creation should be considered as a *true* effect, its measure is far less reliable and subject to methodology and assumptions.

For context, estimates in Norway are:

*Approximately 8,500 people are directly employed in the aquaculture value chain. In addition, thousands of jobs are created in transportation, the supply industry, as well as in commerce. All in all, including spin-off effects, it is estimated that in excess of 21,000 people are employed in aquaculture related activities.*<sup>104</sup>

Norway's aquaculture differs from Scotland's in many ways, with different cost ratios between salaries and operating costs, but this indirect multiplier of around 2.5 in the supply chain is in line with expectations, given that Norwegian labour costs are relatively high.



Of the £537m total salmon production turnover spent on inputs and farm production as far as the farm gate / customer door, as much as £200m of value will not accrue to Scotland because it comprises imported agricultural product, though many other inputs will have relatively ‘deep’ economic impact, including: the remainder that is Scottish agricultural supplies, sourced in Fife and the wider Central Belt; engineering; transport (aside from well boat ownership, hundreds of people derive at least some income from servicing and haulage contracts); and diving, compliance and environmental activities relating to farm sites.



FIGURE 9. SCOTTISH ARABLE FARMERS SUPPLY THE AQUACULTURE INDUSTRY<sup>105</sup>

Beyond Scotland, there are economic benefits that come to Grimsby processors (and along with Scottish production contribute to UK tax revenue), buying up to 1,000t per week<sup>106</sup> and employing over 1,000 processing employees and an expected £500m in turnover directly relating to Scottish product. Note this does not include other types of fish processed in the same premises, including Norwegian salmon, and some of this production could be substitutable with Norwegian or Chilean product. This implies three key points:

1. attribution of benefit to Scottish provenance is not binary, i.e. it is a key advantage but remains to some degree substitutable, especially in price-sensitive markets;
2. it was clear from consultation that Scottish provenance *is* a key advantage, and there is ‘no question’ that more Scottish volume is welcome;
3. growth in Scottish aquaculture production will benefit Scottish processors and producers, but large volume processors and exporters in the rest of the UK and overseas will remain as key players and economic beneficiaries.

Finally, vertical integration in salmon companies means there is an increasingly blurred distinction between aquaculture production and other areas of the value chain. This can be seen at the small scale level, too, where Loch Fyne and others span many sectors in the supply chain.

#### **5.4.1. COMPANY REVENUES AND TAX CONTRIBUTION**

Operating profit for salmon companies has varied from year to year, and reflects the volatile nature of both prices and volumes for aquaculture industry. Many companies made a loss in 2012 (across an anonymous but proportionally significant percentage of salmon companies, the net profit was



close to zero from the previous year of closer to £100m in 2011)<sup>vii</sup>; while an operating profit margin of closer to 20% was achievable in a previous year (the EU average margin for aquaculture is 13%)<sup>107</sup>. This is more in line with expectations, given that Scottish supply is constrained, in growing demand, and viable and profitable against competitors.

Tax revenue was not considered in the consultation, though the tax multiplier is a function of GVA (including taxable personal salaries) and profits (corporation tax and investment agreements). Scotland contributes to UK tax revenue through its own Scottish-based production and supply chain activities, but also stimulates growth in the UK processing sector: particularly in Grimsby where Young's Seafood Scottish salmon is processed; and through the UK retail sector. As stated, the inter-relationship here is not clear-cut for the rest of the UK: though Young's (Grimsby) source Scottish salmon as a priority, and Seachill (Grimsby) are keen to source more, much of the UK-wide retail market will use salmon from Chile and Norway, and therefore the attribution of impact is more complex. Suffice it to say that Scottish product has, even in its current volumes, a significant upstream role in the tax generation from English processors, with a GVA likely exceeding £100m from processing Scottish product at current volumes.

This is paralleled in Shetland where almost all of the tax revenue generated by aquaculture will only benefit Shetland indirectly. Shetland Islands Council, however, has long had its own licencing and authority on planning (exercising, in effect a prototype of the Scottish marine spatial planning): this has brought direct revenue and has localised decision-making in a way that has stimulated economic growth for the region. This will be explored further in the case study below.

#### **5.4.2. CASE STUDY: AQUACULTURE IN THE SHETLAND ECONOMY**

A salient example is that of Shetland, which produces the majority of Scottish mussels and a significant proportion of Scottish salmon. Shetland's recent regional accounts<sup>108</sup> provide a window into how linkages between aquaculture, supplier services, and wider economic benefit.

Even in Shetland where aquaculture is such a significant part of the economy (14.3% of output and 9.4% of GVA<sup>109</sup>), there is a risk that without understanding its supply linkages we will underestimate the true contribution of the industry.

##### **Closer reading of the Shetland accounts**

The Shetland Regional Accounts state:

*"Aquaculture remains the largest sector, yet it contributes relatively less to GRDP than output. By contrast, although not exceedingly large in terms of output, land transport and other personal services generate a considerable share (13%) of Shetland's GRDP [Gross Regional Domestic Product]." (p.14)*

However, not only is aquaculture identified as the largest sector, this highlights that it is also a direct and definitive multiplier in land transport, where whole companies depend on servicing the logistics for aquaculture production. However, the report views the scale and impact on the economy of such services as limited:

*"Multiplier analysis shows thus that aquaculture's contribution to economic growth in Shetland remains largely limited to its own expansion. The reason is that its*

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<sup>vii</sup> Based on analysis of company accounts.



*effects on local consumption, both intermediate and final, are small. Aquaculture demands few local goods and services, while an overwhelming share of its inputs is imported from mainland Scotland.” (p.23)*

And:

*“A £1 million increase in aquacultural sales creates 2.2 jobs directly and 0.9 more indirectly. Naturally, the size of these sectors also is important. Catering, marine engineering, and communications have large employment effects, but none accounts for more than 1% of Shetland’s total output. This is not the case of aquaculture, which contributes 14% of this output, or the public administration, which employs 29% of its labour force. Either directly or indirectly, all of these sectors can have a critical impact on the region’s labour market.” (p. 25)*

Aquaculture, then, even when it is considered to have a low employment coefficient and direct and indirect effects, seems to be employing high-multiplier industries such as marine engineering and land transport, and its scale still brings critical impact.

The accounts give a scenario of export value falling by 50%:

*“58% of Shetland exports [i.e. exported from the Shetland isles] in 2010-11 came from aquaculture (£144 million)” (p. 36), importing £94m of inputs. [...] Since most aquaculture products are exported out of Shetland, a 50% reduction in their value decreases the sector’s revenue by 49%. In 2010-11, this would have represented £77.2 million less in sales, which is equivalent to 7.1% of Shetland’s total output. The decline of aquaculture also leads to lower sales in other economic sectors. Other food and drink processing, retail and catering decrease by more than 2%; four other sectors decrease between 1 and 2%, and 19 sectors by up to 1% (Fig 7.4). Overall, Shetland’s total output declines by 7.5%: 7.1% due directly to aquaculture and 0.4% distributed across the region’s economy. This large decline is expected given that aquaculture, is the largest sector in terms of output value and the largest contributor to economic growth in recent years. At the same time, it is not surprising that the indirect effects of the sector’s decline are relatively small, since aquaculture’s [employment] multiplier is among the smallest in Shetland. (p.45)*

This analysis, then, suggests that the impact of a drop in aquaculture would be significant only because of its relative size, not because it has large indirect multiplier effects. However, interviews with Shetland suppliers (and modelling of associated supply GVA and total revenue) suggest very strong influences between aquaculture production and the high value and impact sectors that supply it, such as engineering. One Shetland engineering firm grew out of the aquaculture industry and now supplies oil companies with marine services and specialised engineering, with supply to aquaculture now comprising approximately 30% of demand. Further, this illustrates the benefit of aquaculture to the ‘skills ecology’ of the island, helping it develop transferable skills for related industries. A haulage firm had a majority of its contracts relating to aquaculture transport from Lerwick. This concurs with the accounts when they suggest that the effect on all of these sectors stacks up, even when they are proportionately small in disaggregate: and in consultation there appears to be a high degree of dependency on aquaculture funding.



The Shetland accounts suggest that the multiplier effect of aquaculture is low: however, we contend that the attribution of impact one can place on Scottish aquaculture for the downstream processing of salmon and mussels suggests that the multiplier is high when causality is taken into account: while £1m invested in aquaculture brings a low number of farm jobs, evidence suggests there is a strong multiplier in other jobs across other industries.

#### **5.4.3. INDUCED MULTIPLIERS FOR SHETLAND**

Interviews with industry give a picture of the combined supply chain employment:

*“The overall way that ramps up in Shetland, if you take 1100 jobs in aquaculture in all aspects of it, the overall working population in Shetland, is less than 10,000. So proportionately we’re looking at something like 12-13% of the entire working population are effectively dependent on aquaculture.”*

**Industry Representative, Shetland**

In addition to this contribution, there is a significant Type II multiplier (i.e. including economic activity induced by additional income circulating in the economy, not only in the supply chain) for other businesses, with leakage of only 33%. Adding day-to-day consumables sourced in Shetland (for example food and fuel) we can illustrate the degree to which aquaculture-derived income circulates in the economy.

**TABLE 2. HOUSEHOLD EXPENDITURE ON CAPITAL GOODS IN SHETLAND<sup>110</sup>**

	All Spending	Furniture	Electrical Equipment	Cars and Vehicles	Clothing and Footwear
In Shetland	67	48	51	61	32
Outside Shetland	25	42	15	36	26
Online Purchases	7	9	28	3	30
Mail Order	1	1	6	0	12
Total	100	100	100	100	100

Our analysis suggests that aquaculture production is more influential on key sectors and rural economies than is currently acknowledged, including those of particular interest to the Scottish Government and HIE like engineering; and upstream in the supply chain, the same applies to a lesser degree for consultancy and research, including bioscience. The total number of Scottish jobs identified in supporting industries by the report’s findings suggests that the current aquaculture multipliers do not capture the full impact of job creation and income accruing to Scotland overall.

Finally, this analysis considers the wider diffuse effect on the human (e.g. skills, education and human purpose through work), environmental, physical and social multipliers that should be captured and characterised. This can be found in the Sustainable Livelihoods Analysis in Section 6, where we consider the benefits demonstrated through having viable jobs, which in turn provides schooling, community and lifestyle opportunities in remote Highland (and also deprived Central Belt and Aberdeenshire) areas. Neil Manchester of Landcatch voiced this point in a recent article, which has been echoed by many in consultation across the supply chain:



*Back in Argyll, Mr Manchester is proud of the jobs that Landcatch provides helped save the local Achahoish Primary School from closure. He also lays great store by the close link he has with Lochgilphead High School. "I go in there regularly to give careers talks because I am trying very hard to employ locally. I want the pupils of today to know there are worthwhile careers for them without leaving Argyll."*<sup>111</sup>

This sentiment capturing community cohesion (and implied prevention of population decline), job participation, career achievement, and education was voiced by boat operators and teachers in Yell, to engineers in Balcardine, and even (in a different context) distribution managers in post-industrial Lanarkshire.

## **5.5. INTELLECTUAL CAPITAL**

*"Experience is exportable."*

Supplier, Argyll

As with renewable energy expertise, and indeed throughout the Scottish economy since The Enlightenment, there is value in the exporting of know-how as well as physical products. However, the total value of consultancy and academic research portfolios is likely less than £5m per year, but including, for example, over a 3-5 year period: small-scale consultancy of between £20,000-100,000 per year; ~£400,000 research and consultancy work at the NAFC Marine Centre, £400,000 seaweed production research by the Hutton Institute; £6m in aquaculture research at SAMS (including IMTA, macro-algae and sea lice); £685,000 of consultancy funding to SRSL on shellfish toxins and environmental impact assessments; to around £7m (over a portfolio that spans financial years) at the Institute of Aquaculture in Stirling<sup>112</sup>. The Institute can claim to have exported around 1,000 aquaculture Masters graduates and runs certification and standards projects in Asia, and research into the Omega 3 content in salmon production and in local Scottish populations: this has relevance to the health and wellbeing of Scots and has implications for the value of marketing and awareness-raising programmes to the Scottish population. Other areas of research at Stirling include environments, reproduction, genetics, aquatic health and production systems. It is estimated that over 50% of the total value of consultancy and research may be 'exported' as intellectual capital overseas, i.e. delivered on overseas projects.

SARF has produced a number of key documents shedding light on both scientific and economic research needs, including for example studies into disease control, and the relationship between tourism and aquaculture.

The Scottish Aquaculture Innovation Centre is completing an approval process and will provide a substantial opportunity to raise Scotland's research profile.

Fusion Marine provides 'turnkey packages' and ongoing management / advisory farming support for clients across Africa, the Middle East and Asia. Other intellectual exports include licensing agreements such as AutoDEPOMOD (and its variants), Scottish-owned environmental modelling software with over 150 licenses in 25 countries worldwide.

The intellectual capital in aquaculture is funded through industry, public research spending and overseas clients. The Scottish industry, in addition to providing relevance and close links with research bodies which gives credibility to Scotland as an aquaculture producing nation, funds



practically relevant research by Landcatch, Novartis and other firms for: genetics and reproduction, nutrition (a major cost of production), veterinary and welfare services. This again should be noted as a valid and important part of the supply chain in terms of additional Scottish production-related GVA, which is not fully accounted for in the GVA of aquaculture production only.





## 6. ENVIRONMENT AND CARBON FOOTPRINT

The following section considers the benefits of aquaculture production on the environmental assets of Scotland as well as the wider impacts. The environmental impacts of aquaculture have been well documented and researched elsewhere and Scottish perceptions of these impacts are discussed in section 7.2.7 of this report. The aim of this section is therefore to provide some contextual background on the subject rather than an all-encompassing review of the impacts and benefits.

Economists now recognise that the degradation of environmental capital means that a country can be impoverishing itself in natural assets (wealth) while experiencing positive economic growth (income). Internalising such externalities into economic models is desirable, since any negative effects should be rightly seen as counterproductive. However, industries can have a mixed set of impacts, and in this section we analyse the local environmental impact and the broader contribution of aquaculture in a low carbon economy. When considering environmental impacts the Scottish Government have recognised the importance of growing the aquaculture industry in a sustainable manner and with due consideration of the marine environment. As discussed previously, Scotland is recognised as having a robust regulatory regime and some of the highest environmental standards worldwide (see section 3.1).

Impacts from salmon farming have been recognised and managed for many years<sup>113 114 115</sup>. The most

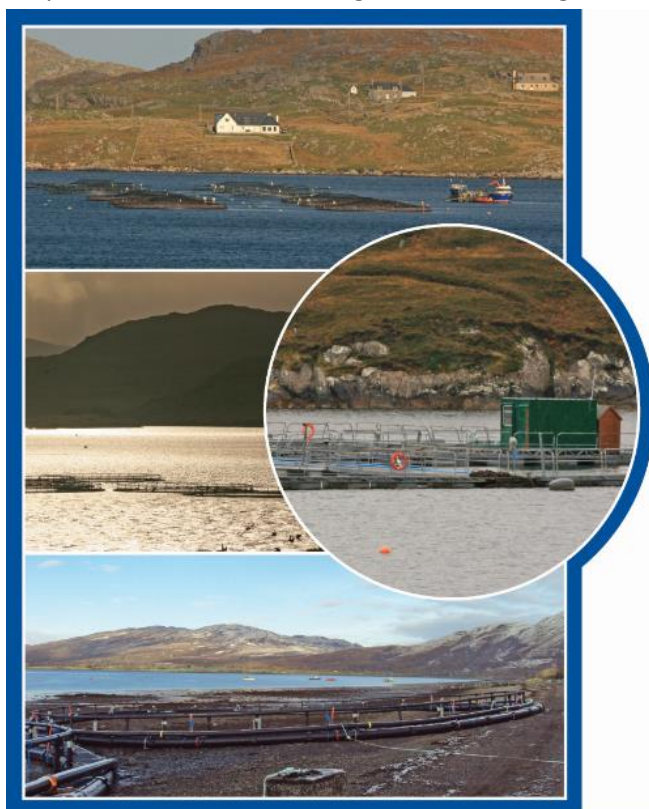


FIGURE 10. SALMON CAGES. IMAGES COURTESY OF IEL

obvious impact is that made on the local seabed environment by the deposition of uneaten feed and faeces, and farm size is largely determined based on limiting this impact to within sediment quality standards<sup>116 117</sup>. Other impacts include the effects of sea lice and escaped fish on wild salmonids, the effect of medicines on marine ecosystems, the effects of nutrients on primary productivity and interactions with seals. Of these the most controversial, and high profile in the media, are the effects of lice and escapes on wild salmonids. Sea trout monitoring has shown that lice levels can be high enough to cause mortality but the evidence that lice are a significant factor in reducing salmonid populations is less firm and further research is ongoing<sup>118</sup>. Many fish farmers recognise that this potential does exist. The key future threat comes from the widespread

occurrence of lice that are resistant to one or more of the few medicines available to treat them<sup>119</sup>. Everyone is in agreement that fish escapes are unacceptable<sup>120</sup>, both in terms of their effects on wild salmonids<sup>121122</sup> and their reputational and financial damage to farmers, and great efforts in terms of training and the development of Scottish Containment Standards<sup>123</sup> are yielding reductions in escapes.



Impacts from mussel culture relate first and foremost to visual aspects but there may also be some effects on sediments<sup>124 125</sup>.

## 6.1. CARBON FOOTPRINT

Given the increase in global meat production with increasing wealth, it is interesting to consider how Atlantic salmon compares with other forms of meat production. Recent studies have shown that Atlantic salmon is highly efficient in terms of its ability to convert feed into meat and is comparable to chicken in terms of GHG emissions per unit of production<sup>126</sup>.

The carbon footprint of Atlantic salmon (Table 3) masks some harsh realities: this is a mean for the global industry. Because of the higher use of fishery derived ingredients demanded by retailers in Scottish feed compared to Norwegian, the carbon footprint is much higher in Scotland: 3.27 compared to 1.78 in Norway.

TABLE 3. CARBON FOOTPRINT<sup>127</sup>

Product	kg CO <sub>2</sub> eq/kg edible part
Beef	30
Pork	5.9
Chicken	2.7
Farmed Atlantic salmon	2.9
Herring	0.52

## 6.2. PRODUCT EFFICIENCY

Atlantic salmon are an efficient product with high edible yield, low Food Conversion Ratio (FCR) and high retention of both energy and protein compared to other meat products (Table 6). Unlike non-fish domesticated farm animals, salmon do not have to expend energy in standing and maintaining their body temperature and have much lower requirements for inedible skeletal material owing to the support provided by their watery environment.

TABLE 4. PRODUCT EFFICIENCY<sup>128</sup>

	Salmon	Pig	Chicken	Lamb
Edible yield %	68.3	52.1	46.1	38.2
FCR	1.15	2.63	1.79	6.3
Energy retention %	23	14	10	5
Protein retention %	31	18	21	5



### 6.3. CONSUMERS AND THE ENVIRONMENT

A recent study<sup>129</sup> showed that purchasing is influenced by both context and attribute variables, including environmental preferences. Specifically, it was found that increased concern over the environmental performance of the salmon farming industry is associated with a lower propensity to purchase salmon.

A contingent valuation survey carried out in Scotland<sup>130</sup> found that people were willing to pay a price premium for salmon that was farmed using production methods that minimized pollution caused by nutrient discharge, while a study by Olesen *et al.*<sup>131</sup> showed that Norwegian consumers were willing to pay a premium of some 15% for organic and Freedom Food salmon relative to the price of the conventionally farmed product.

Farmed fish were perceived to be of lower intrinsic quality than wild fish, and it was this factor rather than sustainability and ethics that appeared to be the main reason why some consumers did not purchase farmed fish. The results of the survey indicate that public attitudes towards the environmental performance of Scottish salmon farming translate into purchasing behaviour. This finding is consistent with other studies showing the emergence of 'green' values among consumers, including concern over whether fish originates from sustainable sources.

The challenge for the aquaculture industry certainly involves increasing public understanding of fish farming practice, but arguably, it also requires a strategy of positioning products in the market so that people who are currently disinclined to buy salmon on account of environmental concerns are persuaded otherwise. The role of independent labelling schemes from the organic or best practice sector could provide additional messages to consumers about the sustainability performance of salmon.

#### 6.3.1. CONSUMER ATTITUDES TO FEED SUSTAINABILITY<sup>132</sup>

There is a ceiling on the world supply of fishmeal and fish oil that have traditionally formed the main ingredients of farmed salmon feed. Aquaculture already utilises most global fish oil and half the supply of fishmeal. Demand from China and other developing economies for these raw materials is forecast to grow. Together with natural fluctuations in production, constraints on the supply of fishmeal and, in particular, fish oil are expected.

In 2007, a study found that consumer attitudes are not a barrier to feed substitution with plant materials providing that the clear health benefits from eating salmon and product quality are unaffected. An Ipsos MORI consumer survey indicated that the majority (79%) of salmon consumers are neutral or positive regarding substitution, while 21% are against. The survey suggests substitution would not significantly affect purchasing decisions; for the 3% who would buy less salmon, there were 4% who would buy more<sup>133</sup>.

One of the five supermarkets consulted was receptive towards increased substitution and two more were not necessarily against, while the remaining two did not intend to sell Scottish salmon grown on feed with increased substitution. The key reason cited by those supermarkets and fish farmers consulted who are against increased substitution is that they consider the use of marine ingredients to be closer to what salmon would eat in the wild and hence the use of fishmeal and fish oil is more natural than plant substitutes. To facilitate the wider acceptance of substituted diets, this SARF report on consumer attitudes to feed sustainability recommended that the feed industry presents



data on the levels of HUFAs achieved in farmed salmon in commercial production and confirms that these meet relevant health claims. While acknowledging that there is a 'premium' market which will continue to demand product fed on marine-only diets, this represents a relatively small proportion of the total volume of production.

### **6.3.2. ENVIRONMENT AND ZONING**

Norway uses marine spatial planning tools to create areas where there is a presumption in favour of aquaculture development and then essentially offers the industry licences to farm – rather like marine wind power in the UK. In contrast, Scotland has a system whereby areas have one of three classifications<sup>134</sup>:

- 1) Presumption against (further) fish farm development,
- 2) Only limited development potential and
- 3) Open for applications.

Essentially Scotland's approach is opposite to that taken in Norway i.e. Scotland indicates where new farms are unlikely to be acceptable.

It is unlikely that Scotland will realise its full aquaculture potential without a robust spatial plan for aquaculture - the Scottish Government have made initial steps towards addressing this through the National Marine Plan and marine spatial plans, although work is still required in terms of zoning for aquaculture. In a recent paper the FAO present the following challenges<sup>135</sup>:

*"Zoning can help address a number of issues, such as integrated management; risk assessment; coastal aquaculture development; expansion of mariculture further offshore; aquatic animal health (biosecurity); better management practices; watersheds management; and aquaculture in the context of competing, conflicting and complementary uses of land and water. Thus, finding optimal solutions to these issues depends, in part, upon finding a suitable zoning strategy supported by zoning policies."*

Feedback received from participants during recent FAO training workshops on spatial planning indicates that the main obstacles for adequate aquaculture zoning processes are:

- i. limited understanding of the concepts and processes of aquaculture zoning and carrying capacity estimates;
- ii. lack of aquaculture master plans that include aquaculture zoning, and lack of political will and institutional interest to establish aquaculture zones;
- iii. conflicts between aquaculture activities and other user interests in coastal zones and waterbodies that ignore aquaculture rights and needs;
- iv. lack of institutional frameworks, including laws, regulations and norms for the allocation of space for aquaculture; and
- v. a general lack of resources and training to support aquaculture zoning initiatives."

Much of this resonates with the Scottish experience.

The Irish Government are currently taking the remarkable position of Applicant in a proposal for Europe's largest fish farm in Galway Bay<sup>136</sup>. This is a step further than Spatial Planning which will likely place the Irish Government in a difficult democratic position that may end up in the European courts. This approach is not recommended in Scotland.



The expectation across Scottish communities and industry players (including SEPA) is that environmental standards remain robust and differentiate Scottish salmon as meeting the highest of standards. This should be seen as a relatively 'fixed' priority in the industry strategy, and it is more likely that game-changing developments like progression to more exposed sites would be the stimulus for changes in environmental regulations, e.g. allowing larger sites because in more exposed areas their benthic impact is reduced.

Finally, as stated above, there are ways in which salmon could be 'even greener' if segments of the market were amenable to low carbon sources of feed, and if salmon were to begin to substitute for other meats (except chicken, where it is becoming a substitute meat in ready meal choices), it could reduce the carbon footprint of meat production up to tenfold per kg.



## 7. SUSTAINABLE LIVELIHOODS ASSESSMENT (SLA)

As discussed in section 4.2, the SLA technique used for this research included both quantitative and qualitative analysis through surveys and interviews respectively. The results have been analysed to provide an indication of what the benefits of the industry are perceived to be throughout the areas in Scotland where aquaculture production takes place. These findings are interpreted within the institutional (e.g. policy, industry, planning) framework, and through a risk assessment which considers how vulnerable or resilient these benefits may be. The personal details of interviewees have remained confidential, however reference has been made to their regional location and relevant sector for context purposes.



FIGURE 11: SUSTAINABLE LIVELIHOODS PENTAGON

The pentagon diagram (Figure 11) is shown throughout this section to highlight which of the types of capital is being discussed. Although the focus here is on the types of capital, it is important that they are considered in the context of the overall diagram in Figure 6. The stakeholder analysis and findings through interviews and surveys are a crucial part of the findings of this study; however they must be examined in light of risk analysis / vulnerability and transforming structures and processes. These are considered throughout this report, particularly in relation to Scottish Government policy and the Private Sector in Scotland, and conclusions are drawn to that effect in sections 13 and 0.

### 7.1. SURVEY RESULTS AND DEMOGRAPHICS

A total of 342 surveys were returned (split into the following: Skye = 61; Argyll = 116; Shetland = 88; Western Isles = 77), which was believed to be representative of the populations surveyed. The surveys were undertaken by approaching members of the general public in the respective locations and at a supermarket chain in each town.

In three of the four study locations, slightly more females than males answered the survey questionnaire as shown in Table 5.



TABLE 5. GENDER SPLIT BETWEEN SURVEY LOCATIONS

Location	Male (%)	Female (%)
Skye	44%	56%
Argyll	48%	52%
Shetland	41%	59%
Western Isles	51%	49%

For Argyll and the Western Isles this gender split was fairly representative of the general population, in Skye and Shetland the split was biased slightly more towards female respondents than in the general population.

In all four case studies, the majority of respondents were aged 45 and over, potentially reflecting an aging population in the West and North of Scotland (Figure 12). The under-25 age group was less well represented in all locations.

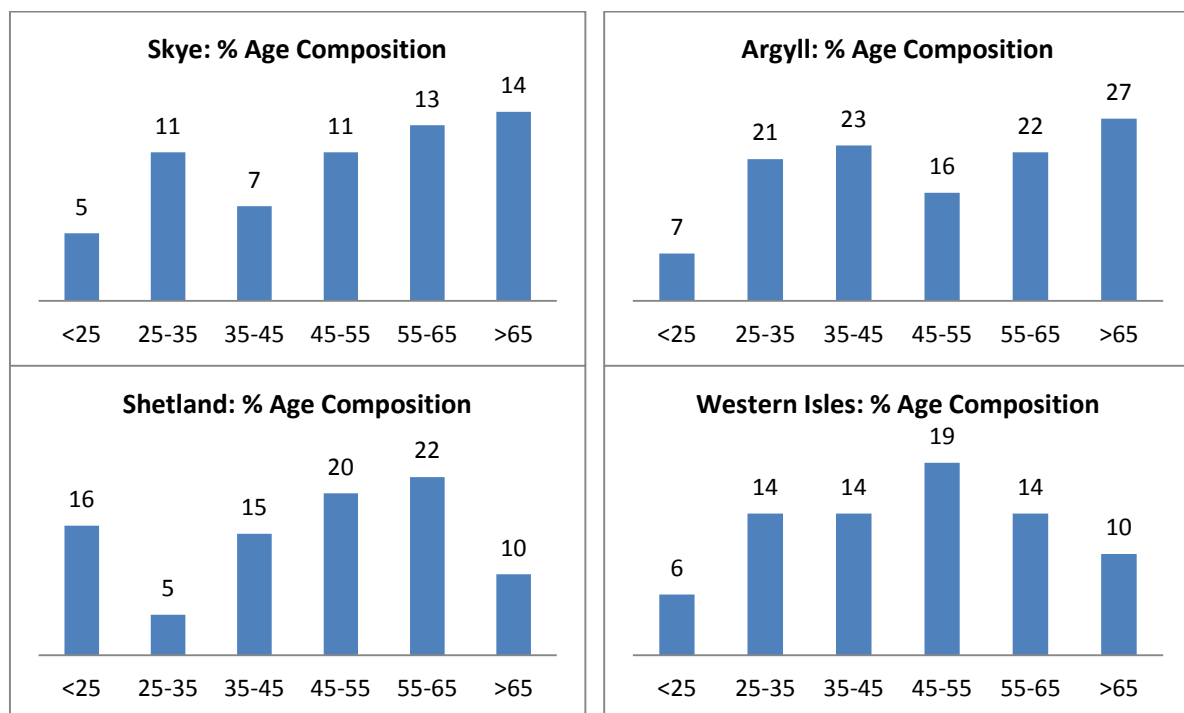


FIGURE 12: AGE COMPOSITION FOR CASE STUDY LOCATIONS

In all case study locations, the majority of survey participants had undertaken further education (either at college or university level). In Skye, 52% of respondents, in Argyll 58% of participants, in Shetland 56%, and in the Western Isles 64% of respondents had undertaken further education. This would suggest that the respondent population was generally well educated. Additionally a number of participants had chosen the 'other' option, although this type of education was not disclosed.





## **7.2. SLA FINDINGS**

### **7.2.1. QUANTITATIVE ANALYSIS**

The spider diagrams / asset pentagons are at the core of the quantitative analysis for the livelihoods framework and provide a visual opportunity for representing the inter-relationships between the various assets. In the following figures the image is based on the number of responses from the surveys undertaken. The scale radiates out from the centre of the pentagon, with the centre representing zero responses and the outer edge being the highest number of responses received. The use of the pentagon is intended as a visual representation and allows analysis at a high level of the general opinions from around Scotland.

In a development context, the pentagon can be used as a way of analysing how aquaculture production impacts on people's access to, or availability of, each type of asset. In this case the method has been adapted and used as a way of highlighting people's perceptions of the key benefits of aquaculture to Scotland. Essentially, the further out from the centre a point is, the more important it was considered by the population surveyed.

This analysis includes spider diagrams (also known as asset pentagons) showing quantitative results for each regional location and the whole of Scotland, which have been discussed in relation to the key topics raised in the interviews. Following this there is discussion relating to each of the types of capital with quantitative results displayed graphically and explained using interview findings and quotes.

The diagrams in Figure 13 show a similar pattern between each of the locations and in the total surveys for Scotland. There is a strong indication that human capital is perceived as being the greatest benefit, which was largely in terms of employment or availability of jobs as discussed in Section 7. The financial benefit through income to ancillary businesses and local community follows closely after, with social benefits next. The negative opinions are generally low, but with a clear focus towards the environment and negative impact of aquaculture both directly through inputs to the environment and also through the landscape and visual impact.

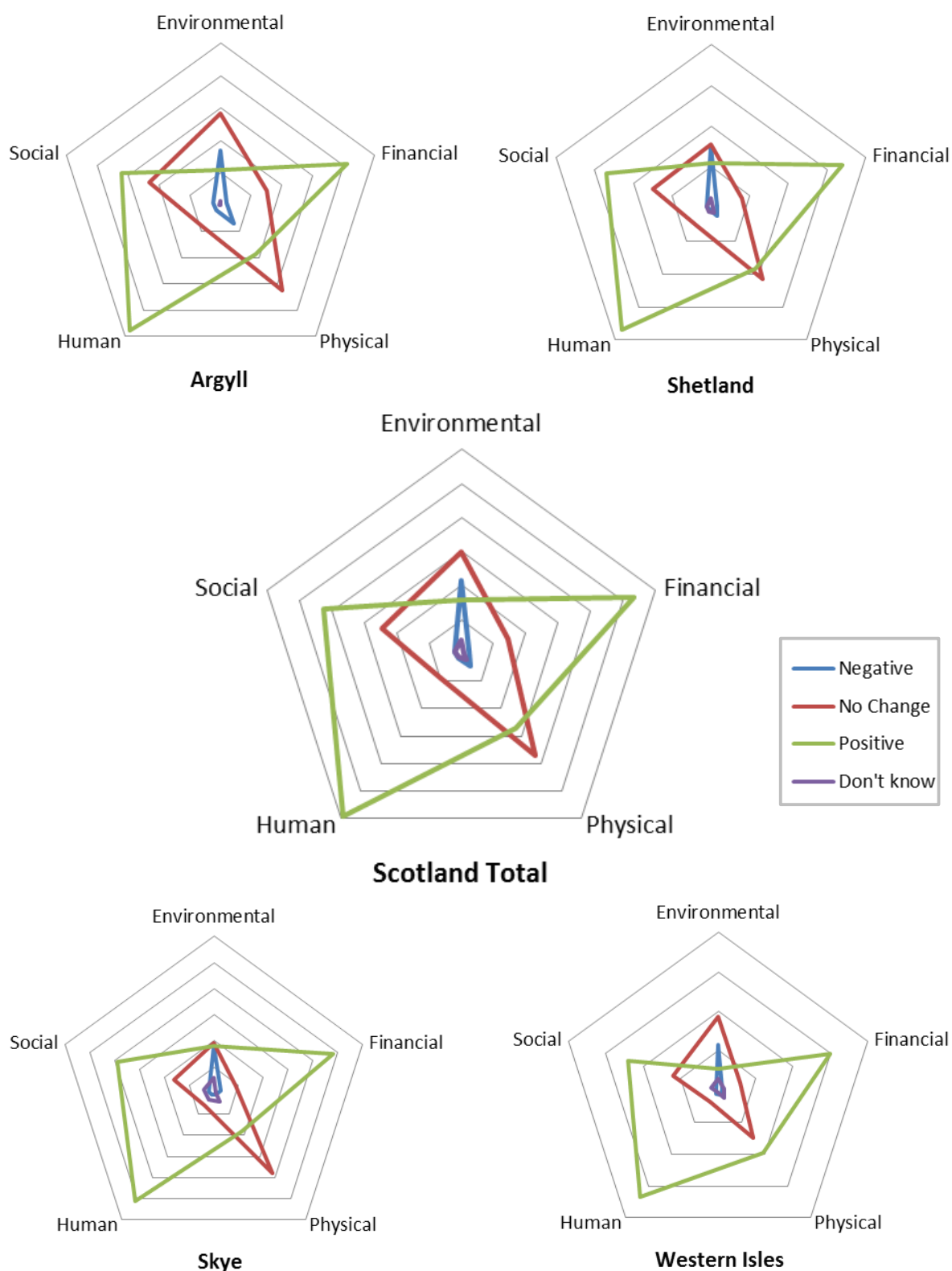


FIGURE 13: ASSET PENTAGONS SHOWING PUBLIC PERCEPTION OF THE BENEFITS OF AQUACULTURE TO SCOTLAND (SCALE FROM CENTRE-OUT IS NUMBER OF SURVEY RESPONSES)



### 7.2.2. QUALITATIVE ANALYSIS

The process of qualitative analysis used interviews with topic guides (see Annex 15.2) to allow the respondents to discuss the key types of capital as they felt appropriate, without leading the questions towards any particular response, therefore ensuring unbiased feedback. A total of 9 sub-categories were identified within Human Capital, 8 within Social, 17 in Financial, 17 in Environmental and 4 in Physical. The categories are listed in Table 6 and a tick is included to indicate the locations where each subject came up in discussion.

TABLE 6. SUB-CATEGORIES WITHIN EACH CAPITAL AS IDENTIFIED IN QUALITATIVE ASSESSMENT / INTERVIEWS

Type of capital	Sub-category	Skye	Argyll	Shetland	Lewis
Human	Economies of scale	✓	✓		
	Education	✓	✓	✓	✓
	Foreign workers				✓
	General employment	✓	✓	✓	✓
	Local employment	✓	✓	✓	✓
	Migration	✓			
	Research		✓	✓	✓
	Skills & training	✓	✓	✓	✓
	Youth employment	✓	✓	✓	
Social	Community Campaigns				✓
	Community Events	✓	✓		✓
	Improved communication	✓	✓	✓	✓
	Location branding		✓	✓	
	Maintaining communities		✓	✓	✓
	Recreational angling			✓	✓
	Schools	✓	✓	✓	✓
	Sponsorship	✓	✓	✓	✓
Financial	Boat hire	✓			
	Boat yards & moorings		✓		
	Carriage	✓	✓	✓	✓
	Equipment				✓
	Exports	✓	✓		
	Fish retail & wholesale	✓	✓		
	Fishing	✓	✓	✓	✓
	Foreign ownership	✓	✓	✓	✓
	Funding	✓			
	Hotels	✓			
	Loan Schemes			✓	
	Local suppliers	✓	✓	✓	✓
	New money	✓			
	Research	✓		✓	



Type of capital	Sub-category	Skye	Argyll	Shetland	Lewis
	Rural economies				✓
	Tourism	✓	✓	✓	✓
	Value adding	✓	✓	✓	✓
Environmental	Benthic	✓	✓		
	Biodiversity		✓		
	Debris	✓	✓		✓
	Escapes	✓			
	Feed waste	✓		✓	
	Fish oils		✓		
	Monitoring	✓	✓	✓	✓
	Noise		✓	✓	
	Pesticides		✓		
	Regeneration	✓			
	Sea lice	✓	✓	✓	✓
	Seals	✓	✓	✓	✓
	Spat	✓	✓	✓	✓
	Toxins				✓
	Treatments	✓	✓	✓	✓
	Visual Impact	✓	✓	✓	✓
	Wild Stocks	✓	✓	✓	✓
Physical	Boats	✓	✓		✓
	Anchorage		✓		
	General infrastructure		✓		
	Harbours, piers & slips		✓		✓



### 7.2.3. HUMAN CAPITAL



Human capital (including skills, education) in this analysis included experience and participation in the workforce (employment). This has been intentional to not only highlight the financial value attainable through paid employment, but the experience, know-how and self-actualisation that can be grown or shrunk according to the success of, and operational approaches taken by, the aquaculture industry. However, employment remained strongly identified as a source of income as well as a human capital that gave someone knowledge, experience and therefore employment 'security'.

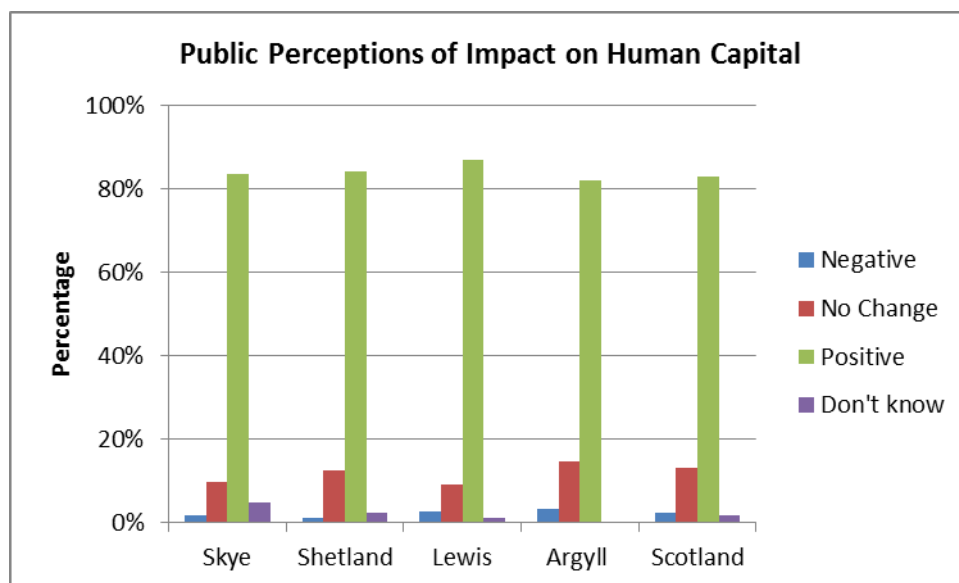


FIGURE 14: PUBLIC PERCEPTIONS OF IMPACTS OF AQUACULTURE ON HUMAN CAPITAL

#### **Summary Discussion of Survey Results**

Aquaculture was strongly perceived by survey respondents as having a positive impact on human capital (translated as jobs/skills/education). Between 82 and 87% of responses amongst the study locations and for Scotland overall sat within this category. Some respondents felt that there was no impact on human capital (between 9 and 15% across the locations). Eight respondents overall felt that aquaculture had a negative impact on human capital, with the largest number of those in Argyll. Very few respondents (6 overall) did not know what impact aquaculture had on human capital.



### ***Top Topics from Interviews***

The key issues that emerged as being of high importance across the study locations were: general employment (which can then be further split into employment for locals and youth employment) and skills and training.

Employment was the most discussed topic when asking respondents about human capital. Jobs were the most recognised benefit of aquaculture in Scotland, and in two of the study locations (Western Isles and Skye) it was believed that aquaculture was one of the biggest employers in the area. However, although jobs were viewed as important, it was highlighted by a number of respondents that there are not as many job opportunities now as there were in the past.

*Well, if we go back a few years when the fish farm was locally owned and locally managed there was an awful lot of jobs here. It's a lot more automated now. There's definitely not the amount of staff that there used to be.*

Hotel Manager, Skye

This was suggested to be due to the automation of farm systems by some interview participants, and due to consolidation of the industry to larger companies and larger units leading to the reduction of labour by others.

The aquaculture industry was also viewed as being a 'good employer' which provided a wide variety of quality jobs, which pay well and which were constant throughout the year (unlike other sectors in Scotland such as the tourism industry).

*So veterinary jobs, biologist jobs, some of the aquatic scientists because we have to monitor our benthic impact...then quality jobs, quality of the product, quality of the raw materials... then there's the growing of the fish themselves.*

Aquaculture Employee, Argyll

Interview participants suggested that there wasn't much alternative employment in a number of the locations that aquaculture can be found, and that in fact in many instances, fishermen were actually moving into the aquaculture industry. However, it was proposed that this wasn't the case in Shetland where there was plenty of available employment.

*There isn't much employment, alternative employment. The fishing industry isn't doing, because that's comparable, quite a lot of fishermen go to fish farming and vice versa, and the fishing industry isn't doing that well either.*

Aquaculture Employee, Western Isles

The aquaculture industry was particularly viewed as providing jobs for local people in small communities. Often, farms particularly are placed in areas which are both rural and difficult to access. Employees tend to be found within a fairly small catchment area. Farm managers suggested that in fact they would specifically try and employ from a local village if at all possible and largely it was believed that the local benefits would be of most importance for those more remote areas.

Some disagreement was evident amongst participants regarding whether aquaculture was of any benefit to youth employment. Some participants believed that whereas fifteen years ago there were a number of 'young lads' involved in aquaculture. Nowadays those employed tend to be more mature. However, others felt that aquaculture provided an opportunity for those school leavers who wanted a career that meant that they could stay in the area that they were brought up.



*I see young boys who are earning really good money. It was unheard of, leaving school at seventeen, eighteen, they're driving about in a good car. That's because they're working in fish farms. That's a good thing.*

Recreational Angler, Shetland

Aquaculture also benefits human capital in terms of skills and training. Firstly, within the study locations, two education/ research institutes (Shetland and Western Isles) offer training courses, both in the form of practical skills such as survival at sea, VHF radio and boat navigation skills. Additionally, one institute offers basic SQA SVQ level II and III qualifications in aquaculture finfish and for shellfish (although the latter has not yet run). Also in Shetland, a Secondary 3 and 4 National Progression Award (for Secondary School pupils) runs which covers European aquaculture, finfish and shellfish farming amongst other topics. Some organisations also run their own internal training programmes. Skills which are learnt as part of aquaculture training are transferable, and can be used in the fishing industry as well as offshore industries such as oil and gas.

*I keep hearing of people who maybe started on a fish farm, got some boat-handling skills and then they've developed from there into the fishing side or gone offshore. And they've all worked vice-versa.*

Local Council, Western Isles

In addition to the training offered by education/research institutes in Scotland, aquaculture is becoming an area of interest at the primary school level, particularly in Shetland. A project is currently being developed called 'Shetland Seafood Project' which aims to educate primary school children about seafood, and about aquaculture. In addition, Shetland Catch in Lerwick offer school trips where children can learn about what is done in the factory. In terms of public education, it was also suggested by a number of respondents that interpretative facilities which could educate the public about aquaculture would be of real benefit.

### ***Other Key Points of Interest***

A number of other topics were also raised in relation to human capital. Much research is ongoing in Scotland amongst a number of establishments, increasing Scotland's intellectual capital in relation to aquaculture and this was recognised by a number of respondents who referred to examples of research undertaken relating to sea lice and cleaner wrasse, but who also pointed out the need for targeted research to allow the industry to expand.

Finally, in Lewis particularly, there was some discussion regarding foreign workers and the suggestion made that the majority of those who work (particularly in processing factories) are Eastern Europeans. This was refuted by a local farm manager who explained that a minority of workers were foreign, but who also pointed out that those who come to work in aquaculture often stay in the area, thus adding to the human capital potential within Scotland.

*Mostly local, some migrant workers who had actually stayed here and married here and had kids here who were going to school here.*

Aquaculture Employee, Western Isles

However, it was also pointed out that internal migration also occurs as part of the employment process for the aquaculture industry. Aquaculture can bring people in to more rural and remote areas.





#### 7.2.4. FINANCIAL CAPITAL

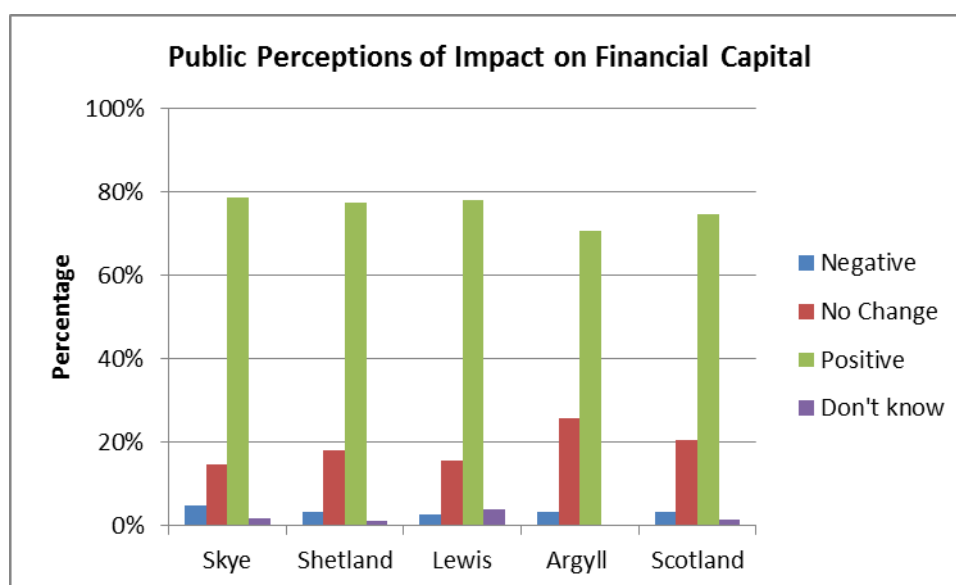


FIGURE 15: PUBLIC PERCEPTIONS OF IMPACTS OF AQUACULTURE ON FINANCIAL CAPITAL

#### **Summary Discussion of Quantitative Results**

Aquaculture is strongly perceived by the individuals surveyed as having a positive impact on financial capital (Figure 15), with 75% of the responses. Only 3% of those people interviewed felt that the impact was negative, 1% didn't know and 21% felt there was no change as a result of the industry being present.

The results show very little geographical differences of opinion in relation to how people see the impact on financial capital as well as the total and the average for Scotland as a whole.

#### **Top Topics from Quantitative Results**

In the interviews, three key issues – local suppliers, carriage and tourism - were highlighted as being of high importance across all geographical locations.

Many of the interviewees commented on local suppliers and the wider financial benefits within communities surrounding aquaculture locations. Discussion indicated that a benefit was felt throughout the value chain both downstream and upstream of the farms themselves, including suppliers of equipment from nets, cages and fish feed to storage boxes for the fish during transport. Service providers were also commonly mentioned such as welders, electricians, engineers and local



mechanics / boat yards for vehicles and boats. Those upstream of the farms included processors and haulage companies both locally and nationally. In a number of cases these service providers work with a number of different industries, but the presence of aquaculture provides the economy of scale required for them to remain a viable business, with some now expanding and providing new work opportunities nationally. Interview participants also noted the use of boat hire, boat yards, equipment and even local hotels by the industry.

The benefits to local suppliers were particularly relevant in rural communities where the farms supported local businesses indirectly for example by employing staff who live locally and supporting rural shops.

*You can see by the amount of stuff that's out there, its feeding its way right down through the whole economy. They're buying ropes, they're buying chains, they're buying plastic this and boxes and whatever. It goes right through the whole community.*

Recreational Angler, Shetland

*We've done...a study on this plant and its impact locally, economically. So for every £1 in wages we spend here that generates £4...because every pound that the guys spend here on the island has a knock on effect.*

Aquaculture Employee, Western Isles

Carriage / haulage was regularly mentioned as a separate benefit from local suppliers, partly as the scale of it was perceived to be so large. In a number of cases well boats were noted as having a negative impact as they are seen as coming to the farms from outside and taking fish away without benefitting the communities where the farms are. In the case of Shetland and the Western Isles, carriage was viewed as particularly important for the role it plays in sustaining the ferry services by trucking products off the Islands for sale on mainland Scotland. Back-filling trucks with aquaculture products helps keep costs down for the trucks supplying superstores, and therefore benefits communities by keeping prices competitive. The support for ferries also keeps costs down for tourists, a key part of the Islands' economies. The carriage benefits are felt both by the large-scale hauliers as well as the smaller couriers who move around value-added products for the processors.

*All our food is moved by Fergusson transport, which is huge. If we're producing 50,000 tonnes a year, then they're moving 60-70,000 tonnes of feed around the West Coast...it's been a huge boost for them, they've gone from a lorry haulage company to one that shifts feed by train and by boat.*

Aquaculture Employee, Skye

*Our industry is effectively subsidising the public purse in providing a lifeline service to Shetland. If it wasn't for the salmon industry in particular, we wouldn't have the service we've got because it would be financially unjustifiable.*

Industry Body, Shetland

Tourism is a key industry in Scotland and another key topic of discussion during the interviews. Negative opinions were expressed by some people regarding visual impacts, however a number of tour operators actively approach farms to show tourists, particularly on days with less wildlife sightings. In some cases aquaculture directly benefitted tourist operators as an alternative source of revenue through training of staff in boat handling.



*We discuss fish farms as we go past on the tour boat, and it is quite a major part of it...it does take up to 10-15 minutes of the discussion on how the process works and so on and so forth.*

Hotel Manager, Skye

*You know I do training for the fish farms as well. So there's obviously that as well and that keeps me going through the winter, keeps some of my team working through the winter as well. So it's all generated from the money fish farming makes...I would say 75% of the work for that business is generated by fish farms.*

Tour Operator, Western Isles

Those involved in value addition also spoke positively about the benefits of the aquaculture industry for tourism both in terms of the supply of fish and shellfish, but also as a product that is sourced locally. Within Argyll and Bute in particular, discussion highlighted that the Economic Development Plan has 'Food and Drink' and 'Tourism' as two of the four key economic drivers and that they should not be considered as mutually exclusive.

*When somebody comes here and wants a memento from here or to take something back from here, it has to be sourced as much as possible from here. That's important.*

Processor, Western Isles

In general there was a feeling that there could be greater interaction between tourism and aquaculture by actively promoting fish and shellfish farming to tourists, with Scottish production considered something to be proud of.

*It would be nice if some of that [money from aquaculture] was put back into things like a visitor centre, that type of thing, something educational. And an organised trip to have a look around the cages and even on land. I could see that as a real positive.*

Tourism Representative, Shetland

### **Other Key Points of Interest**

Value addition was considered of high importance to the financial capital of the aquaculture industry, positively in terms of retail / wholesale and employment, as well as negatively in locations which see high production and associated environmental impacts but less income from processing.

*The big employer in the aquaculture activity is not the production; it's the downstream activity – the processing, the packaging, the added value products. If you're producing a thousand tonnes of fish, you're creating 3 or 4 jobs producing fish and 30 to maybe 80 jobs processing the fish.*

Consultant, Argyll

*I think some companies have decided that it is more cost effective to send it down to the bigger companies on the Scottish mainland and just produce the fish here and get them processed on the mainland.*

Local Council, Shetland

*It's something that bothers some people that some companies don't process, they just pick up the fish in the well boat and take it off the island...fish that is just taken away somewhere else with very little community benefit at all.*

Local Council, Western Isles



For those smaller companies that have remained successful in value addition, the distinctly Scottish product allows them to sell to a niche and high-value market both in Scotland and internationally.

*We do a lot in Europe: France, Spain and Belgium are our main mail order stuff. At Christmas time we do a lot of corporate stuff out in America and Canada.*

Processor, Argyll

*All the chefs...would far rather have "Skye Mussels" than just mussels. I mean, they all say that even if there's a difference in quality or whatever, they'd still rather have that "Isle of Skye mussels". People will pay more...if you've got that brand. Same with oysters.*

Wholesaler, Skye

The issue of recreational fishing arose on a number of occasions, particularly with fisheries trusts and individual anglers. Strong opinions exist regarding potential financial impact, however this seems to be being managed better now than previously, although the loss of Area Management Agreements was noted on more than one occasion along with an associated reduction in dialogue between farms and fisheries.

Rural economics was raised, highlighting the importance of aquaculture in relation to survival of fragile communities (as is discussed further in the 'social capital' section).

*It's probably more beneficial to the Hebrides because of the economy we have over here than over in the mainland where they have such a variety of things, it's actually an asset to our Island I would say.*

Supplier, Western Isles

Some of the stronger concerns relating to financial capital were linked to the impact upon commercial viability of fishing, particularly for in-shore operations which are closer to aquaculture farms.

*There is great concern that nobody seems to have an answer to, whether the chemicals used on the fish farm are affecting the live storage of shellfish, and that's become a major issue.*

Local Council, Western Isles

A further issue raised was foreign ownership, although many of those directly involved in the industry acknowledged the growth in local suppliers, such as those mentioned above.

*I believe it's a Norwegian company which owns these ships. That's disappointing because there are 4/5 of these ships on the West Coast of Scotland and that revenue is disappearing to Norway.*

Hotel Manager, Skye



### 7.2.5. SOCIAL CAPITAL

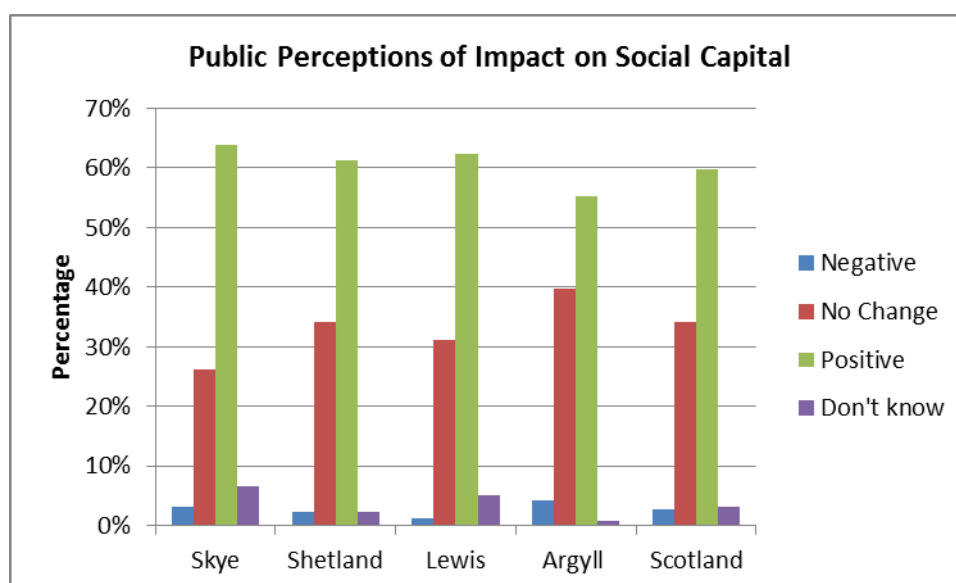


FIGURE 16: PUBLIC PERCEPTIONS OF IMPACTS OF AQUACULTURE ON SOCIAL CAPITAL

#### **Summary Discussion of Survey Results**

Public perceptions of the impact of aquaculture on social capital (interpreted as family and community) are largely positive. Between 55% and 64% of the respondents surveyed in the four study locations believed that aquaculture was good for social capital. A total of 11 people out of the 356 surveyed didn't know what the impact was, while 10 people believed that there would be a negative impact. Of the five types of capital investigated, social capital was the one which the respondents felt was least likely to be impacted (positively or negatively) by aquaculture. Nearly a third of all respondents picked the 'no change' option.

#### **Top Topics from Interviews**

A number of topics arose as being central to the concerns of the public regarding social capital: that aquaculture helps to maintain communities was the most common. This is closely tied in to human capital, as it is the provision of jobs which allowed communities to be created and maintained. The provision of these jobs means that specific age groups (particularly those of child-bearing age) can stay in rural and fragile communities, having potential knock-on effects. It was also suggested by one respondent that those people who have worked in aquaculture and who are highly skilled and



well paid are important for the social structure of a community, that they are likely to be active in things like community councils.

*I suppose by having aquaculture in some of these more remote outlying areas potentially it might help bring young families in, which these areas are missing, which obviously then has a knock-on effect for schools and things like village shops etc. These are all aspects of community which have been under threat in outlying areas...*

Local Resident, Argyll

It was however pointed out by a couple of respondents that there was a conflict becoming evident in relation to aquaculture helping to maintain communities. This conflict exists between those locals who want to maintain communities by staying in the area where working for the aquaculture industry allows them to do this, and those who have retired into the area to get away from urban life, who don't want to see anything industrial affecting their perception of a 'natural' area.

*You'll find that an awful lot of the incomers, the folk that have moved up here from the South don't want to see it happening. They don't want to see the place getting developed. But, on the other hand you know, it's keeping us all here. My son certainly wouldn't be here if we weren't here. I don't think I'd be either.*

Processor, Argyll

The ability for improved communication between the aquaculture industry and the communities within which it sits also emerged as a key topic of discussion. Although not obviously related to social capital, the need for industry and the public to work together and communicate well can only help to maintain the social fabric in these communities. Additionally, improved communication and working together can only help to expand the aquaculture industry as negativity and conflict would be reduced.

*...some have engaged better than others and some have learnt the hard way that it does not pay to engage. Because when they antagonise the community by in the community's view not listening to them then that never pays so it's always better to negotiate. Some have learnt that better than others.*

Local Council, Western Isles

Sponsorship was another key way in which aquaculture was viewed by respondents as benefitting social capital in Scotland. Although, as was noted by a number of respondents, aquaculture does not play on the same field as renewable energy for example, they are still involved in providing sponsorship for sports teams such as the Shinty league (Marine Harvest North and South Divisions), badminton teams and sailing clubs. Community events have also been sponsored with the aquaculture industry providing vouchers and doing 'guess the weight of the salmon'. Also, the aquaculture industry has assisted towards funding community infrastructure. In Skye, gardening equipment was supplied to a local school and all of the stone for a war memorial supplied and delivered by an aquaculture organisation. In Argyll, an aquaculture organisation helped to supply moorings into a harbour to help develop the area and another helped to sponsor a local swimming pool.

*We've got the local swimming pool here in Lochgilphead which was sponsored by SSC and they have their logo somewhere at the pool and provide a source of income to a really important community resource there, because it has been teetering on the brink and a*





*number of times has come very close to getting shut down. I'm not saying that the fish farm company has actually saved them, but they've certainly contributed towards sustaining that community resource.*

Local Resident, Argyll

### ***Other Key Points of Interest***

A number of other topics were also raised for discussion during interviews. Again linked to the provision of jobs and the maintenance of communities in fragile areas, it was felt by a number of respondents that indirectly the aquaculture industry was assisting in keeping primary schools open and this was of particular importance in Argyll. Indeed, there was a push for support for a planning application from people who lived in the area based around keeping the school open.

*There was a big push in support for the application from people who lived at Ulva Ferry, purely on the basis that things like the local school were down to absolutely tiny numbers and getting one or two children could make a big difference as to whether that was a viable rural school or whether it was likely to be one that was on the death list.*

Local Council, Argyll

A social activity, recreational angling, was on a number of occasions raised as being negatively impacted by the aquaculture industry. Largely this was through the impacts upon wild fish (which is discussed in the environmental capital section). However, in one instance a respondent pointed out that actually the aquaculture industry was helping the angling association by providing feed.

*I need to say that our programme of restocking is actually supported by the local industry in that they supply us with feed for our stock, for our brood stock. Which is not a huge amount of money, but it's a few bags of feed that we get when we want it from them.*

Recreational Angler, Shetland

Last but not least, a couple of interview participants pointed out that the aquaculture industry has been very important in terms of 'location branding'. Oban, Argyll has been marketed as the seafood capital of Scotland with food and drink being one of three key growth areas in Argyll and Bute – aquaculture is a large part of that. For Shetland also it was believed that aquaculture helped to promote Shetland's name throughout the world.

*I would say that as soon as you get, when you have quality products like quality Shetland smoked salmon, that type of thing, if that is being sold in supermarkets or whatever down south, then obviously that's going to have a positive effect as long as it's good.*

Tourism Representative, Shetland



### 7.2.6. PHYSICAL CAPITAL



Physical capital can refer to the resources available to regions, individuals and communities, including in this context the provision of ferry services, power, slipways, housing, broadband and other infrastructure.

The economics of ferry services are complex, but (as seen in Section 8.2) the value of aquaculture products helps make a strong financial case for the provision of what can be per capita an expensive infrastructural project. Broadband internet is similar in that it is particularly costly to install for a small community, but when a new commercial development takes place, these fragile rural communities are able to make the most of economies of scale and have broadband installed. For the aquaculture company installing the network they appreciate the limitations of having a business and social activities in areas with poor service and so see the benefits of working with communities in the development.

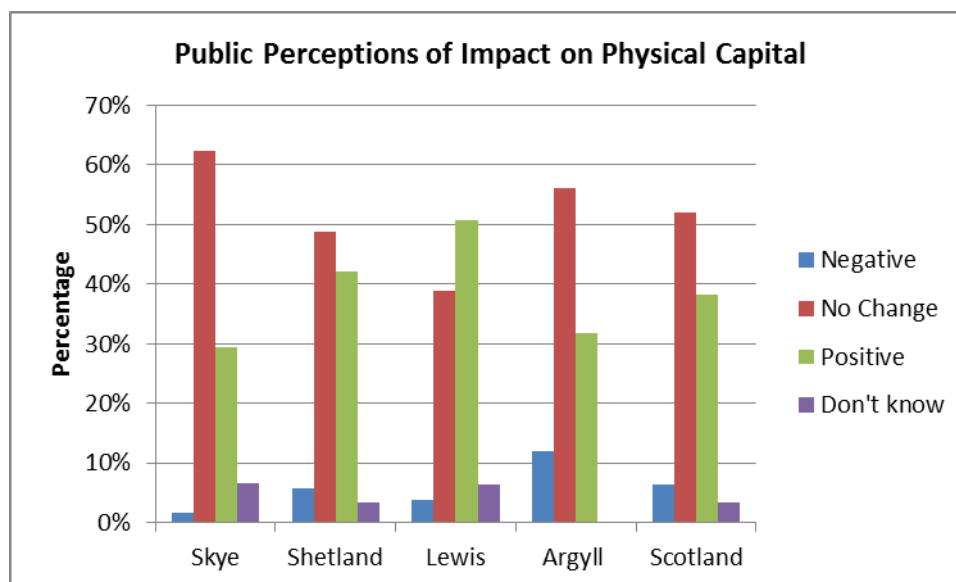


FIGURE 17: PUBLIC PERCEPTIONS OF IMPACTS OF AQUACULTURE ON FINANCIAL CAPITAL

#### **Summary Discussion of Quantitative Results**

It is clear that very few individuals felt that the impact of aquaculture had been negative on physical capital, with only 6% of the total surveys in Scotland. While 38% of people believed that the impact was positive, 52% felt there was no change and 3% didn't know.



Geographically there are some differences in opinions; however the overall opinion is certainly that that the impact was either positive or no change. In Argyll 12% of responses suggested a negative impact on physical capital, which was considerably higher than other locations and no individuals gave 'No response'. The location with the most positive feedback was Lewis with 51%, which also had the lowest number of people saying there had been 'no change'. Skye had the largest number of people saying there had been 'no change' with 62% - the highest of any response to physical capital.

### ***Top Topics from Quantitative Results***

The key topic in relation to physical capital was marine infrastructure developed by and used by the aquaculture industry i.e. harbours, piers and slips.

*There is also a side benefit to fish farming. A lot of the harbours and the small slipways have been improved dramatically by the fish farms, which are also of benefit to the locals as an indirect benefit. There's a lot of very, very good slipways and small harbours have actually been made by the fish farmers which are benefitting the local anglers. All that would never have happened if it hadn't been for fish farming because they are taking in bigger boats and they needed better facilities and that's what's happening. So that's a side-kick that has benefitted the local community, not economically, but by making life a little bit easier.*

Supplier, Western Isles

In a few cases there was frustration that farms can be required to remove marine infrastructure such as piers and slipways when they are decommissioned. A number of interviewees felt the planning system should state that farm infrastructure that can still be useful for members of the public should remain after farm has gone.

*You're creating an infrastructure for the future then even long after the fish farm has moved on or closed down then that remains a community benefit – not just for the locals but for visiting community of people to want access to the water too. So having a slip way nearby that the operators will be able to use, should be made available to the public, to the aquaculture sector so that if for example aquaculture sector said we want to build this thing here, then those same benefits could accrue to the visitor economy.*

Tourism Representative, Argyll

In some cases it was felt that aquaculture companies should be more open to allowing members of the public and other industries to use their facilities, however most often the comments were positive and showed the effort industry has gone to in allowing access.

*In Lemreway I think it's like a communal facility but Marine Harvest improved it. And yes, locals do use them, both there and the one on Harris.*

Aquaculture Employee, Western Isles

*The pier at Oban achieves quite a lot of aquaculture for loading feed, some harbours at Mallaig have well boats coming in for harvesting fish. We are very supportive of all of our industries using our pier / harbour, and our new policies are very supportive of that...we need to be using them for all sectors together.*

Local Council, Argyll



Negative views expressed in relation to aquaculture and physical capital were largely around recreational yachting.

*Farms create, they tend to be in sheltered lochs and the like that would potentially be yacht moorings or anchorages for visiting yachts maybe...it's the anti-social problems with the noise, and it's just generally not a great thing for attracting visitors...the West Coast is where you go to get away from it, that's what a lot of them are after.*

Boatyard Employee, Argyll

*Recreational boating can be an issue, in terms of yachting, in terms of particularly if sites are inappropriately located so they make it difficult getting into moorings and anchorages and that sort of thing.*

Local Council, Argyll

However, there was also some positive feedback in relation to recreational boat users and aquaculture from within the tourism industry.

*Marine infrastructure – harbours, slips, hard standing, craneage – the kinds of facilities that modern recreational boaters expect. And I use the term recreational boater to describe everyone from rich men in large yachts down to dudes with a canoe! When it comes to infrastructure planning or improvement, then the principle of mixed use and widest possible benefit should strictly apply.*

Tourism Representative, Argyll

#### **Other Key Points of Interest**

Other points of interest relating to physical capital were the use of ferries and well boats, however, these are covered in the financial capital section (7.2.4). Another area of interest is in relation to ancillary services to the aquaculture industry, such as boat repairs.

*I was doing work for the Port Authority in Stornoway last week and I was talking to one of the guys on the slip way and he said if it wasn't for Marine Harvest we wouldn't have work. The only boat building and servicing that's coming in is now all the barges and boats and stuff are from the fish farming industry.*

Tour Operator, Western Isles



### 7.2.7. ENVIRONMENTAL CAPITAL

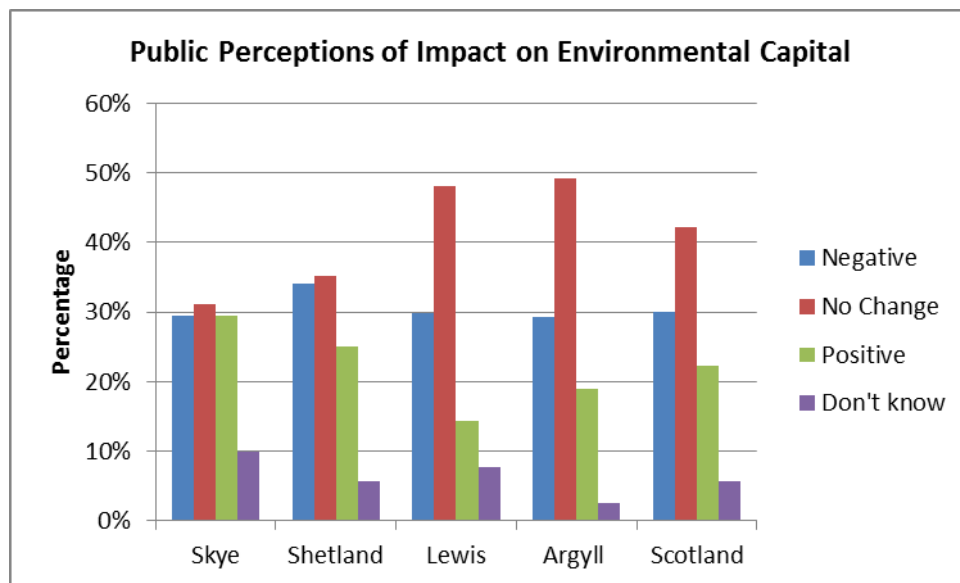


FIGURE 18: PUBLIC PERCEPTIONS OF IMPACTS OF AQUACULTURE ON ENVIRONMENTAL CAPITAL

#### Summary Discussion of Survey Results

In each region (except Skye) the proportion of negative reactions to the impact on environmental capital exceeded the positive reactions but in all cases the 'no change' option predominated. The ratio between negative and positive was highest in Lewis and lowest in Skye. In general there was a relatively superficial understanding of the nature and extent of the ecological impacts of aquaculture, indicating an educational need or communication gap.

#### Top Topics from Quantitative Results

**Interactions with wild fish** was the most discussed topic in relation to aquaculture and the impact on environmental capital, which is not unexpected. The key issues raised were in relation to the economic impacts on recreational fishing through decreased catches, escapes and sea lice. Although the comments were largely negative, there were a number of individuals who noted that there have been positive improvements in the aquaculture industry.

*We take a fairly pragmatic approach here and we realise [aquaculture] its important economically, it's a growing industry that is slowly but surely cleaning up its act and becoming more efficient and a bit less controversial – lessons have been learned and in the*



*main they've been acted on. But it's still viewed with a degree of caution by the wild fish sector because in some respects it's a dirty industry.*

Fisheries Representative, Skye

*The number one impact is really sea lice, the problems with sea lice and also escapees and genetic integration...The industry's accepted that, certainly at a local level, but it's about how we move forward. We do have good relationships...but there's still quite a bit of room for improvement. There's still a level of distrust I think between us and them.*

Fisheries Representative, Western Isles

The **visual impact** was also raised as a top issue both by residents who were directly impacted as well as those with concerns regarding associated impact on tourism. A number of people commented on mussel farming being of greater visual impact than fish cages, particularly in relation to debris as discussed later in this section. There were also interviewees who suggested that the visual impact is fairly subjective and down to individual opinions, so not always negative.

*The salmon farms in the voes, it's pretty unsightly, but then I think the most unsightly thing is the mussel rafts in voes. Just lines and lines and lines of them ken? It's unsightly, salmon farms in the voes like. It f\*\*\*s you off sometimes when you are trying to take a photo and you are trying to do it at night and the f\*\*\*\*\*g fish farm lights are on.*

Wildlife Photographer, Shetland

*The only issues we ever get raised in connection with applications are the fact that some people are of the view that these things are unsightly and the spoil lochs and all the rest of it, and they make them unattractive for tourists. I'm not sure that that's the case. Anecdotally I think that people find these things quite interesting. If you are travelling around Argyll and you see a fish farm in the water, it's probably not going to spoil your day.*

Local Council, Argyll

**Debris** was the third highest topic raised during the interview process across the regional locations. The indication was generally that this impact is less than it has been in the past, with impacts generally perceived to be worse from mussel farms than from fish farms.

*Well we get a lot of stuff floating on the water here which has come from the fish farms... And we get up in the mornings sometimes and it almost looks like washing up liquid. And it's all frothy round the edges. I do worry about what sort of impact that's having because it doesn't look very nice.*

Boatyard Employee, Skye

*If you look at all the mussel farms out there...they're not regulated as tightly they just cut loose all the old floats and they either sink or float to shore and old rope they just let them sink to the bottom. So that's just lying on the seabed. Then through time things are getting caught up in it and then come loose and are just floating about the Loch. All the tabs and this is the plastic sticks they use for catching the mussels on, that's never going to, in our life time and probably in loads of lifetimes, that's probably always going to be there.*

Tour Operator, Western Isles





### **Other Key Points of Interest**

Concerns over chemical **treatments** were raised by a number of individuals but not all within the same context. Concern from the wild fishing sector was particularly in relation to the impact of chemical treatments on wild shellfish stocks and those being stored in lochs. In addition to negative comments there were, however, some comments noting the improvements that have been made.

*In that area when sediment surveys were done they were something like...I would say 150 times the level of chemicals in sediments that were taken to what should be there... SEPA seems to be auditing everything that's being done but it seems to be that it's totally unenforceable from an audit point of view.*

Commercial Fishing Representative, Western Isles

*Well personally I think it's a good thing now because I think we've got to grips with a lot of the chemicals and things that they were using in the beginning and I think they are more environmentally friendly.*

Wholesaler, Skye

The levels of monitoring and auditing within the aquaculture sector came up in interviews with some suggesting not enough is done, but others indicating that there have been improvements and that the level of regulation has been positive for reducing the impact of aquaculture operations.

*...in general the Community Council are in favour or are happy with a proposed expansion on the basis that SEPA are on top of things, SEPA are monitoring which is a given, they are going to be anyway.*

Community Council, Skye

*We're audited to death now – I think I had 13 audits last year...Environmental issues – again, we're so closely monitored, we're so closely audited and sampled and tested that it's not really an issue now days. All our waste has to be disposed of properly and we're audited for fish in fish out, and very closely watched and have to toe the line. Which from my point of view is great, it's the way you want things to be.*

Aquaculture Employee, Skye

In relation to mussel production a few key issues were raised including the lack of spat settlement following over-production in particular lochs and the potential for harm to recreational yachting.

*The mussel farms and the increase in fouling on the bottom of the yachts. I don't know how you prove that, but it definitely does seem to have increased since the start of mussel farms in this area. Presumably it's if you put mussel farms in the area, there's a higher density of mussels and therefore there is more spawning and so naturally you get more fouling.*

Boatyard Employee, Argyll

*So what we've seen in the last three years has been no spat whatsoever in the Loch Roag area for mussels. And what the mussel farming sector have to do there now is introduce spat from outwith that area you know, if they're going to survive. So whatever seems to be happening, the balance in the marine environment has shifted and the only thing that I can see that's been introduced there is additional chemicals.*

Commercial Fishing Representative, Western Isles



### 7.3. MOST SIGNIFICANT CHANGE

The most significant change (MSC) methodology was included in the quantitative and qualitative research to ensure the data captures an overall picture of the factors which survey participants thought were the most important impacts of the aquaculture industry. By engaging 356 relevant stakeholders in answering the MSC question, this evaluation broadly considers the impacts, both positive and negative and across the diverse spectrum of different possible areas, at the local level.

The responses were grouped as per the five categories of capital in accordance with the SLA. The responses are displayed in Table 7. As well as the figures in the table, there were a total of 68 individuals surveyed who preferred to state 'no response' to the MSC question.

TABLE 7. MOST SIGNIFICANT CHANGE RESULTS

		Skye	Argyll	Shetland	Western Isles	TOTAL	
Human	Providing jobs	34	72	41	45	192	206
	Providing jobs for young people	1	3	3	2	9	
	Rural employment		2	1	2	5	
Social	Maintaining communities	3	4	2	2	11	14
	Problems for recreational boating		2			2	
	Improved quality of life			1		1	
Financial	Contributing to local economy	3	4	7	5	19	27
	Price of fish	1		1		2	
	Providing seafood		4			4	
	Wasted funding			1		1	
	Impacting fishers				1	1	
Environmental	Polluting the environment	6				6	39
	Visual impact	3	3	6	1	13	
	Affecting wild fish		4	2	4	10	
	Lice		1			1	
	Pollution		1			1	
	Benthic impact		1			1	
	Escapes		1			1	
	Impacts on seals			2		2	
	Debris			1		1	
	General environmental impact				3	3	
Physical	Improving slipways	1				1	2
	Upgraded roads			1		1	

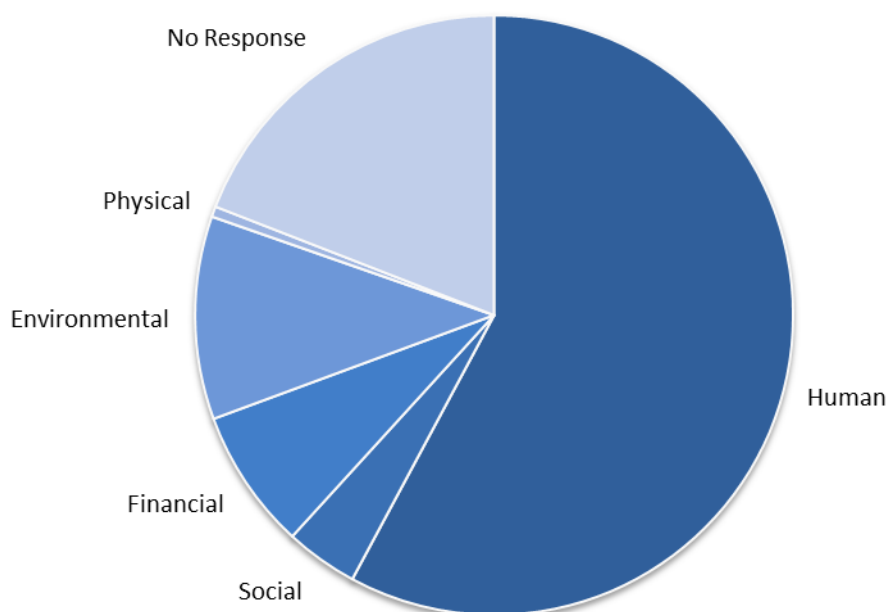
A breakdown by area has been included in the table to highlight the wealth of data collected by the MSC methodology and to enable regional comparisons to be made. Using the data for those who responded to the question, the popularity of the different areas is highly consistent and follows the same pattern – “human” gained the most votes, followed by “environmental”, “financial”, “social” and lastly “physical”. Furthermore, the range in the relative popularity of each type of capital across locations was 10%, 3%, 5%, 5% and 2% for human, social, financial, environmental and physical capital respectively. Therefore the data shows that there was a high degree of uniformity in the



responses collected across the country. The consistency in these findings suggests that these results could act as a good indicator for the views of individuals elsewhere in Scotland who are impacted by aquaculture at the local level but could not be included directly in the research.

There were some slight variations in the data between locations. For instance, Argyll and the Western Isles seemed to rank the impacts of human capital relatively slightly higher compared to Skye and Shetland where greater weighting was assigned to environmental impacts. Furthermore, Shetland residents appreciated the financial impacts comparatively more than the other areas.

The overall responses for the combined statistics for the four locations are shown in Figure 19 as a proportion of the total. The majority of the people responded by saying that the human impacts of the aquaculture industry have provided the most significant change. As shown by the table, although this category can be subdivided into three separate categories, essentially all of the responses in this area highlighted the improved job prospects locally as a result of the aquaculture industry. It is likely that this category came out in pole position because job security is a key area of concern in remote and fragile communities where the aquaculture operations are based. The state of the employment prospects in these more vulnerable locations means that often individuals are more concerned with the availability of secure job opportunities rather than their pay levels, allowing continued residence in the area. These findings show strong correlations with the findings for human capital (Section 7.2.3) which confirmed that most individuals think that the aquaculture industry has had a positive impact on human capital and mainly due to the benefits to job opportunities.



**FIGURE 19. SUMMARY OF MOST SIGNIFICANT CHANGE RESPONSES**

Interestingly, even in those categories which gained fewer votes, such as social and financial impacts, the most popular sub-headings (“maintaining communities” and “contributing to the local economy”) are both directly related to the sustainability of these rural communities, and hence they tie neatly into the job security issues discussed above. This theme was also highlighted in the social and financial capital sections (Sections 7.2.4 and 7.2.4) where the maintenance of communities and local suppliers were the most commonly cited benefits. This provides further proof of the perceived importance of the industry in supporting the fragile communities that accommodate aquaculture farms.



The second most popular response to the MSC question was “no response”. These individuals felt that they could not select one single most significant impact of the aquaculture industry.

Figure 19 shows that the third most popular answer (11%) was that the environmental impacts of aquaculture are most significant. This category of response, as shown by the breakdown, captures predominantly negative impacts and which roughly mirrors the findings in the environmental capital section (Section 7.2.7) where the majority of responses showed either “no change” or “negative” environmental impacts. The main three MSC impacts noted were pollution, impact upon wild fish and visual impact on the landscape. However a broad range of issues were highlighted under this category. In some instances, we know that the responses was referring to a negative effect based on our qualitative findings, for example our qualitative research helps us to understand that those mentioning visual impact mean that the farm infrastructure has a negative rather than positive impact upon the landscape.

Those who stated that financial impacts were the greatest (7.6%) were referring to a mixture of both positive and negative impacts however 93% of the responses were referencing a positive issue such as providing cheaper fish to the local area. Although some of the main topics from the qualitative research (Section 7.2.4), namely haulage and tourism, were not specifically mentioned in the MSC analysis, they can both be considered to contribute to the “Contributing to the Local Economy” sub-heading.

The social and physical impacts were less popular responses to the MSC question as they gained only 3.9% and 0.6% of the overall responses. This was probably to be expected for physical capital because over 50% of those asked thought that the aquaculture industry did not have any impact on physical capital at all. Overall, the MSC responses for these two categories showed that whilst the impacts tended to be very similar to those discussed in the qualitative analysis (see Sections 7.2.4 and 7.2.6), these factors are considered of less importance than those covered in the other types of SLA capital.



## 8. ECONOMIC GEOGRAPHY

Consideration of economic geography is essential in the analysis of the benefits of aquaculture, since its production is well suited to providing sustainable employment and income generation in remote areas that might otherwise lack alternative economic options: and since it can also interact with other industries in rural areas e.g. through visual impact, tourism opportunities and local environment. To this end, analysis is undertaken in section 6 of the impact it has on livelihoods in Argyll, Skye, Western Isles and Shetland.

However, as value chains develop to handle aquaculture's increased distribution and export volumes, and increasing appetite for feed, we can see the substantial impact it has on jobs in other parts of Scotland which are closer to warehousing, transport infrastructure and agriculture supply chains. This 'other half' of the aquaculture industry remains largely unrecognised, even though it employs 100s of managers, warehousing and haulage staff and contractors across economically disadvantaged regions of Scotland, and provides an estimated £20-30m<sup>137</sup> in revenue for Scottish agriculture.

Finally, while there are economic drivers for basing certain activities across Scotland, there is vibrancy in the downstream processing and retail sectors across all areas: from the award-winning Frankie's Fish & Chip shop in Brae, Shetland, which sources local mussels; to Aquascot, an employee-owned salmon processing company in Alness (north of Inverness) exceeding £30m turnover; to traditional fish processors in Aberdeenshire now processing farmed salmon; to DFDS Logistics in Larkhall shipping a next-day delivery service to France.

Mapping this economic geography offers some unique insights into where the industry value lies. In particular, the hypothesis that the non-HIE regions benefit from the rural aquaculture industry is very well founded and should be captured in GVA, employment and other measures.

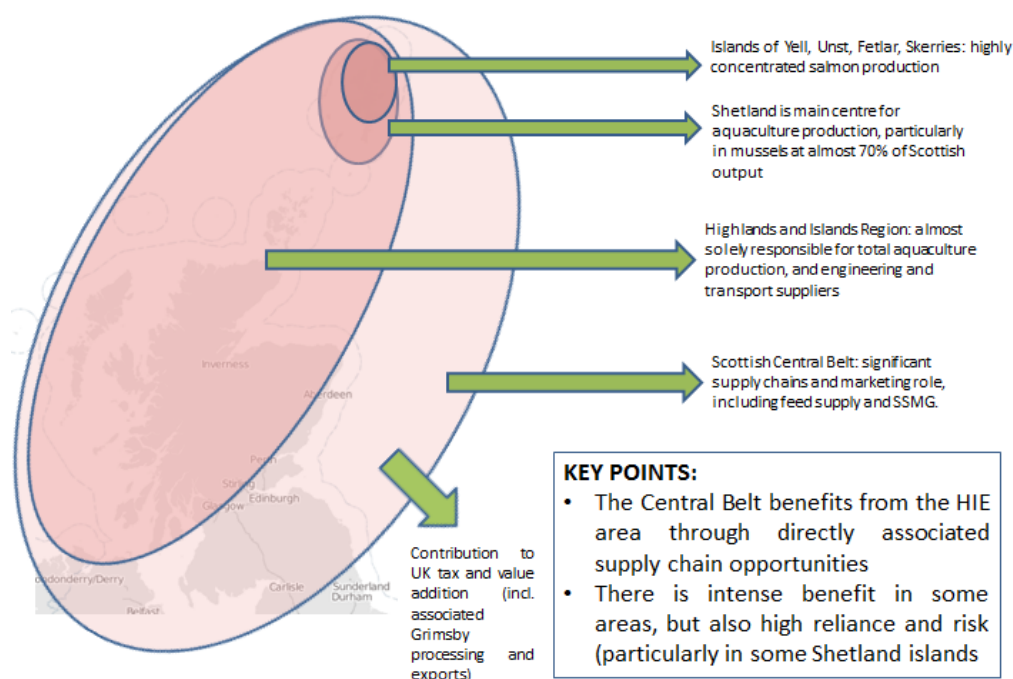


FIGURE 20: THE CONCENTRIC VALUE CHAIN

The Shetland aquaculture industry typifies the benefits that can be gained through the Scottish Government framework aspiring to sustainability of the population and the economic principles of



solidarity, cohesion and sustainability. There is an intensifying, concentric relationship for Shetland within HIE, and even the North Isles within Shetland. It highlights the dependency of some areas on aquaculture, which means there is high value but also a degree of risk due to the reliance on the industry.

Focal points, or heat spots of activity, can be found in surprising places. For example, in the landlocked village of Ford in Argyll a reasonable proportion of the working population of households are somehow engaged in aquaculture related activities i.e. Loch Awe trout, Lochgilphead area salmon, as well as the Ford smokery. It suggests not just that aquaculture jobs are sufficiently high value that local employees are prepared to travel long distances to work (a livelihoods issue itself), but that there may be few alternative sources of employment. The Lanarkshire area is another focal point for non-production stages, both for inputs and on-processing or distribution. The numbers of people may be relatively small, but illustrate the degree to which some areas are benefiting, and depending on, aquaculture production. In aggregate, the contribution to the economy, not least in the provision of services, is considerable, and this is why it is essential to consider the multiplier of the production section of the value chain, not just the GVA of the production itself.

In the Highlands, there are integrated arrangements with suppliers which suggest that the straight GVA capture of the production side does not give a full picture. For example, Marine Harvest has co-invested with Ferguson Transport to fund specialised liquid tankers and trailers. Such integration should suggest a valuation of such investment as a core business cost (and contribution to the wider economy) of the aquaculture industry.

### **8.1. HIGHLANDS AND ISLANDS REGION**

The economy of the Highlands and Islands has distinctive attributes based on its historical economic development and more remote location. The HIE Operating Plan (2012-2015)<sup>138</sup> priorities are:

- Supporting businesses and social enterprises to shape and realise their growth aspirations
- Strengthening communities and fragile areas
- Developing growth sectors, particularly distinctive regional opportunities
- Creating the conditions for a competitive and low carbon region

Food and drink is cited as a priority sector, and this is a good characterisation of the area in which the HIE area can benefit through aquaculture, since the provenance of salmon and its processing should be considered as vital to the development of the food and drink sector. This should be addressed where possible, for example through the SALSA project (safe and local supplier accreditation): above all raising awareness of what is possible within regulations.

The plan also cites 'solidarity', 'cohesion' and 'sustainability' among its economic growth priorities, including maintaining the average European population growth. To achieve this, youth employment has been a policy consideration. These objectives complement the Scottish Government's broader strategies for economic development, and is strongly borne out in the priorities of rural communities in the sustainable livelihoods analysis.

In all these respects, the aquaculture industry should be seen as a strong and positive contributor, particularly in strengthening fragile areas through employment and income generation. To this end, HIE are able to, and should continue to, work with aquaculture companies on overcoming barriers to doing business in the region. While many businesses in the salmon industry are now large and





neither require nor are eligible for enterprise grants, trout and shellfish producers should be supported in their efforts through strategic funding. The European Fisheries Fund (EFF) was repeatedly cited by mussel farmers as having given value development support, with £5.8m recently awarded to Scottish organisations<sup>139</sup>.

Geography is central to defining aquaculture's position in the Highlands and Islands, since it is the most suited area for aquaculture, and a planning moratorium on development on the East Coast of Scotland, which includes traditional angling rivers such as the Don and Spey. The UHI-NAFC based in Scalloway in Shetland is an active supplier of training for the industry. Developing a 'skills ecology' (see policy recommendations) will be vital in the years ahead to create a virtuous circle, or education multiplier.

## **8.2. AQUACULTURE CONTRIBUTION TO RURAL SERVICE PROVISION**

Aquaculture production has a relevant inter-relationship with the provision of public services in Scotland, in particular rural infrastructure including ferry routes and roads. Farming often takes place in remote rural areas, including islands, and requires transport for inputs (such as large volumes of feed, equipment, divers and other services) and outputs (live fish, harvested fish, and fish in various stages of processing). This means that a high value industry depends on the provision of adequate transport links. Factors to consider are as follows:

- 1. *Mitigating the perceived cost of public service provision obligations:*** The first benefit is that aquaculture can nominally, if not directly, recover the cost of provision of subsidised transport when local or national government are committed to maintaining those transport links for social or wider economic reasons. For example, the islands of Yell and Unst benefit from regular ferry links with the Shetland mainland, the cost of which is borne not just by customers but by Shetland Island Council. An appreciation of the value of salmon production taking place there (estimated at £37m per annum) means that the subsidy which is considered a loss in economic terms can be seen as a productive economic, as well as social, investment. This contribution to the islands' physical capital is borne out clearly in the sustainable livelihoods analysis.
- 2. *Aquaculture industry as requiring protection of, or additional, provision of public services:*** Conversely, the argument can be taken beyond the mitigation of cost, and aquaculture production can be used as a reason to protect or improve public service provision. In the case of the Yell and other North Isles (NI), aquaculture was cited as the major contributor not only to the GDP of those islands, but of Shetland and in turn Scotland overall<sup>140</sup>.



**BOX 3: THE YELL COMMUNITY COUNCIL MADE THIS ARGUMENT AGAINST PLANNED CUTS TO THE FERRY PROVISION LINKING TO THE MAINLAND**

“The NI produce 25% of Shetland's salmon (£37m + per annum):  
[...]

- has contributed to the factory in Scalloway to remain functioning
- employs 93 people in the NI to feed and grow the salmon
- employs an estimated additional 200 employed in the industry with related work for divers (4-5 commute daily over Yell Sound), net cleaners, harvester factory processors and hauliers
- contracts 2 to 3 artic lorries to transport processed salmon from Yell 5 days per week [...]

“The North Isles produce 950+ tonnes of mussels per year and expanding:

- this figure includes an additional 200 tonne from Unst [...]
- demand is double to what currently produced
- mussel industry is helped along with the salmon by the way of freight: salmon is produced in greater volume, allowing shared costs of freight for other users
- employs 18 in NI and 10 in mainland [...]

“Yell CC would again, respectfully point out that all Councillors need to be aware that the overall economy of Shetland is also dependant on this ferry service. [...]

“Another point worth giving serious consideration: Shetland's biggest export is salmon and if this is hampered then the cost of goods imported will increase. The most cost efficient way to transport from the Isles is by ferry and road. If the ferry costs increase and service is reduced salmon producers will begin looking at alternatives.

Recent history shows us how sheep sales in Shetland were badly affected when livestock were exported directly from Unst to the Scottish mainland bypassing Lerwick. There is the concern that salmon producers could try a similar method - again by passing mainland Shetland and thus increasing import costs.”

There are of course limits to the cost-benefit of subsidising services on the basis of supporting industries, but in this case the ferry services were retained, and all respondents concurred with the validity of this argument. Shetland aquaculture representatives meet with ferry service providers regularly to discuss how journeys best fit with industry needs. One can compare this case study with comments from a salmon company representative running farms in the Western Isles, who stated that ferry companies were not set up to assist the aquaculture industry and in turn made export from the islands more challenging.



### 8.3. CENTRAL BELT (AND NORTH EAST) IMPACT

In the Central Belt there is a potentially huge unacknowledged GVA that is not only indirectly supplying the aquaculture industry, but may be considered part of it given the increasing vertical integration that is taking place. Feed supply, discounting the large imports of feed inputs (which do not directly benefit farm production in Scotland, only agro-processing of that feed), employs around 600 people and provides income for Scottish farmers growing wheat and beans, though this is likely to be around 10% of total feed supply.

There is a significant economic contribution through processors in the North East of Scotland, for example John J Ross in Aberdeen, which sells high value smoked salmon, selling in Waitrose at £5.99 per 200g<sup>141</sup> (i.e. equivalent to £30 per kg at retail). Salmon processing is hard to quantify because some of it can be undertaken by salmon producers themselves (at primary processing stage, and some at secondary), and some processing takes place outside of Scotland, particularly in Grimsby. However, even conservative assumptions show £270m in processing value to Scotland, with over 1,400 people employed<sup>142</sup> from Scottish salmon. There are also planning, head office, research and consultancy jobs emanating directly from Scotland's aquaculture activities.



**JOHN ROSS JR SCOTTISH SMOKED SALMON**

This award-winning Scottish smokery uses oak and beechwood to cold-smoke salmon in traditional red brick kilns, which really makes a difference to the final taste. The delicate balance between smoke and fish is very impressive, and the tender, silky texture is really enjoyable – especially when put in a bagel with plenty of cream cheese.  
**£5.99 for 200g from Waitrose**

#### BOX 4: SHETLAND SHELLFISH FARMER

“How many jobs in Edinburgh are depending on Shetland?”



#### **Research, regulation, representation and headquarters:**

SSPO in Perth; SSC in Edinburgh; SSF, Landcatch (Alloa), Institute of Aquaculture in Stirling. Estimated 300 employees (including up to 10% of salmon producer employees).

#### **Feed:**

**Grangemouth:** Biomar has 50 direct employees for production of salmon feed.

**Bathgate:** Ewos has 65 employees from across the Central Belt, supplying feed to Scottish producers and for export, with approx. CAPEX spend of £2.5-3m / year. In 2011 export sales from EWOS Scotland to the EU and Norway increased by over 30 percent to 15 000 tonnes.

#### **Logistics:**

Larkhall: DFDS has 70 employees and 80 subcontracted hauliers for handling aquaculture products

#### **Total benefit to the Central Belt:**

Employment: between 1,400-2000

GVA: min. £150m

Turnover: over £450m

#### **Processing and Marketing:**

Bellshill: Scottish Shellfish Marketing Group employs 83 people serving 20 members (farming 37 HIE sites) with total sales of £13.7m

Livingston: Macrae Foods employ 200

Rosyth: large processing plant planned for 2014, up to 500 jobs

FIGURE 21: THE CENTRAL BELT: SUPPLYING THE RURAL AQUACULTURE PRODUCTION



The Shetland shellfish farmer's question is quite pertinent: 'jobs in Edinburgh' and across non-Highland Scotland are substantial – for example, Macrae in Livingston employ over 200 processors,<sup>143</sup> and the Morpol Rosyth plant planned for 2014/15 could employ hundreds of workers (500 jobs being cited) and process as much as 40,000t once operational.<sup>144</sup>

On available data, there appears to be a fairly even split in economic value across the supply chain between the Highlands & Islands and the rest of Scotland.

#### 8.4. SHETLAND: TYPIFYING AQUACULTURE IMPACTS FOR SCOTLAND'S GROWTH

As demonstrated above and in section 6, consultation in Shetland (and their 2011 regional accounts) drew out clear models and lessons for Scotland in terms of benefits, and prospects for growth. Critical to this section is noting that Shetland produces almost 70% of Scotland's shellfish output, and around 30% of its salmon: therefore its approach is as much the rule as the exception.

Shetland's aquaculture sector produces a total value of £156.3 million, with a value add (GVA) of £49.5m. It generates 'export' (from Shetland) earnings of £144.1 million, compared to import value of £93.7 million for inputs. It is the highest contributor to Shetland's growth in recent times, with a contribution of nearly 15% of turnover and 10% of GVA in 2011.

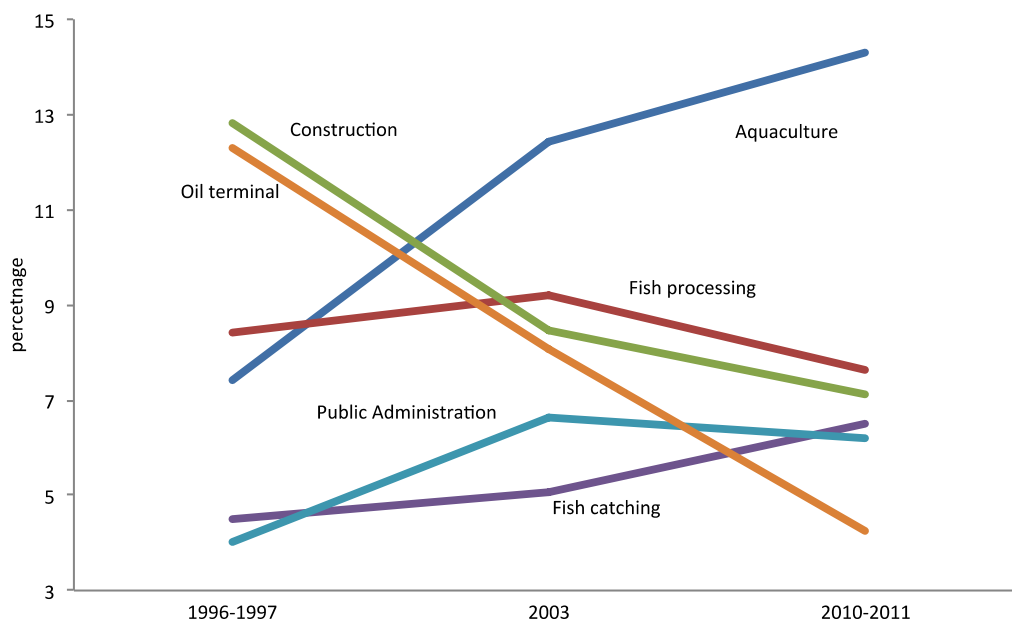


FIGURE 22: RELATIVE CONTRIBUTIONS OF LARGEST SECTORS TO VALUE OF OUTPUT SINCE 1996-97, SHETLAND<sup>145</sup>

Proportionately, aquaculture continues to have an intensity of impact in regions like Shetland, even when the total value may be comparable in the Central Belt. The benefits of investing in human capital (skills, education) can pay dividends here – securing suitable candidates to take positions in remote areas can be challenging (as borne out in sustainable livelihoods and industry interviews). Shetland College (part of the University of Highlands and Islands) offers management, accounting and administrative skills, and these could be as much value to the sector as nautical college skills.



## 8.5. INDUSTRY CONCENTRATION & OWNERSHIP

The concentration of ownership in the salmon industry is notable, with 4/5 large companies: the recent acquisition of Meridian Salmon (under Morpol) by Marine Harvest, for example has been conditional on the divestment of Scottish farms in order to avoid the concentration of up to 40% of total production under one owner. Significantly, the European Commission cited Scottish salmon's differentiation in the market as a contributory factor, stating that:

*"There is an important group of customers with a clear preference for salmon farmed in Scotland as compared to salmon farmed in other countries, in particular Norway.*

*"As a result, the possibility for customers to buy salmon from other origins would not have been sufficient to defeat a possible price increase of Scottish salmon. Nor would alternative suppliers in Scotland have been able to offset such a price increase given the lack of sufficient spare capacity. Finally, high regulatory barriers make entry in the market for Scottish salmon unlikely in the foreseeable future and in any event insufficient to remove the identified competition problem.*

*"The commission therefore concluded that the proposed transaction, as modified by the commitments, would not raise competition concerns. This decision is conditional upon full compliance with the commitments.*

*"The commission also found that the transaction would not raise any competition concerns as regards Norwegian salmon farming and primary processing, and salmon secondary processing."<sup>146</sup>*

The combination of 1) constrained supply or market entry and 2) lack of direct substitutability with salmon with foreign origins will indeed affect the growth and benefits of salmon production, particularly for on-processing and availability or affordability for consumers.

However, there are other contributory factors to consider in evaluating whether industry concentration and ownership is beneficial:

1. **Quality assurance and risk management:** A common refrain in the industry is that 'you should've seen how things were done 10 years ago', whereby a less 'professionalised' (or 'cottage industry') and more dispersed industry structure negatively affected:
  - the quality of management of inputs such as feed (the excess supply of which directly affects a farm's benthic impact)
  - disease control, and
  - fish escapes.

It is commonly agreed across all stakeholders that industry concentration has brought a higher degree of risk management and professionalization. This favourable influence has also benefited smaller producers by proxy. It presents a strong case in support of a relatively concentrated set of industry players, since these factors are the foremost downside risks affecting the industry today and are considered as critical factors for success. Re-organisation of the industry's sites, whereby each company seeks to have 'its own areas' (or a 'one-loch' policy), means that there are clearer demarcations of responsibility and management. This is supported by planners and industry alike, though it increases the barrier to entry for new or existing small producers.



2. **Financing growth:** The industry is now predominantly owned by Norwegian companies, with UK-registered subsidiaries operating within a group structure. While this means that Scotland can benefit from the tax and employment income streams deriving from the industry, it must ultimately lose headquarter management value, profit and loan interest to overseas shareholders, often still concentrated largely in Norway. For example, Leroy Seafoods is listed on the Oslo Stock Exchange, as was Marine Harvest: in January 2014, Marine Harvest was listed on the New York Stock Exchange, with a concentration of Norway-related ownership remaining, including over 30% by Gerevan Trading.<sup>147</sup> This must be accepted as legitimate and consistent with Scotland's economic principles of an open economy that welcomes competitive foreign direct investment, operating within the bounds of law and European Commission competition rules. The advantage is that Norwegian owners have been willing to invest large sums into the Scottish industry when it is clear that Scottish or UK financing has not been equally forthcoming. Conversely, they have been willing to accept the cyclical and irregular nature of profitability, where large losses can be incurred in some years (for example in 2012). If Scottish organisations and companies seek to regain ownership of value in the salmon industry, understanding the long term principles and investing in shares may be the most suitable method of re-entry, but equally by seeking to invest privately in existing smaller Scottish competitors that have a track record in competing with larger firms. However, this investment knowledge may have been lost and is hard to regain easily.

One large Scottish producer, wholly owned by a Norwegian company, noted that Scotland production is more expensive, but can equally charge a premium on its product. When presenting the business case for expansion of farms in Scotland, therefore, it compares well against its Norwegian counterparts.

3. **Indirect multiplier effect:** This includes the impact on other value-addition industries, both Scottish and foreign-owned. Aquascot, based in Alness, north of Inverness, is an excellent example of an employee-owned company producing high-quality processed salmon products. The large industry players, equally, are seeking further vertical as well as horizontal integration as per the following statement by Pal Angell-Hansen of Meridian Salmon (now bought by Marine Harvest).

*"[Meridian Salmon are] currently fine tuning the set-up and are restructuring, rebuilding and refitting to ensure a much more efficient production process. The longer we've had to deliberate over plans, the better the ideas we've come up with. By taking a closer look at the development, we think we'll be able to diversify to supply smoked salmon as well as fresh fish to the UK, European, Gulf and Asian markets. We'll be sourcing Scottish salmon from a number of areas, including Shetland and Orkney, as well as the mainland, and are even looking to source other mainland farming suppliers."*<sup>148</sup>

This strategy (or a variation of it) is now being pursued under Marine Harvest, with Rosyth continuing to be developed. The operating profit margins for large companies are volatile and this is likely to be the key driver for substantial vertical integration: but the de-risking of the industry is possibly the more fundamental factor in determining volume growth, and indeed what serves as a deterrence for funding of smaller firms.





### **8.5.1. OWNERSHIP OF SCOTTISH SALMON PRODUCTION**

The majority of Scottish salmon production is Norwegian-owned: the largest Scottish-owned firm is SSC with a target volume of 27,000t (approximately 15% of total Scottish output) for 2014: many of the sites were a result of divestments from the other large Norwegian players. How does this affect the benefits to Scotland?

From an overall industry point of view, the conclusion is that the impact of large scale, Norwegian firms has been on balance positive for Scotland, though it is regretted by many that it has not benefited more through emulating Norwegian approaches:

*“The Norwegian state and the Norwegian business community has grasped the opportunity to develop [this] market, they’ve developed the technology themselves [...] they’re extremely go ahead in terms of looking at where they’re going next with that [...] As a nation we’ve missed the opportunity, our financial institutions have not backed the opportunity, and frankly we’ve lost out and it’s regrettable but we’re pulling back a little bit. We’ve got the opportunity to come in at some level or another and take a slice of that pie [...]”*

Industry Representative

The reasons posited for the strength of Norwegian firms are, as above: 1) UK financial institutions failed to offer investment in expansion, 2) pro-active licensing and state investment in R&D than the Scottish industry, and 3) one manager suggested it was also due to the EU protectionism in the 1990s which protected the Scottish industry, slowed rationalisation in ownership, and made it an uncompetitive ‘easy target’ for Norwegian dominance once restrictions were lifted. More subtle than these points was 4) the suggestion that the scale of the Norwegian industry simply allowed it to ‘think big’ in expansion terms: combined with the other three factors this seems sufficient to create an ongoing competitive advantage. (It should be remembered that the Norwegian-owned firms have to negotiate some of these Scottish limitations as well, like identifying viable sites.)

Despite these advantages, the Scottish product remains competitive and profitable in its high-value niche. The volatility in operating profit margins tells us a great deal about the risk profile of farm ownership and investment decisions. However, it can also shed light on the strategy of large firms.

For example, the Scottish arm of a Norwegian-owned large salmon company will be submitting expansion proposals to an internal committee must justify expansion in terms of being profitable in comparison to other Norwegian proposals submitted internally. If it did not, there would be a cost in lost potential revenue to the global company.

This internal discussion is a direct and real reflection of the wider market challenges: it is not the fault of the company in question. The company has, by Scottish standards, an ability to invest significant amounts of capital, and indeed has demonstrated this through tangible growth plans and investment, and its appetite to acquire smaller firms. If Scottish investment has not achieved results that are on a par with their investments elsewhere, an opportunity has been missed which the Scottish industry should seek to avoid in future through improved strategy and funding.

The profitability of Scottish salmon must be considered in the context of its constrained supply, and that for a multinational company to ‘over-promote’ Scottish product and degrade the value of a company’s Norwegian or Chilean product should they have it (and in large volumes) would be illogical. There is a risk, therefore, that the slow growth in Scottish capacity has a two-fold effect:





- 1) It constrains volume that has high market potential
- 2) It discourages large multinational firms promoting Scottish salmon to the hilt, since it is a small volume in their wider portfolio of other national salmon stocks.

Again, it should be remembered that producing in the Scottish market is challenging and relatively expensive, so the benefits of large firms remain compelling, and any potential drawbacks should be addressed through pro-active policy, existing EU competition legislation and possibly investment models that support the interests of a diverse range of producers.

### **8.5.2. SMALL SCALE SALMON PRODUCERS**

The remaining smaller-scale salmon producers (with turnover of up to £25m) face, therefore, a multiplicity of different challenges to the larger producers, though they can also in some ways benefit from the industry structure. Many are overwhelmed by the scale of investment of the 'Big 4/5' and simply cannot compete in securing sites that have high acquisition and capital costs. However, some small producers produce salmon under contract for the larger firms, and this provides a route to market that may otherwise have been absent. The impression of the quality of salmon production is another positive benefit for remaining small producers, and the growth of the Scottish 'quality niche' in the market suggests that the rarity value of small producers remains an advantage, where they can command high value pricing strategies but also benefit from the extensive infrastructure of the salmon supply chain (for example, ship salmon overnight to international markets via DFDS Logistics or similar).

Nevertheless, it is hard to imagine that for the small producer (not for Scotland overall) it is the best of all possible market structures.

Aside from the financial implications of running a small salmon company, the owners of smaller firms (in both farming and processing) tended to have a strong belief in their contribution to the social, environmental and human capital of communities in comparison to larger firms. There is a clear satisfaction derived from producing globally admired products in remote areas, providing local employment and so on. However, this artisanal ethos was matched by a frustration that scaling up was becoming increasingly challenging.

#### ***Interaction between companies***

Both 'big' and 'small' scale salmon production has benefits to the Scottish economy. The interaction between the scale of the large companies, and small companies benefiting from those economies of scale through feed and distribution channels, has much merit. However, it does appear that Scottish producers will continue to face an uphill struggle as long as the risk management in, and access to, finance remains stacked against them.

### **8.5.3. MUSSEL INDUSTRY STRUCTURE**

As we will demonstrate further in mussel value chain (section 10.2.1), the industry's structure is very different to salmon, with 153 businesses<sup>149</sup>. However, the large volumes are now increasingly concentrated with a few key mussel growers, and there is a call from Shetland for the West Coast producers to 'keep up' with them, not least because it helps spread the sourcing of supply for SSMG members as a supply security measure.

Loch Fyne Oysters (owned by Associated Seafoods) are an example of some consolidation where they have recently bought out Hebridean Mussels in Lewis<sup>150</sup>. This is likely a function of the ability to



manage risk and to raise capital, and so perhaps after all we will see mussel production following the same logic as 'big salmon'.

## 8.6. VALUE MATRIX

The following table captures the known impact across all the aquaculture value chain, not only in economic value but also in strategic benefit for the people of Scotland. It is essential that the full contribution to Scotland's economic, social and environmental objectives are captured rather than simply an enumeration of the industry, since it is clear that the industry has intense and diverse impacts on the people it employs across the value chain and those who live in the vicinity of its production.

Figures are captured from primary and secondary data including the following:

- Company accounts
- Industry interviews
- Industry data
- Seafish processing survey data
- EU, FAO Fishstat
- Scottish Government survey data

Industry data has been tested with government survey data and publicly available sources, and vice versa. Where necessary, subsequent interviews have been undertaken to verify data. Estimates based on government multipliers suggest the effect on catalysing the economy is underestimated: with quite direct supply chain impacts alone looking to exceed the expected full impact through the economy.

Employment figures include full and part time jobs, since in a sustainable livelihoods approach a part-time role should be considered as in balance with other assets, e.g. maintaining social capital. In this context it is not correct to say that a half-time job is half the worth of a full-time job.

*Turnover* is used here to describe the broad economic activity and gives the scale of the industry, within which each sub-industry and supplier is adding value (though there are some areas such as the importation of feed where much of the value does not lie in Scotland). Using the Office of National Statistics (ONS) income method of establishing GVA, the value added by the industry and ancillary suppliers to the industry is estimated, where they are dependent on the Scottish aquaculture production. This dependency is critical.

An exhaustive survey of suppliers to the industry is not available (only for production and salmon processing), and it is very likely that these conservative estimates do not fully capture the full employment impact of aquaculture on Scotland across smaller supplier firms, for example diving supplies, consultancy etc. Where appropriate, references are provided for sources, otherwise figures are based on multiple sources.

Following the wider discussion of impact in preceding chapters, the economic values given are conservative: they do not hazard values generated through the induced multiplier of additional jobs and income injected into the economy unless considered absolutely relevant (type II induced multiplier figures are marked in grey italics). However, as stated in preceding sections of this analysis, while this effect is unreliable, it is indeed a 'true' effect where significant additional benefit is thought to be derived.



TABLE 8. VALUE MATRIX

Benefit	Type / Magnitude of Value
Total economic value of Scottish aquaculture to Scotland <sup>viii</sup>	<ul style="list-style-type: none"> <li>• <b>Minimum £800m across supply chain</b> <ul style="list-style-type: none"> <li>◦ Including fish-farming, transport, feed, processing</li> </ul> </li> <li>• Employment across the supply chain: <b>4,800 jobs</b></li> <li>• GVA across supply chain: <b>£270m</b></li> <li>• <i>Total Scottish economic activity generated directly and indirectly from aquaculture production (est.) up to £1.4bn, over 8,000 jobs.</i></li> </ul>
Value of Scottish aquaculture ( <i>production only</i> ) to Scotland <sup>ix</sup>	<ul style="list-style-type: none"> <li>• <b>Minimum £550m</b></li> <li>• <b>2,800 jobs</b></li> <li>• GVA: <b>£166m</b></li> </ul>
Capital investment across the aquaculture supply chain	<ul style="list-style-type: none"> <li>• Est. <b>£100m</b> per year</li> </ul>
Aquaculture exports	<ul style="list-style-type: none"> <li>• <b>Minimum £470m</b></li> </ul> <p>(Plus minimum <b>£30m</b> from other industries in supply chain such as Scottish feed and engineering exports)</p>
National Economic and Social Objectives	<p>Meeting Scottish Government objectives:</p> <ul style="list-style-type: none"> <li>• New industries for existing low income areas such as Lanarkshire ('solidarity')</li> <li>• A key industry for Scotland's wider Food and Drink strategy and food exports</li> <li>• Tourism: aquaculture can be positive for tourism and create a 'living landscape'.</li> </ul>
Scottish Government Environmental Objectives	<ul style="list-style-type: none"> <li>• Scottish aquaculture, despite having some local impacts which have been improved significantly over the past 5 (and certainly 10) years is, under SEPA rules, recognised as having some of the strictest and highest quality standards in the world.</li> <li>• Scottish aquaculture can further Scottish Government as assisting a transition to a low carbon economy. Salmon and particularly mussel production should be recognised as having strong low carbon credentials and provide a sustainable food source. Salmon is now considered a competitor to chicken in ready meal preparation: higher consumption of salmon in lieu of other meats such as beef could cut the carbon footprint of meat by up to 90% per portion.</li> </ul>

<sup>viii</sup> Values have been included only when attributable to Scottish aquaculture production rather than other income sources (e.g. processing non-Scottish product).

<sup>ix</sup> equivalent to 'farm-gate' though may include a variety of transport and processing arrangements depending on customer contract and company integration.



Benefit	Type / Magnitude of Value
Strategic Development	<ul style="list-style-type: none"> <li>Scotland has a high-value industry which has one of the strongest growth opportunities in the 21st Century. Global demand could rise to multiples of current production.</li> <li>The quality niche of Scottish production must be protected through marketing and maintaining rigorous standards, but has a bright future in domestic and export markets.</li> <li>Aquaculture helps Scotland maintain a balanced economy with strong rural industries and economic participation. It provides high skilled and low skilled jobs across all parts of Scotland.</li> <li>Scottish GDP growth and assisting in maintaining a balance of regional per capita income equality.</li> <li>Aquaculture provides an opportunity to learn from competitors like Norway and to institute positive change in policy and financing spheres. This lesson may apply to other industries such as whisky, where ownership and investment (and return) was internationalised while production remains in Scotland due to geographic specificity.<sup>x</sup></li> </ul>
Public / Wider Economic Benefit	<ul style="list-style-type: none"> <li>Aquaculture helps maintain the economic and social fabric of the Highlands and Islands area, maintaining rural populations.</li> <li>Aquaculture production is seen by the UN and other bodies as a key method of efficient protein / meat production in the 21st Century. It is consistent with Scotland's aim to be a low carbon economy.</li> </ul>
Value for the Highlands and Islands Region	<ul style="list-style-type: none"> <li>Minimum 2,800 jobs across production (2,300) and secondary processing / retail (500) <ul style="list-style-type: none"> <li><i>(est. 4,700 jobs across the HIE economy)</i></li> </ul> </li> <li>Total aquaculture turnover of est. £450m</li> <li>Production GVA of approx. £150m <ul style="list-style-type: none"> <li>(£145m salmon and £5m shellfish)</li> <li>Further £10m-£15m generated through associated industries</li> </ul> </li> <li>Salaries: over £60m <ul style="list-style-type: none"> <li><i>(est. income for employees generated across the Highlands and Islands: £162m)</i></li> </ul> </li> <li>Example of Highlands and Islands industry (like whisky, tourism, energy) as an engine for economic growth across the whole of Scotland, and a vital</li> </ul>

<sup>x</sup> 'Value added from Scotch whisky is reported as around £3bn – about 2½% of Scottish GDP – but this figure reflects essentially arbitrary transfer prices and export valuations. Around 10,000 people are employed in the Scotch whisky industry: their wages and salaries, and purchases of goods and services used in whisky production amount to only about £400m. To this should be added the returns to beneficial Scottish ownership of whisky related assets.' 'Scotland's Economic Future, p.19, <http://www.johnkay.com/wp-content/uploads/2011/11/Scotlands-Economic-Future.pdf>



Benefit	Type / Magnitude of Value
	<p>contributor to the wider 'Brand Scotland'.</p> <ul style="list-style-type: none"> <li>Provides high intensity benefit to 'fragile areas', meeting HIE objectives of maintaining population, cohesion, sustainability.</li> <li>Provides opportunities for youth employment and human capital</li> <li>Strengthens the economic case for public service provision (education, ferry services) for remote populations (social and physical capital)</li> </ul>
Value to the Central Belt and North East	<ul style="list-style-type: none"> <li>Number of jobs hard to estimate, but likely over 1,400</li> <li>Over <b>£450m</b> in turnover</li> <li>GVA of min. <b>£150m</b></li> <li>Central Belt and North East benefit from the Highlands and Islands farm production – this is a departure from the narrative that the Central Belt drives rural Scotland, and should aid Scotland's economic strategy of cohesion and solidarity.</li> </ul>
Total economic contribution to the whole UK	<ul style="list-style-type: none"> <li>Minimum <b>£1bn</b></li> <li>Employs minimum <b>5,172</b> people full and part time.</li> <li><i>UK economic activity stimulated by Scottish aquaculture: Over <b>£1.8bn</b>, <b>8,800 jobs</b></i></li> </ul>
<b>Salmon</b>	
Total value generated across the Scottish supply chain	<ul style="list-style-type: none"> <li>Over <b>£700m</b></li> <li>Over <b>4,000 jobs</b></li> </ul>
Total employment in salmon farm production	<ul style="list-style-type: none"> <li><b>2,200 jobs</b></li> </ul>
Total production value in salmon farming	<ul style="list-style-type: none"> <li><b>£537m</b></li> </ul>
GVA of salmon farming (production only)	<ul style="list-style-type: none"> <li><b>£161m</b> (adj.)</li> </ul>
Highlands and Islands Region (production only)	<ul style="list-style-type: none"> <li>Minimum <b>2,000 jobs</b></li> <li>GVA of <b>£145m</b></li> <li>Turnover of approx. <b>£450m</b></li> </ul>
Capital investment	<ul style="list-style-type: none"> <li>Minimum <b>£61.7m</b></li> <li>(likely exceeding <b>£100m</b> across supply chain)</li> </ul>
<b>Mussels</b>	
Total employment generated across the Scottish supply chain	<ul style="list-style-type: none"> <li>Over <b>500 jobs</b></li> </ul>
Total income generated in Scotland	<ul style="list-style-type: none"> <li><b>£17m</b></li> <li>(more likely <b>£20m</b> when including other shellfish)</li> </ul>
Total employment in mussel farming	<ul style="list-style-type: none"> <li><b>358 jobs</b></li> </ul>
Total production value in mussel farming	<ul style="list-style-type: none"> <li><b>£7.5m</b></li> </ul>
Total GVA of mussel farming (including farmer-owned processing)	<ul style="list-style-type: none"> <li>Minimum <b>£5m</b></li> </ul>



Benefit	Type / Magnitude of Value
<b>Supply Chain<sup>xi</sup></b>	
Feed supply	<ul style="list-style-type: none"><li>• Employment: Over <b>200 jobs</b> across Scotland</li><li>• Purchases <b>£20-30m</b> (est.) of Scottish arable product (wheat, beans)</li><li>• Total industry value: <b>£274m</b></li><li>• GVA of feed supply: <b>£46m</b></li><li>• Exports approx. 10% of production.</li></ul>
Processing and on-transport	<ul style="list-style-type: none"><li>• Employment: at least <b>1,420</b> employees in Scotland and hundreds in Grimsby attributable to Scottish salmon, with opportunity to increase by multiples if Scottish supply were available.</li><li>• Turnover est. minimum <b>£270m</b> in Scotland, <b>£0.5bn</b> in the UK</li></ul>

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<sup>xi</sup> NB: inputs such as feed supply provide additional jobs but the total industry value is subsumed in the turnover of the purchasing company and is part of total production value at farm-gate.



## 9. SUB-REGIONAL CASE STUDIES

The following section seeks to take information gathered within both the economic analysis and SLA chapters and highlight the key regional benefits of the aquaculture industry. The spider diagrams are the same as per section Figure 13, however they are discussed in a regional context in greater detail here, as opposed to the livelihoods assets in section 7.2.

### 9.1. SKYE

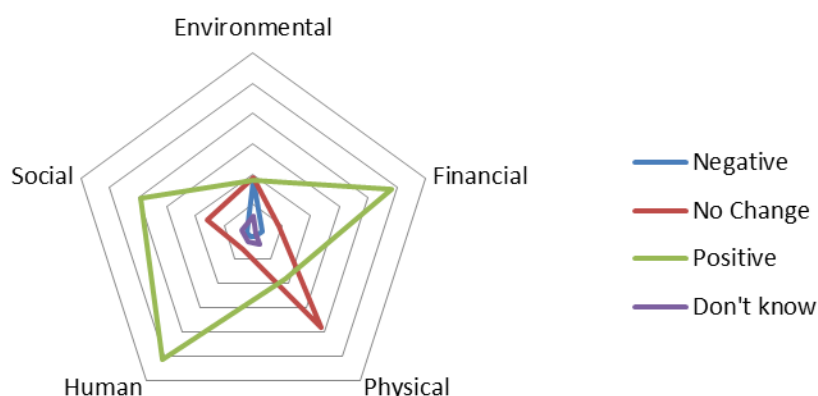


FIGURE 23. SKYE PERCEPTIONS OF IMPACT OF AQUACULTURE

Interviews suggested that there is a strong need to improve the connection between local people on Skye (and their economic activity which often relies on Skye provenance) and the fish farm industry. One local fish wholesaler in Portree pointed out that they need to source their Skye salmon from Inverness, possibly 'because of EU rules' restricting local sales / slaughter. This should be explored further and overcome, since a deeper connection with the product would be of great benefit in improving the acceptability of sites in the island. One respondent noted that a fish farm was sited on a loch directly outside a holiday rental cottage, although feedback from further interviews and surveys suggested that tourists were more fascinated by it than deterred. Far more should be done to make the 'connections' between locally farmed fish and the provenance message in tourism and tourism-related food industries, such as local restaurant and hotel servings – a lesson that should be applied to the aquaculture industry as a whole as well as in this geographical instance. The Isle of Skye has cachet and one interviewee noted specific desire from chefs for 'Isle of Skye' mussels. This was the particularly strong end of the provenance spectrum, though other areas such as the Western Isles look to differentiate further from 'general' Scottish salmon too: and Label Rouge certified salmon are farmed in the Skye area.

Economic data for Skye is often integrated with Lochaber and Badenoch figures, reflecting the economic and geographic integration, including commuting. HIE region profile notes the strong seasonality of Skye employment<sup>151</sup> due to the prominence of tourism: aquaculture can offer year-round employment. This is a significant spreading of risk at household and at an island level, and likely deepens opportunities for local employment. Nearby Skye (and an employer of people living on Skye) is the Mallaig harvest station, operated by Marine Harvest – this station reflected the sense that they have employed 'most of the town' at one time or another. This reflects the impact of having routes to employment that are accessible and available outside of the tourist season.





Associated activities including planning and monitoring of sites can provide demand for divers, environmental specialists, accommodation and transport. For example, boat hire can be up to £1,000 per day, as well as appropriate equipment and crew costs, for up to 12 days (i.e. £12,000) across 3 sites.

Plans are underway to create a fish processing site that would create a further 30 to 40 jobs (full and part time) and provide increased infrastructure to Staffin, in close consultation with community organisations:

*‘Skye Sea Harvest Ltd, working with the Staffin Trust and supported by the European Fisheries Fund, say they will move forward with extensive consultation proposing to build a state-of-the-art seafood processing facility that will not only encompass servicing the local fish farms, wild fishing and shellfish industry but will also enable the community to achieve further development of the slipway and surrounding area. The upgrade of the Staffin slipway will enable both commercial and leisure vessels to berth at all tides and access improved services delivered through the collaborative project.’<sup>152</sup>*

Benefit	Type / Magnitude of Value
Economic Contribution to the Region	<b>Employment:</b> <ul style="list-style-type: none"><li>• Direct farm employment: minimum 50 jobs (full and part time, finfish and shellfish)</li><li>• Indirect employment: accessible associated servicing and processing jobs on island and accessible parts of Scottish mainland include management, environmental &amp; planning specialists, diving, demand for accommodation, fuel, construction and other ancillary services</li><li>• Capital Investment: possible Staffin slipway, processing plant. Investment in each site (up to £15m including £3-4m equipment, plus insurance, smolts, start-up) though only some of this will accrue to local business.</li><li>• Salaries: estimated £1m per year for direct production-related jobs, with likely excess of £2m in wider economic activity.</li></ul>
Socio-economic benefits	<ul style="list-style-type: none"><li>• Could be improved with deeper connections to local supply chains, possibly improving perception of fish farms by linking them to local provenance interests.</li><li>• Some concerns about environment, but gainful employment and financial benefits seen as a priority in discussions.</li></ul>



## 9.2. WESTERN ISLES

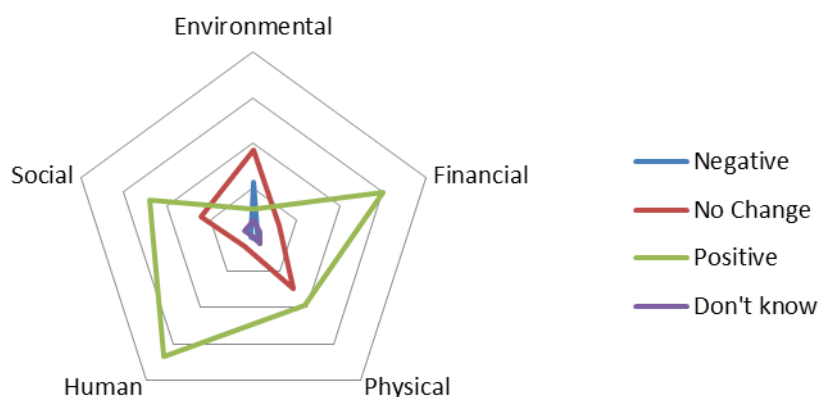


FIGURE 24. WESTERN ISLES PERCEPTIONS OF IMPACT OF AQUACULTURE

### CASE STUDY: Economic Spinoff

The Western Isles (like Shetland) have their own particular economic and social priorities. There were some of examples of resistance towards aquaculture and less integration of services - for example, ferry times were cited as inconsistent with fish transport, while in Shetland sailing times are aligned deliberately in discussion with the aquaculture industry. However, as with other areas, overall perceptions of those interviewed and surveyed indicated that the benefits associated with aquaculture in relation to employment are considered to be of greater importance.

In terms of the benefits that stem from aquaculture in the Western Isles, and its importance in relation to local economic impact, a discussion with a farm manager highlighted the following points:

*"We use [services] you wouldn't even have thought of – Hebridean Hygiene come here to replace the sanitary products and toilets - that's a wee business you know we're supporting. The vending machine guy – we subsidise that so the staff get a can of coke at a price that's cheaper than you could buy it. [...] Even for the water cooler and the milk, the bread, the soup. In the winter we use the local health board and they make soup for the staff. It's the wee things that you'd never really consider but they all have a knock on effect.*

*The other thing that we do is we service things like vehicles locally in the local garage.... We've actually done that [an economic study] in the past...So for every pound in wages we spend here that generates £4 or whatever because every pound that the guys spend here on the island has a knock on effect.*

*We use the [supplier], but [another supplier] is a big one – we've even started using them for our pallets and you're talking about a million pound spend when it's that kind of order. It's that kind of supplier.*

*We try to buy local for refrigeration. Oh we've used local builders, in fact in the last three years we've spent in order of three hundred thousand with a local building contractor.*

Aquaculture Employee, Western Isles



The interview further highlighted the use of services and suppliers from elsewhere in Scotland through equipment (Fusion Marine and Gael Force) and specialist welders who travel to the Western Isles from Oban.

The following case study is indicative of the added value that aquaculture can bring to rural areas<sup>153</sup>.

#### Case Study: Scottish Salmon Company (SSC) in the Western Isles

- The Scottish Salmon Company currently employs 196 people in the Western Isles - at 19 fish farming sites, 3 hatcheries and a harvesting station (c30 are seasonal)
- That level of employment contributes over £4m in salaries to the Western Isles economy
- In 2011 SSC made capital investments of over £6.8m at company sites across the Western Isles region
- Brand new harvest station (Arnish)
- Recently employed staff as part of a Job Centre re-employment scheme
- 3 Freshwater hatcheries and 3 Marine farms in Harris (23 staff)
- In 2011 SSC spent some £1.2m with suppliers based locally in the Western Isles – using local business, shops, hotels

Benefit	Type / Magnitude of Value
Economic Contribution to the Region	<ul style="list-style-type: none"><li>• Employment: 327 full and part time employees (including finfish and shellfish)</li><li>• Capital Investment: est. minimum £7m</li><li>• Salaries: Over £8m</li><li>• Total GVA: est. £20m</li></ul> <p>Salmon:</p> <ul style="list-style-type: none"><li>• Typical spend of £1.2m on local suppliers by large salmon company.</li><li>• Potential for further differentiation of Western Isles provenance from general Scottish for value addition.</li></ul> <p>Shellfish:</p> <ul style="list-style-type: none"><li>• Around 10% of Scottish shellfish production, 10% of mussels (629 tonnes)</li><li>• 18 businesses</li><li>• 51 sites</li></ul>
Socio-economic benefits	Potential for more collaborative activity, including greater integration of public services and tourism. More work required to determine perceptions of aquaculture in Western Isles and how to reconcile with other industrial impacts (e.g. wind farms).



### 9.3. SHETLAND

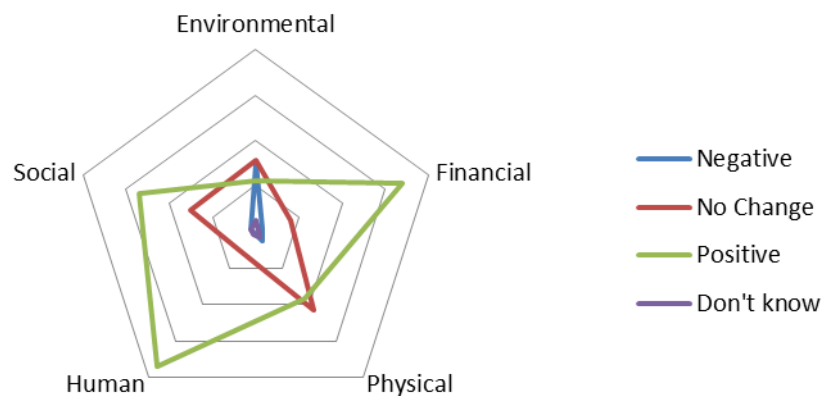


FIGURE 25. SHETLAND PERCEPTIONS OF IMPACT OF AQUACULTURE

As demonstrated throughout this report on aquaculture benefits, Shetland is the *ne plus ultra* of aquaculture impact. It illustrates effects that are more apparent there given the relative scale of the industry per head of population compared to other regions, often the same effects are found elsewhere but less recognised or are less obvious. For example:

- Aquaculture is a pillar of the Shetland economy employing around over 500 people in production, and likely exceeding 1,000 jobs in some form including processing and supply services.
- Synergy between aquaculture and fishing – high integration of both large logistics, and processing and marketing.
- Aquaculture promotes a strong identity across Shetland as a regional unit – Lerwick jobs rely on North Isle fish farming. Public services like ferries and schools are ‘underwritten’ by commercial activity in remote areas.

On physical capital (infrastructure) and economic contribution:

*“The scale and the cost of running what’s known as the lifeline service which is supported by public funds is huge. Now I turned that on it’s head, at the moment my view is that our industry is effectively subsidising the public purse in providing a lifeline service to Shetland. If it wasn’t for the salmon industry in particular, we wouldn’t have the service we’ve got because it would be financially unjustifiable. So effectively the passenger ferries and the freight ferries, which is that boat that’s just gone past, our industry is effectively supporting [...] that. When people say that we exist from a subsidy, I turn it round and say “no, the service is supported by us”, we’re a net contributor to the Scottish GDP from Shetland and therefore we’re a, you know there’s a benefit from that, and I think that’s an extremely important equation to get hold of.”*

Industry Representative, Shetland

This point of view, that there is a holistic approach in Shetland to the economic infrastructure, in order to further the economy, is internalised across most agents in the supply chain there. Nothing is taken for granted, and the causal links are well considered. This has allowed Shetland to act on its priorities (demonstrated through the SLA model research, but made real in decisions by the council, community councils and industry) to become the major aquaculture producer in Scotland.



Benefit	Type / Magnitude of Value
Economic Contribution to the Region	<ul style="list-style-type: none"><li>• Employment: 554 full and part time jobs, (around 5% of population) plus processing and supply chain jobs, likely exceeding 1,000.</li><li>• Capital Investment: minimum £11m</li><li>• Salaries: £10m</li><li>• Total GVA: est. £55m</li></ul> <p>Further Benefits:</p> <ul style="list-style-type: none"><li>• Key export from the Shetland Islands</li><li>• Synergy between aquaculture and fishing supply chains and high-level (haulage and market logistics) and ground-level (crabs and caught fish processed within an aquaculture supply chain)</li></ul>
Socio-economic benefits	<ul style="list-style-type: none"><li>• Social and population cohesion through paid work in remote areas (particularly the North Isles)</li><li>• Strengthens the case for public service provision (including ferries, roads)</li><li>• Transferability of skills with fishermen, de-risking employees in fishing industry</li><li>• High job creation despite low direct number of jobs relating to farm output</li></ul>



## 9.4. ARGYLL

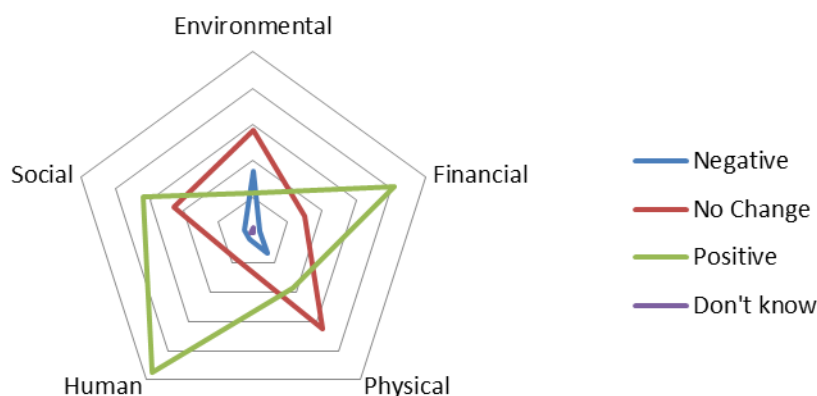


FIGURE 26. ARGYLL PERCEPTIONS OF IMPACT OF AQUACULTURE

Argyll and the islands of the Inner Hebrides demonstrate pockets of intensity of impact in aquaculture, while some areas and communities (and individuals) perceive the industry as intrusive to other activities. Nevertheless, on balance there are strong positive views about the contribution of aquaculture to human and financial capital, as well as its power to provide a rationale for schools and family income in fragile remote areas.

Some impacts identified in interviews and surveys were unexpected as detailed below:

- **Housing as part of a package for island communities:** far from having a 'zero footprint' model for a farm site, housing was seen by some island communities as central to the benefit of aquaculture production, along with associated jobs for the island.
- **Ford, Argyll:** the village of Ford, inland and separated from the coast, is a small hub for diverse aquaculture employment, including a smokery and the home of fish farm employees. A high proportion of households are understood to derive income from aquaculture-related activity throughout the value chain including fresh water and marine aquaculture employment and value addition.
- **Opportunities for tourism:** there was enthusiasm from interviewees for aquaculture and its potential role in tourism, as well as a diversification away from an over-reliance on tourism as a primary industry for the region.
- **Ability to respond to yachts:** some interviewees noted the added assurance to the sailing and boating community that farms are a regular presence in remote sailing areas, since the farms are nearby and can respond to distress signals. Some investigation could be worthwhile into how farms can welcome or accommodate yachts on their infrastructure and how the two activities can operate together (as per consultation in marine spatial planning).

The following quotes also confirm some interesting points raised in Argyll:

*"The only issues we ever get raised in connection with applications are the fact that some people are of the view that these things are unsightly and the spoil lochs and all the rest of it, and they make them unattractive for tourists. I'm not sure that that's the case. Anecdotally I think that people find these things quite interesting."*



*You know, if you live in Birmingham and buy salmon in Sainsbury's, it's quite interesting to see where it comes from."*

*Local Council, Argyll*

*"Our biggest purchase is salmon from Scottish Sea Farms. They're our main supplier. We buy halibut from Kames fish farm in Kilmelford. It's all sourced locally. If the aquaculture wasn't there, we wouldn't be here.*

*Local deliveries we go as far as Oban, and south-wise Glasgow, Tarbert, that kind of place. Then we've got mail order as well. We sell a lot on mail order. That's world-wide.*

*We do a lot in Europe: France, Spain, Belgium are our main mail order stuff. At Christmas time we do a lot of corporate stuff out in America and Canada. There's an oil company that we've been delivering to for years. A guy walked in here [... and now] he orders about £10,000 every Christmas.*

*Two vans do all the local stuff. And all the other stuff is delivered by couriers such as TNT, Oban Express. Again, I suppose you could look at that as a knock-on effect. There's a van from Oban Express that can come in here every day."*

*Processor, Argyll*

Such examples illustrate the integration in Argyll, though it is occasionally met with more wariness than elsewhere. Argyll, operates in a complex environment of competing claims (perceived or real) and should explore win-win solutions with tourism and sailing, just as it is pursuing win-win negotiations with island communities to consent new sites.

Benefit	Type / Magnitude of Value
Economic Contribution to the Region	<ul style="list-style-type: none"><li>• Employment: 595 (489 finfish, 109 shellfish) plus processing jobs (full and part time)</li><li>• Capital Investment: £5m + new sites</li><li>• Salaries: £12m (£10m finfish, £2m shellfish)</li><li>• Total GVA: Est. £31m, plus processing and retail</li></ul>
Socio-economic benefits	<ul style="list-style-type: none"><li>• Created mini-hubs for aquaculture production: Ford in Argyll has a significant proportion of households linked to aquaculture</li><li>• Democratic development with positive impact on housing</li><li>• Pressure on aquaculture from perceived visual impact, but evidence suggests opportunities for integrated aquaculture tourism, including Mull, Lochgilphead area and examples such as Loch Fyne Oyster Bar.</li><li>• Maintaining rural schools and populations across remote areas</li><li>• Some evidence that the increased presence of boats, moorings and staff may help de-risk recreational sailing.</li></ul>





## 10. INDUSTRY VALUE CHAINS

This study has highlighted some of the key benefits associated with the aquaculture industry in Scotland, which occur throughout the value chains. In order to help visualise the extent to which these benefits are spread across the industry, it is important to consider the value chain as a whole and the benefits from start to finish i.e. initial capital investment right through to the final retail product. In this section examples are provided for salmon and mussels as the key aquaculture sub-sectors. Each company's cost and market structures vary, and rather than dividing the value chain up by specific figures, the purpose here is to indicate the scale and proportion of benefits at the different stages of production.

As demonstrated in previous chapters, the supply chain into salmon production and subsequent on-processing deserves mapping to gain a full picture of the constituent industry players. Ultimately, the products reach the end consumer, and either domestic (Scottish) or wider UK and international.

*Domestic Consumption:* Domestic consumption remains, per capita, fairly low in Scotland, though for good health reasons it should be encouraged. The Institute of Aquaculture is leading research into Omega 3 (of which there tends to be high content in Scottish salmon due to feed specifications demanded by consumers); and campaigns promoting fish in schools or in the media (for example Sainsbury's Switch the Fish initiative promoting trout<sup>154</sup>) and Jamie Oliver's endorsement of mussels<sup>155</sup> demonstrate that consumer attitudes can change positively to consume more fish. As more farmed fish is processed into ready-meals, Young's point out that it can increasingly be seen as a meat with a degree of market substitutability for chicken, which would give potential for a different magnitude of demand.

Levercliff analysis summarises the UK consumer priorities as follows:

*Provenance: UK meat industry has been successful in promoting British meat, Scottish aquaculture needs to consider how to do the same (whilst also highlighting the health benefits of fish – this is what they have so far focused on)*

*Sustainability: all retailers/ wholesalers/ producers are supporting sustainable fish sourcing and it is becoming a “must have” (could be a potential barrier?). Aquaculture should capitalise on demand for sustainable produce at retailer/ producer levels.*

*Convenience: Sales growth can be achieved by introducing convenience products for (lazy!) consumers.<sup>156</sup>*

Nevertheless, the value chain analysis below suggests that the total proportion of end product coming to the UK across aquaculture production will change as markets grow relative to supply.

*Exports:* seen as particularly advantageous since their income is derived externally and not, in theory, at the opportunity cost of a Scot spending the same fixed sum on another product in Scotland, as with domestic consumption. As seen in other industrial growth for countries such as South Korea and oil-rich states, exports can provide effectively limitless market opportunities, which may only be limited by ability to supply with the correct value proposition of price and quality.



## 10.1. FINFISH

Although this study includes a review of the benefits of aquaculture from across the industry, the focus has remained on salmon when considering finfish as it is by far the most dominant sub-sector with nearly 99% of production. The following section looks at salmon primarily, with subsequent discussion on other finfish value chains and potential for expansion in the Scottish context.

### 10.1.1. SALMON

In 2012, Scotland's production of salmon reached 162,223 tonnes<sup>157</sup>, with a value of £537 million. The GVA of salmon production was far lower than previous years at approximately 21% of turnover: in an average 'good' year should have been at or above a more representative historical rate of 30%, equating to around £161m in value at 2012 volumes.

The growth of salmon sales (and the likely effect of pulling up other products with it) is attractive to Scotland, and it is important for Scotland to have a quality food product alongside whisky. Salmon production is a highly concentrated industry, both internationally and within Scotland, with between 95 and 98% of production being generated by the largest producers (some volume is grown by small producers on contract to the larger).

It is estimated by *Scotland Food and Drink* that Scottish salmon is now being exported to 60 countries, with a total value of salmon and seafood of £590m,<sup>158</sup> of which over around three-quarters (reaching £464m in 2012) is thought to be salmon<sup>159</sup>.

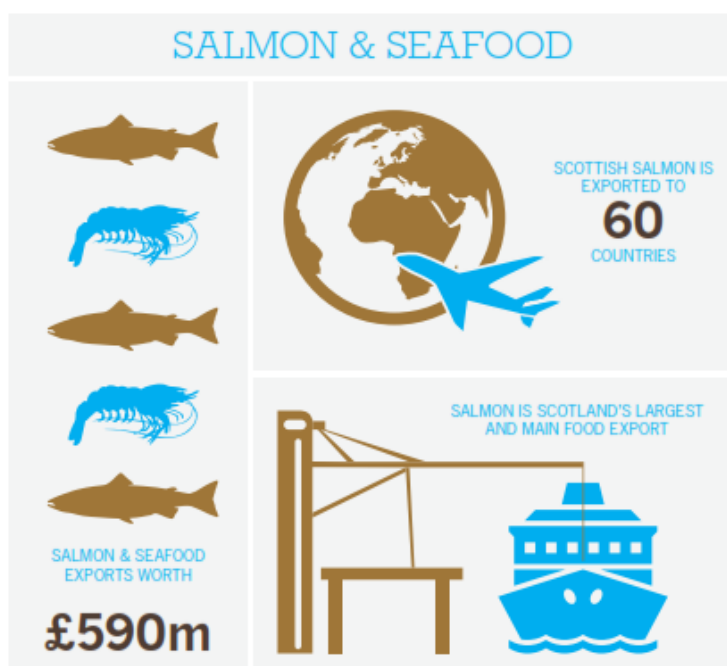


FIGURE 27: SALMON IS AN IMPORTANT EXPORT FOR SCOTLAND<sup>160</sup>

The large, established markets are the US and France, comprising 46% and 23% of total exports respectively. They are now being joined by emerging markets, cited by industry as including China, Taiwan, Japan, Kenya, Nigeria, South Africa, Middle East. The Middle East and Far East markets are growing at a rate of 64% and 95% respectively, though from a low base. In Asia, low value, high volume aquaculture is vastly more large scale than in Europe, yet China for example has a large



middle class demanding high value products, including Atlantic salmon, from 10 kilos in 2000 to 30 kilos per capita in 2009<sup>161</sup>. The Far East market bought £37 million of fresh, frozen and smoked salmon products<sup>162</sup>, but this is considered to be a very small proportion of the potential market.

This encouraging news, and the indication that there is a vast potentially untapped market, must be tempered by the reality of constrained supply. Scottish salmon's product differentiation allows it to enjoy some price discrimination in the market, capturing the more expensive markets; but limited volumes mean that potential gains in the export market are to some extent at the cost of growing UK sales which, as has been demonstrated by UK intermediary buyers, is willing to buy far larger volumes of Scottish salmon at a 'reasonable' price.

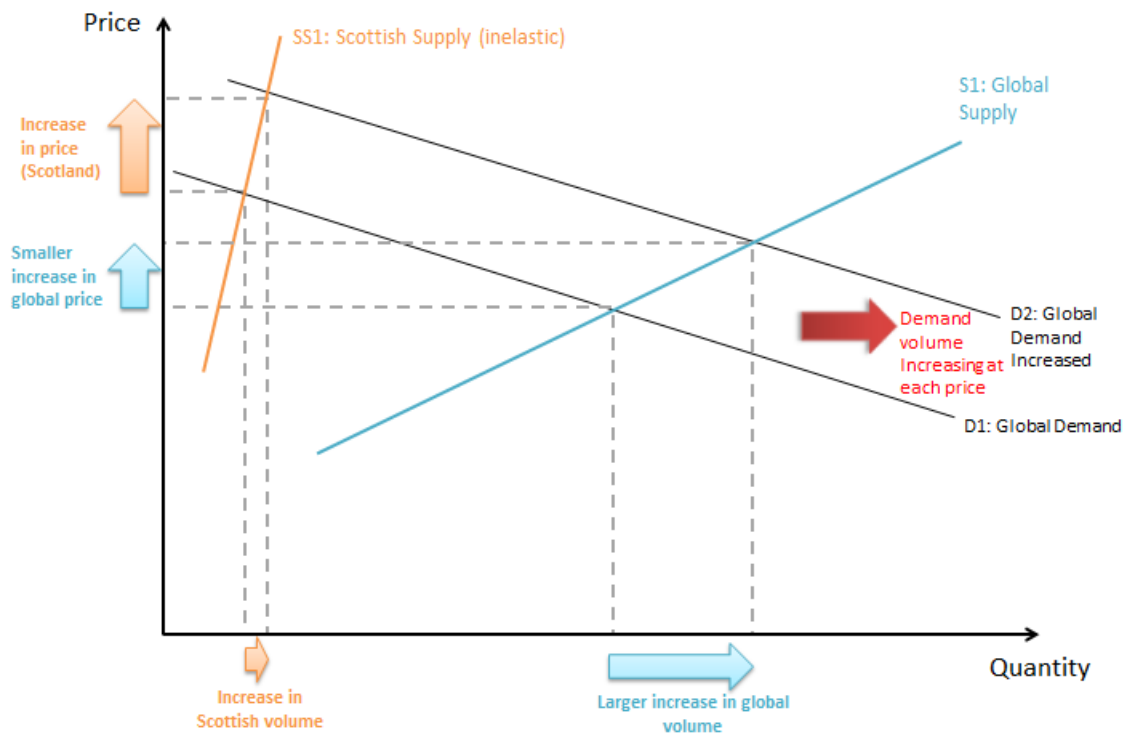


FIGURE 28: PRODUCT DIFFERENTIATION OF SCOTTISH SALMON AND MUSSELS IN GLOBAL MARKETS. (IEL, 2013)

The implication of supply inelasticity is that modest gains are possible under current constraints, while competitors such as Norway and Chile are more capable of responding to increases in global volume (and even occupy sections of the local UK market as Scottish producers focus on exporting their relatively fixed supply, rather than grow local market share).

The perception of Scotland as a clean and fresh environment for growing fish, the verifiable reality of strict SEPA environmental standards, and certifications (such as Freedom Foods, Label Rouge and Protected Geographical Indication) are factors which differentiate the product.

Fresh salmon exports (excluding frozen product) reached a value of £404m in 2011<sup>163</sup>. Consultation with processors confirms that fresh, whole salmon exports from the UK (with the exception of small volumes) are Scottish salmon. It is believed that, similarly, the majority of processed salmon *that is exported* is Scottish product, too, since most of the Norwegian salmon processed in the UK is destined for the domestic UK market: to import to the UK to re-export is believed to add sufficient cost to the process that the rationale would be marginal, or very much the exception. The assumption should be, therefore, that at least 50%, or even upwards of 75%, of the export value of



processed salmon is safely attributed to Scottish production, though further examination of this could yield a more accurate estimate.

UK FRESH SALMON EXPORTS				
	2011	2010	% INCREASE	% TOTAL
USA	43,703.71	31,924.22	37	46
FRANCE	21,699.73	26,475.78	-18	23
E.EUROPE	8,110.42	4,869.24	67	8
EIRE	5,869.20	4,509.20	30	6
CHINA	4,942.21	11.06	44569	5
GERMANY	2,152.01	2,458.38	-12	2
MIDDLE EAST	1,614.66	1,300.39	24	2
TAIWAN	929.31	83.49	1013	1
JAPAN	907.50	587.56	54	1
CANADA	749.86	1,111.22	-33	1
ITALY	562.88	456.79	23	1
SPAIN	474.41	209.81	126	0
OTHER	3,974.56	4,575.32	-13	4
<b>TOTAL</b>	<b>95,637.53</b>	<b>78,611.67</b>	<b>22</b>	<b>100</b>

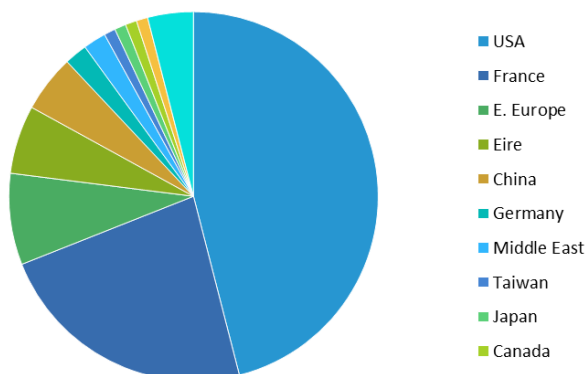


FIGURE 29: SEAFISH 2012 TRADE SUMMARY (PPT)<sup>164</sup>

In 2012, the value of exports fell due to a drop in price of over 10%, though it was considered ‘a bad year’ and that it should not overshadow the bigger picture. However, it was suggested that some long term pressure will be exerted through large expansions in volume in Chile and Norway.

TABLE 9. SALMON EXPORT DATA<sup>165</sup>

Salmon	2011 Exports		2012 Exports		% Change		Average Price/ Kg	Average Price Change (%)
	Value/ £000s	Volume/ Tonnes	Value/ £000s	Volume/ Tonnes	Value	Volume		
	491,492	96,732	464,018	103,592	-6	7		

Approximately two-thirds of Scottish salmon production is exported, and it is considered likely this proportion will increase given the projected growth in emerging markets: though, as we have stated, in the context of constrained supply this may be a mixed blessing since the UK market also indicates untapped demand (see section 2.2).

### Commercial Drivers for Differentiating Scottish Salmon

Calculating the value of salmon being produced is a complex process as large increases in production, which are projected across Scotland and its key competitor countries of Norway and Chile, will influence price. Nevertheless, value is of strategic importance to Scotland’s position in the salmon market, since the ‘Scottish brand’ and Scotland’s verifiable animal health (e.g. freedom foods), environmental (e.g. SEPA) and provenance (e.g. Label Rouge) standards mean that Scottish salmon can command a premium above the market rate. This is essential to appreciate since it allows Scottish producers, and in particular the Scottish companies operating within Norwegian ownership, to perform favourably against lower-cost competitors in terms of profit margin per kilogram.

The salmon value chain can be said, perhaps in a different way to other aquaculture products, to have stimulated or grown an ecosystem of associated suppliers which exist, largely or only, to serve the salmon industry. For input suppliers and downstream processors the key driver is to expand volume to make as large as possible the impact: from a Scottish national interest also, this would be welcome, all other things being equal, in order to maximise employment and the sum of the multi-



sector GVAs across the supply chain. From the point of view of salmon producer companies, the key driver is to avoid boom and bust in salmon prices: and for *multinational* companies, to maintain profitably high value Scottish salmon without degrading the image of other countries' product.

All parties wish to see Scottish salmon maintain a strong reputation for quality and environmental standards, but above this there is a rationale to have promotion of the Scottish product through SSPO, Scotland Food and Drink, SDI etc. over and above what each individual multinational firm may be directly interested in pursuing. This is not to criticise the achievements of those firms – if anything they should be far more forthcoming about the benefits they have brought to Scotland by generating volumes that would otherwise have been unachievable in any other ownership scenario, given other constraints.

### **Processing**

Table 10 gives the number of people employed in salmon processing in Scotland in 2012.

TABLE 10. SALMON PROCESSING IN SCOTLAND AND THE UK<sup>166</sup>

UK Salmon processing industry population: FTEs and processing units						
Region	Scotland			UK		
Year	2008	2010	2012	2008	2010	2012
No. of jobs	4,073	3,737	2,859	5,223	4,223	3,465
No. of processing units	48	43	39	71	54	53
Average FTEs per unit	85	87	73	74	78	65

Consultation suggests that a reduction in the number of jobs can be attributed to 1) the increasing mechanisation of processes and 2) industry rationalisation, though there is evidence of new scale processing emerging that may help counteract the fall, including a new large depot in Rosyth. The picture is one of broad improvement in productivity per employee.

The causality between the provenance of Scotland's salmon production, and the processing being based in Scotland, is very strong if not absolute (it is absolute for those engaged in primary processing). Some of these jobs and processing units are operated by the salmon producer companies, and captured in their SSPO industry survey figures, but not the Scottish Government farm production surveys which focus on smolt and farm production.

Beyond Scotland, in Grimsby, some production is strongly dependent on Scottish salmon but it also processes Norwegian and Chilean product. These factors have been accounted for in the final industry employment figures for this study, where a conservative figure has been attributed directly to Scottish production.

Finally, the Seafish processor survey data suggests that the vast majority of processing jobs are in Scotland, with a low number in Humberside. Given the level of processing in Grimsby, this suggests that the Humberside number is an underestimate, and that an even larger number of people than currently recorded are employed in processing. This suggests that the total additional value to the UK economy will in turn be conservative and likely much higher.



### **Cost Structure**

As explained in the approach to GVA and total turnover, within the total turnover of salmon producing companies we can find value addition in total production (the GVA), but also the spend on inputs such as:

- diving services
- equipment manufacturing (e.g. Fusion Marine)
- boat supplies (e.g. from Alexander Noble & Sons, Norwegian well-boats, barges)
- haulage of feed and salmon
- smolt production, genetic research
- initial logistics and distribution

#### **Example: Representative CAPEX Expenditure for a Salmon Cage Site**

<b>Equipment</b>	<b>£000</b>	<b>Location of Supplier</b>
Barge & Moorings	875	HIE region
Mooring Grid	155	HIE region
Cages	650	HIE region
Cage Nets	190	Wider Scotland
Camera System	95	HIE region
Boat	48	HIE region
Rotor Spreaders	21	HIE region
Feed Pipe	11	HIE region
Mort Lift Up	66	Norway
Seal Scarer	37	HIE region
Chain Link Weights	13	Wider Scotland
	<b>£2,161m</b>	

These economic activities in the supply chain are covered by the total turnover figure of £537m, likely closer to £600m in 2013 given that 2012 was 'a bad year' on price and some unanticipated challenges in supply. Additional to that figure will be third party processing (additional value exceeding £270m), on-transport and export costs, plus retail and catering value addition in Scotland, UK and internationally. This total value is over £800m (likely closer to £1bn) in Scotland and over £1.4bn across the full UK value chain.

Between 50% and 60% of the salmon industry's input cost base is comprised of feed supply, much of which is based on imported feed ingredients, which suppresses the GVA of the overall value chain. Nevertheless, it remains an essential part of the chain, since it tailors its feed to Scottish-specific quality and market requirements and its geographic proximity, giving a direct and causal (dependent) relationship with serving Scottish salmon production. Further, there is increasingly vertical integration of the salmon supply chain, where feed supply and other segments of the chain may be integrated within the producer company.

### **Supply Constraints**

The danger for Scotland is that supply limitations begin to inhibit the positive impact of providing Scottish salmon in the domestic market (and potential advantages in promoting healthy eating, tourism and local value addition) and Norway or other competitors capture increasing segments of the UK market.



An estimated 1 million smoked salmon meals are consumed in the UK every week<sup>167</sup>: many of those will be sourced from Chile and Norway in addition to Scotland, and there is a risk (as stated in this report) that static Scottish supply with increasing exports will further exacerbate the availability of Scottish salmon in the UK market. This in turn will impact on the strong provenance message for UK consumers that Scotland can command. Increasing supply of Scottish salmon will therefore impact positively on Scottish processing and UK retail sections of the supply chain. One processor stressed that:

*There is no question that we would absorb more Scottish product if it were available.*

Processor, UK

Therefore, one should not look at the total current value of processing (estimated to currently exceed £0.5bn across Scotland and UK) of Scottish salmon, but ‘the lost benefit’ (or opportunity cost) of the unmet demand in the UK and for export: this could be many times the current value. Processors will provide processed salmon product for retailers (Marks & Spencer, Waitrose, Sainsbury) demanding specifically Scottish sourced salmon, but even those who are not required to source from Scotland would do so more if possible. This is supported by the 2011 Levercliff market analysis which, focusing on one supermarket’s salmon offering, notes that

*‘There is an opportunity for a producer to work closely with Tesco to develop sales for Scottish salmon*

- *Work in partnership to promote provenance and increase sales of salmon within the category*
- *Displace Norwegian/Irish salmon from the category*
- *Whilst Tesco are unlikely to switch to an all Scottish supply there is potential to capture a greater share of the market*

Levercliff (2011)<sup>168</sup>

In summary, from a processor’s viewpoint, the Scottish industry should increase in volume as much as possible with the belief that this would be welcomed by the market. Government initiatives should focus on supporting the industry to have a ‘licence to grow’ in a more efficient manner, i.e. mainly by removing barriers to growth by improving understanding and acceptability of aquaculture sites – within a framework of promoting provenance to maintain strong margins. The acceptability of sites cannot be forced upon local areas – the acceptability must be achieved not only through negotiation but through engagement that ultimately helps local communities reconcile the benefits of production with any drawbacks.

This message is tempered by the industry, who argue that growth should be steady to avoid the ‘boom and bust’ of pricing and flooding the market, and this is borne out by depressed prices in the mid-2000s as Chilean volume grew: after several years of depressed volumes Chilean production is recovering. It is possible that this argument for organic growth in supply applies in a multinational company setting, but strategically Scotland will have little influence over Norway’s and Chile’s vast expansion, and should follow suit rather than fall prey to any price drops but without any benefit in increased volumes. This is a classic ‘prisoner’s dilemma’ problem, but Scotland being a relatively small player has more to gain through expansion. The Levercliff analysis, and this report’s product differentiation modelling, would support the view that more could be done to insulate Scottish product from price pressures through further promotion of Scottish provenance over other





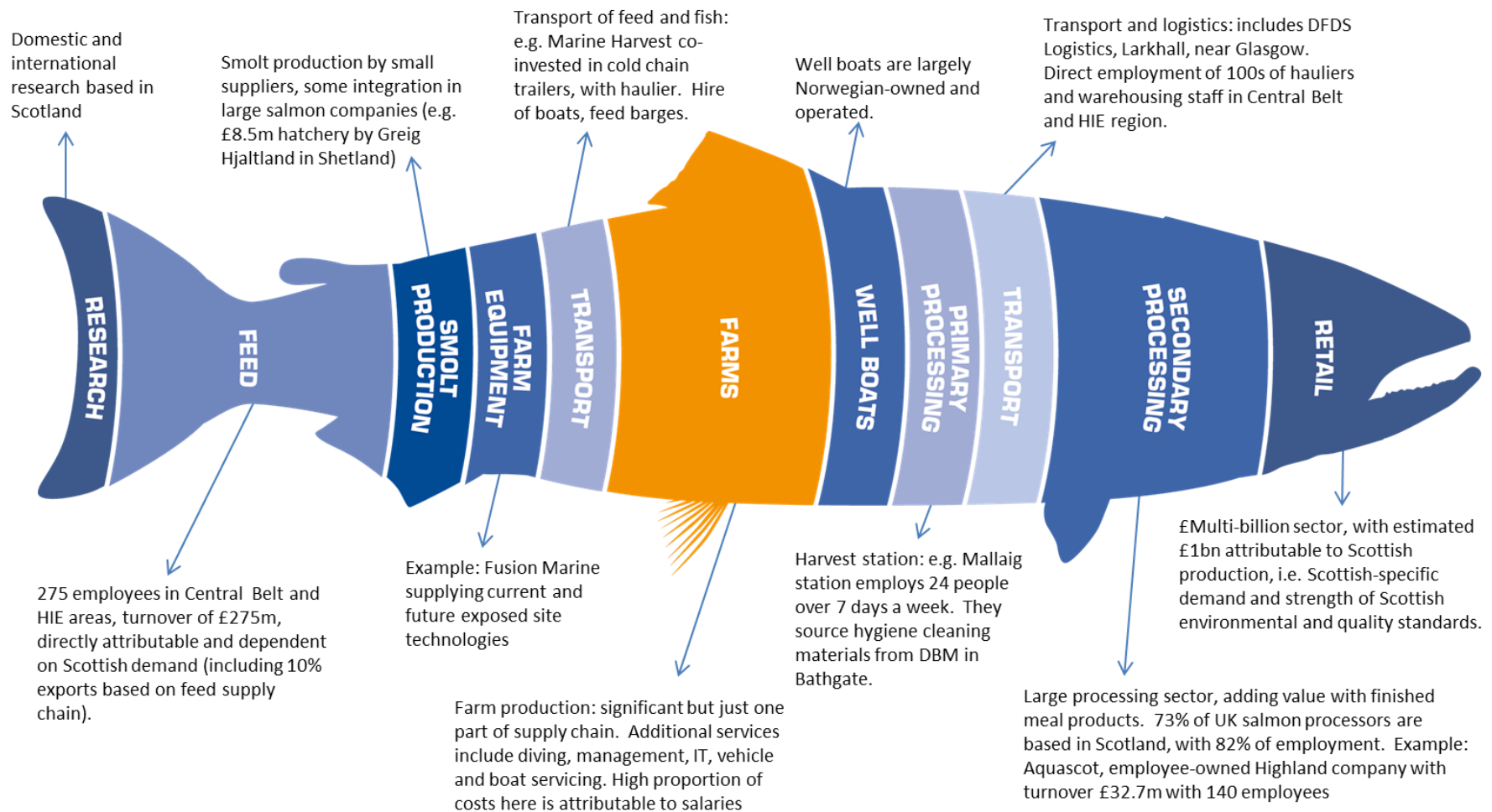
countries on the basis of environmental and production standards. Again, this is a strategy that may be welcomed by, but will not be a priority for, multinational companies with a broad geographic portfolio.

The volume growth discussion assumes that Scotland *could* grow its volume faster than current rates (though over the past 5 years Scotland's salmon production is superficially growing sufficiently quickly to meet the 2020 target). How can Scotland expand its volume? Prospects for future growth are explored in section 12, but it is hoped that using different equipment on more exposed sites would move new production from contested or crowded inshore areas, mitigating environmental impact and interaction with other industries. It is thought that this approach will 'give us the next 30,000t of volume' (equipment manufacturer).

The drivers and incentives differ across each producer and processor, but common ground is to be found:

- 1) Supply constraints in production, created by a difficulty in consenting appropriate sites, rather than demand for Scottish salmon, remains the biggest limitation to economic benefits (though disease events remain a high risk factor).
- 2) More exposed sites may offer an opportunity to reduce conflict between aquaculture and competing industries, and could offer much larger volumes while possibly alleviating environmental pressures and concerns
- 3) Technological and policy development (allowing a step change in site options) is welcomed and policymakers have a role to play in achieving this.

## Salmon Value Chain 1

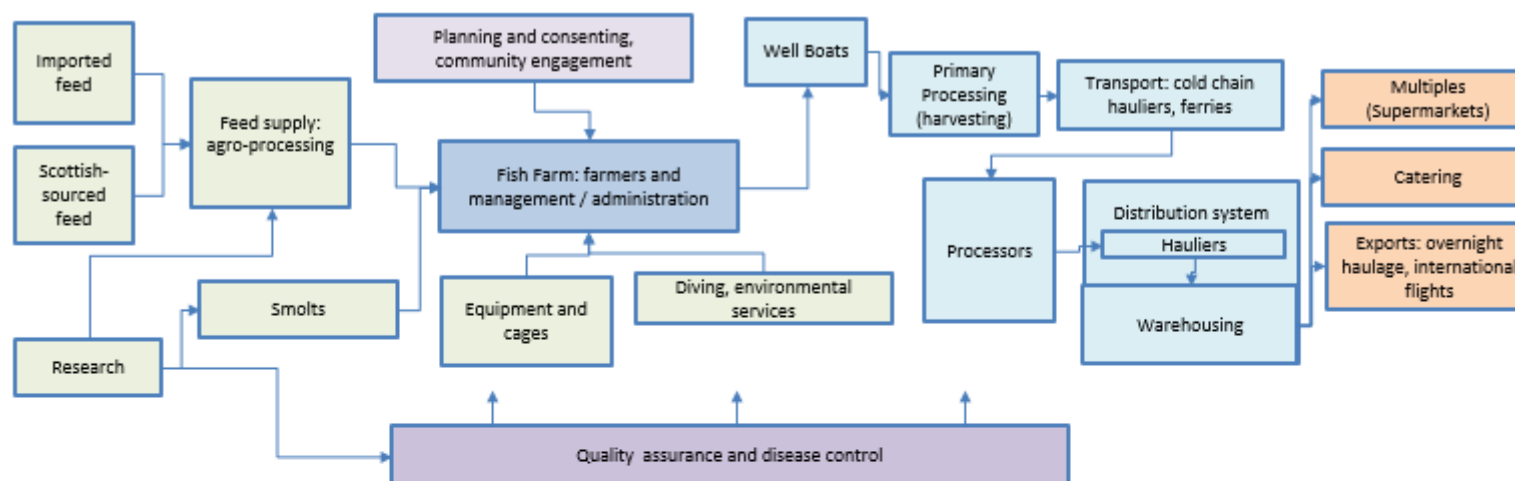


NB: the proportions of inputs are indicative, since each producer company has a distinctive and specific supply chain: some companies will be highly integrated, breaking down these distinctions; while others will be selling into local, wholesale, processed or even retail and catering markets. At the post-primary processing stage (from factory gate or from DFDS Logistics), salmon will be dispatched globally.

FIGURE 30: INDICATIVE SALMON VALUE CHAIN



## Salmon Value Chain 2



### KEY

	Inputs: major import is through feed supply, with around 85-90% of feed value, while other inputs often Scottish-sourced. Equipment, diving and environmental services often local / Scottish-based expertise, benefiting from 'skills ecology' of aquaculture education.
	Fish farms: strongly Highlands & Islands specific, geographically close to production. Around 10% of management and admin staff based in the Central Belt in salmon, whereas owner-farmers (and cooperative owners) in shellfish are likely to be Highland-based.
	Quality assurance, regulation, planning: informed by research, but largely independent of (though largely influential over) supply chain. Community engagement increasingly seen as 'core' to supply chain, not an add-on.
	Downstream logistics and processing: costs of well boats, primary processing and often transport (and occasionally secondary processing) usually borne in farm-gate cost (or usually to the processor's gate, i.e. including transport cost) depending on contract arrangements.
	Retail & Export: often highly diverse and ranging from wholesale to very high mark-up restaurant servings.

FIGURE 31: DETAILED SALMON VALUE CHAIN

### **10.1.2. OTHER FINFISH**

#### **Trout**

Unlike salmon, the trout industry is internationally far less concentrated, with a long history of trout farming across inland and landlocked countries. Aside from angling, Scotland has less of a unique selling point in trout. The representative body is the British Trout Association (BTA). It is based in Edinburgh, which reflects the scale of the Scottish production in relation to the rest of the UK. The key market for BTA-member-produced trout is the South East of England. Rainbow trout volumes increased by 22.8% in Scotland to 5,670 tonnes in 2012, employing 107 FTEs<sup>169</sup>. Of this, 2,076 tonnes (41% of all rainbow trout production) was marine-based: clearly at present it remains a small volume industry relative to Atlantic salmon. Nevertheless, the success of salmon and an ongoing expectation that trout could command a position in supermarket retail, should the supply volumes be sufficient and reliable, gives hope that potential in trout can be realised in the coming years, and indeed large investment in the industry is staked on this being the case. For Scottish 2020 marine finfish targets, freshwater rainbow trout is not included, and only the 2076 tonnes of marine rainbow trout is relevant.

The lack of concentration in the trout industry offers an interesting comparison to that of salmon: relatively smaller volumes from individual trout farmers means the ability to satisfy market orders is diminished, and this creates a vicious circle that inhibits greater scale in production. Efforts at a collaborative supply model (Scot Trout) fell by the wayside, instead developing into 2 paths which can be seen today:

- 1) Scot Trout was taken over by Dawnfresh, which as a relatively large-scale rainbow trout producer shares many of the characteristics and potential of the comparatively mature salmon industry.
- 2) The Scot Trout model was replicated or echoed in the mussel industry (the SSMG). SSMG's success in de-risking and marketing individual members should remain a useful model for land-based trout producers today.

Dawnfresh are a large trout processor in Uddingston, Lanarkshire (and with other Scottish depots including Arbroath) where their processing was double the total Scottish tonnage. In 2013, sales increased by 5.2% to £40.2m, employing 418 staff. A previous loan from owner Alastair Salvesen exceeding £10m, and ongoing losses as the market develops (as it likely will continue to do since it is considered undersupplied in comparison to salmon) demonstrates that, like salmon, the return on aquaculture farming and on-processing can be volatile and will continue to favour those with the financial resources to absorb such risk<sup>170</sup>.

The processing of non-Scottish trout suggests that (in the case of rainbow trout, at least) some processing of aquaculture product can be captured by Scotland independently of whether the product was farmed in Scotland.



FIGURE 32: TROUT: FROM SEA TO PLATE<sup>171</sup>

### Trout Exports

Salmon dominates finfish aquaculture exports (though increasing volumes of trout are processed by Dawnfresh (9,000t in 2009) most of which is exported outside of Scotland, particularly into the wider UK market, but also 13 other countries across US, Europe and Middle East). It should be noted that this is a combination of Scottish and non-Scottish trout that is then re-exported, processed, from Scotland. The full value of this is likely to exceed £30m of sales 'exported' from Scotland to other destinations, though only around £4m are exported outside the UK.

### *Halibut & other species*

Other finfish (halibut, turbot, brown trout, lumpsucker, wrasse) are produced in smaller volumes: for example, halibut (73t) is produced by Kames and Otterferry in Argyll, and on Gigha, though there remain some technical challenges in breeding. Wrasse are of high relevance to the salmon industry, and research into effective species is ongoing. Halibut and other finfish have different farming requirements compared to 'large salmon', but can yet benefit in some cases from the scale of the salmon industry, not just in feed supply chains, but because producers can produce salmon on-contract and add on a parallel halibut or similar enterprise. In this sense, salmon production can paradoxically stimulate diversity in other areas and create opportunities in and around its scale production. This is echoed in fisheries where fishermen see and use farms as reefs for wild fish, and in mussel production where firms can use salmon volumes as an economic 'baseload' and then add on other niche lines of production (see section ).

Seeing the challenges of aquaculture being played out in niche species such as halibut can be sobering and can suggest a counterfactual to the way salmon is now produced in Scotland. While many may mourn the passing of the labour-intensive era of salmon, one can appreciate that the current scale gives sufficient impetus to solve disease, planning or other problems, while halibut (and even trout) can show that insufficient scale can let whole species industries remain prone to high financial risk, and subsequently less attractive opportunities in overcoming challenges. In particular, challenges in juvenile production remain unsolved due to technical issues that are expensive to overcome at a small scale.



## 10.2. SHELLFISH

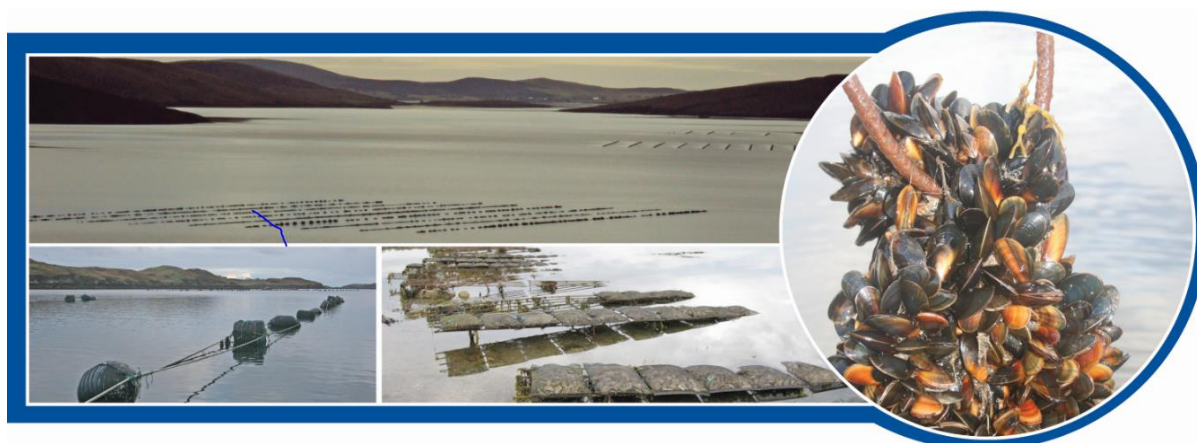


FIGURE 33. SHELLFISH IN SCOTLAND (IMAGES COURTESY OF IEL)

The majority of Scottish farmed shellfish by volume comprises mussels: oysters are also grown and more are finished (through depuration) in Scotland.

The total value of the shellfish sector in Scotland is estimated to exceed £17m in value once processed (£8.7m at farm gate, of which £7.5m is mussels) and ready for on-sale to retail and catering.

The shellfish sector differs considerably from salmon production, both in terms of a large number of small producers, and a cooperative marketing model through the Scottish Shellfish Marketing Group (SSMG). The success of this model is that it provides:

- market access for small producers
- unified market engagement for retailers (especially supermarkets)
- it may serve as a price-setter for other Scottish shellfish, even for non-members.

SSMG's Stephen Cameron noted recently that:

"Because we are a co-operative of farmers all working together, we aim to align supply and demand, so we see this as an advantage of our co-operative, however we operate under the same economic pressures that we are all currently experiencing in the marketplace and broader economy."<sup>172</sup>

However, it also *mitigates risk* for individual producers, for example in 2013 when Shetland supplies of mussels were limited due to an algal bloom – West Coast cooperative members were able to supply adequate amounts to maintain supply.

Other producers like Loch Fyne maintain a separate supply chain which is more vertically integrated, including restaurants, delicatessen and marketing of oysters and mussels alongside salmon and caught shellfish. This demonstrates the variety of ways in which shellfish can be successfully marketed, Loch Fyne stress that:

*'No one works harder than we do to make sure that every oyster we harvest, every salmon we prepare and every fish that leaves our shops and kitchens is cultivated, farmed or fished in accordance with our strict environmental and quality guidelines'.*<sup>173</sup>

Both the SSMG (Scottish Shellfish Marketing Group) and Loch Fyne supply chains are effective but depend (particularly the SSMG model) on scale limitations at production level. Despite the large





number of small producers, because few companies have achieved significant scale there is, after all, some concentration of production within a small number of (mainly Shetland) producers. More could be done to develop new sites, and stimulate investment, through considering how mussel farms could assist salmon companies in maintaining sites that would otherwise lie empty.

#### ***10.2.1. MUSSELS***

Some key differences between the Shetland salmon and mussel sectors are discussed in the following sections.

##### ***Industry structure***

The industry is not highly concentrated like salmon, where a small number of large players produce the vast majority of output (though there are a small number of companies achieving larger volumes). Breeding is not undertaken as with salmon, and peripheral industries are less evident (though there are some, such as crab processing alongside mussels by a Shetland producer).

The supply chain is therefore far simpler, and with integrated supply chains through Loch Fyne Oysters and the Scottish Shellfish Marketing Group (SSMG), a higher proportion of value is returned to producer-owners. SSMG have achieved a co-operative platform for 80% of Scottish mussel output (across 20 members), giving individual farmers the best possible access to market, and a means of price negotiation and managed supply to supermarkets / multiples. Over the last five years there has been “decent” growth in the SSMG, with turnover rising to £13.7m.<sup>174</sup> SSMG previously invested £1.6 million in the plant, aided by £420,000 from the Scottish Government and the European Fisheries Fund.

The map below shows the existing SSMG-registered sites.



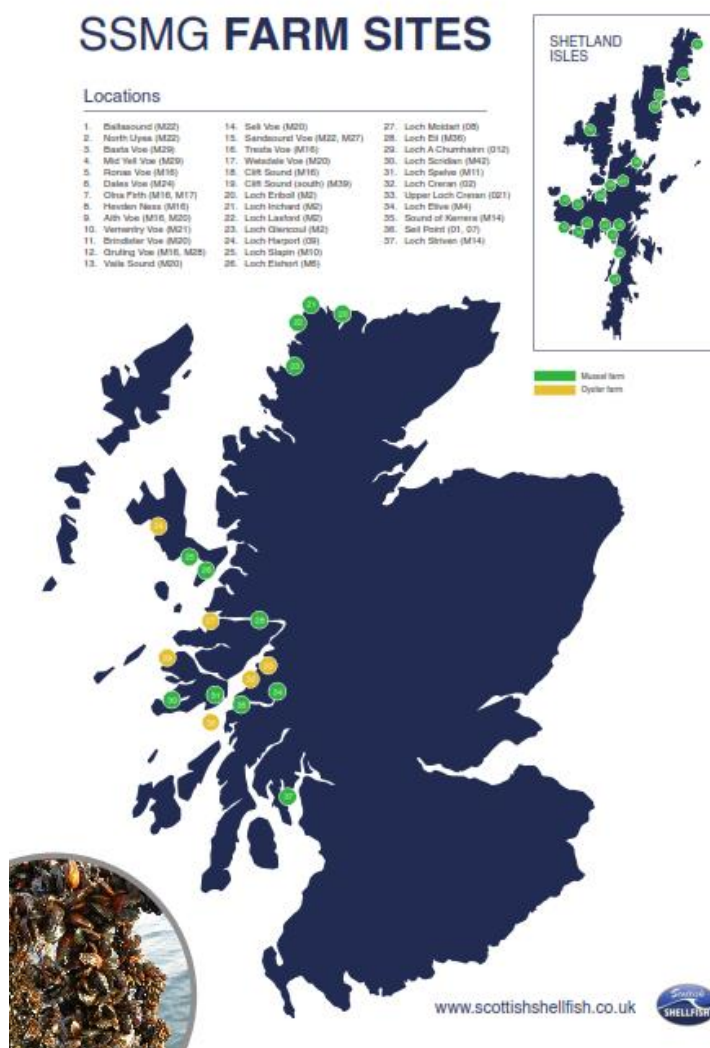


FIGURE 34. SSMG SITES IN SCOTLAND<sup>175</sup>

### ***Farm production characteristics***

Mussels that are produced in suspended cultivation – not on the sea bed – have certain characteristics. Their shells may be thinner, depending on age and rate of growth and, consequently, the meat-to-shell weight ratio is usually high. Shells may also be less prone to certain biofouling organisms. This method of production means shells never touch the seabed, guaranteeing grit-free meats<sup>176</sup>.

- Mussel supply does not require a highly costly feed supply chain: shellfish do not need to be fed by the farmer, being entirely dependent on naturally occurring foodstuffs from the sea. In a similar fashion, mussel farms are populated by young larval mussels known as spat arriving naturally in the tide and settling on the ropes in the shellfish farm. The natural stocking and feeding means that shellfish farming is **considered to be highly environmentally sustainable**<sup>177</sup>.
- The nature of the feed means it is more difficult to control input-output variables through intensification: overstocking is limited by yield and carrying capacity. For example, overstocking led to Loch Fyne being closed for mussel production for 3 years. As such,

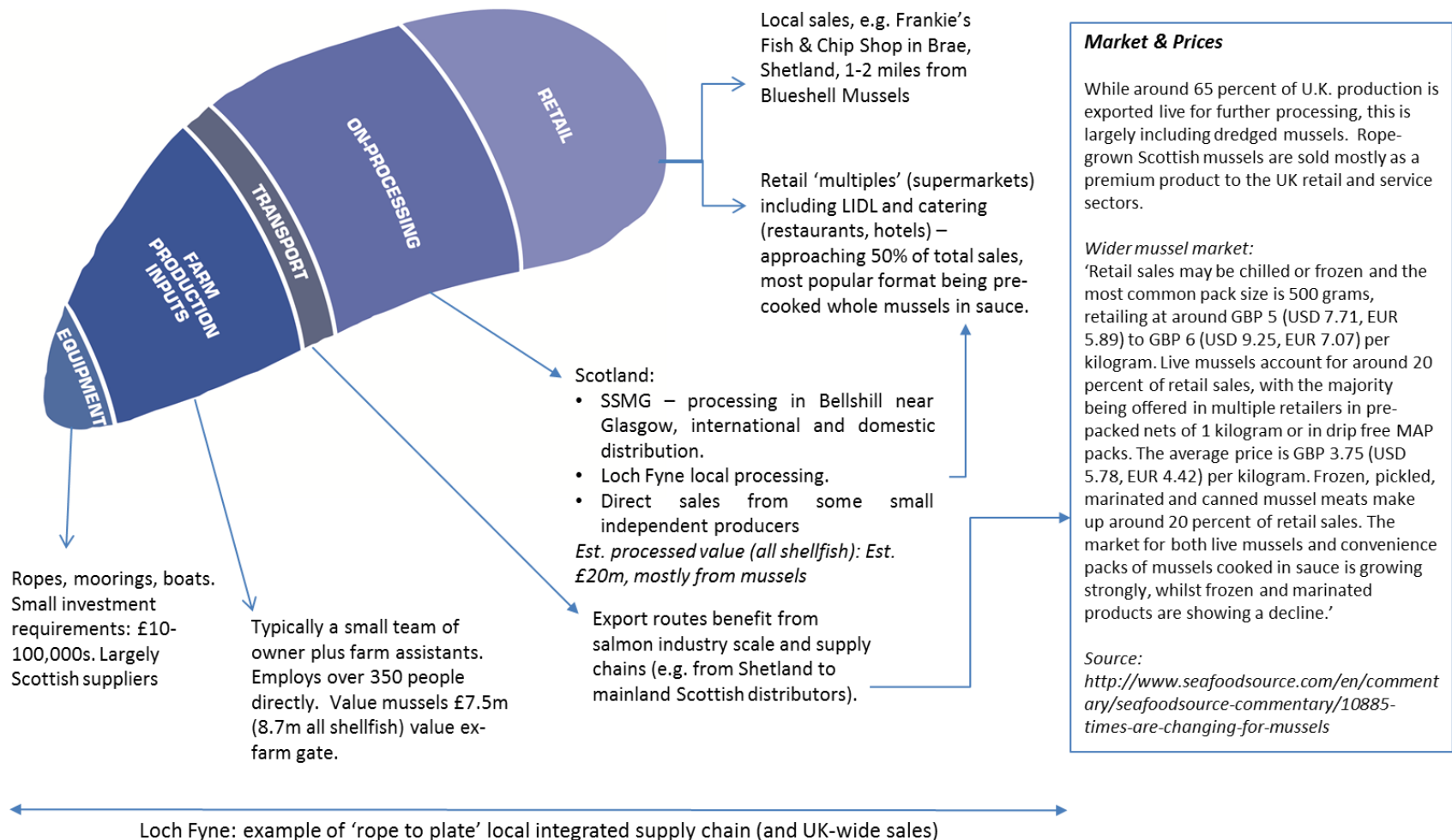


production costs are highly variable; cost effectiveness depends directly on site productivity, rearing density and cultural practices. The use of automatic equipment or dredges which reduce labour costs tends to optimize profitability. The level of supply, as well as competition from wild fishery production, affects market prices and therefore the overall yield. Moreover, spat supply and the rate of predation by ducks, seagulls and crabs are significant factors in determining overall production costs and yields.<sup>178</sup>

- Estimated costs for a 100t mussel farm in Scotland are approximately £100,000.
- Smaller companies still harvest and grade mussels manually, which is a much less stressful technique. But bigger companies rely on mechanization. Grading is followed by depuration and conditioning depending on water quality etc.<sup>179</sup>

Shetland produces the majority (69.7%) of Scottish mussels (4,340t of the 6,227t total) with a farm-gate value of around £5.1 million, of a total Scottish value of £7.5m<sup>180</sup>.

## Mussel Value Chain



*Capturing value: no individual company's supply chain is the same, but in the case of mussels (and to some extent other shellfish) the 25% or so of value that goes to the farmer in farming is also supplemented through vertical integration / ownership of processing (approaching 50% of value). This applies in the case of both in Loch Fyne Oysters and SSMG, which comprises almost the whole market.*

**FIGURE 35: INDICATIVE MUSSEL VALUE CHAIN**

As for salmon, the mussel value chain should be considered in the context of what value potential is *not* captured as much as what is. For various reasons (species, value profile), New Zealand and other mussels imported into the UK total 3,300t<sup>181</sup> (Levercliff estimated the UK mussel retail market at £21.1m<sup>182</sup>), around half the current production in Scotland. The total production of blue mussel and Mediterranean mussel in 2011 was around 1.20 million tonnes, valued as 572 million Euros<sup>183</sup> (unprocessed). Maintaining product differentiation through marketing and quality, and adding value, are crucial (volumes have decreased but spend has remained the same<sup>184</sup>).

### ***Mussel exports***

Scottish mussels, like salmon, can command a premium over the large wholesale market mussel production (mainly through The Netherlands), reaching as high as €900/t in 2013. It is seen as critical that Scotland does not compete at the lower value, high volume end where the price can be below €600 for dredged mussels.

Scottish product is exported internationally (mainly to mainland Europe including France and Spain) largely by SSMG in Bellshill. The European market is vast: according to Globefish, ‘mussel imports to the EU increased by 69.6% to 208,000 tonnes in 2011, [... seen ...] particularly in Italy, Netherlands and Spain. In 2011, Italy imported 58,300 tonnes of mussels compared with 38,500 tonnes in 2010, an increase of nearly 50%. In 2011, Spanish purchases of Chilean mussels rose by 70% in volume compared with the previous year, totalling 18,200 tonnes.’<sup>185</sup>

## **10.2.2. OTHER SHELLFISH**

### ***Oysters***

Oyster production differs significantly from mussels, requiring closed system depuration tanks with high input costs after growing – although depuration can also be a requirement for mussels depending on the classification of water body they are grown in. They are usually traded as a live product (at a value of £5m across the UK), and in 2011, about 42% of UK oyster exports were sent to France (670 tonnes), with a further 33% to Hong Kong (526 tonnes) and 19% to Spain (201 tonnes). The remaining 377 tonnes went to 24 other countries<sup>186</sup>. The production of oysters in Scotland is complicated by the fact that a significant proportion are grown in Morecambe Bay in England, then brought to Scotland for depuration and preparation for on-sale.

CEFAS notes that in 2011, oyster exports to non-EU countries have increased seven fold since 2007. This indicates that even during the recession period, opportunities are increasing, though the requirements of relatively high investment relative to other aquaculture production, and wider competition internationally, will constrain growth. Scottish producers did not identify oysters as offering a significant scale opportunity compared to other farmed species, and total production value was £0.95m in 2012<sup>187</sup>, though it is a successful pillar of the Loch Fyne production and brand.

The growth in the opportunities for new interventions in the oyster value chain is highlighted through the fact that more companies in Scotland are showing an interest in investment. For example, Fusion Marine in Argyll are now distributing systems for oyster production that can be used independently or as part of a wider IMTA system. Such growth, although perhaps small in comparison to the scale of the salmon industry, provides key contributions to Scotland in terms of the benefits stemming from the aquaculture industry with job creation and economic activity from manufacturing through to labour, processing and retail sales.



## Oyster exports

Oysters for Loch Fyne are largely grown in Morecambe Bay and then brought to Loch Fyne for depuration and processing before export. The majority of the £2m of oysters produced in Scotland are consumed elsewhere in the UK and overseas.



FIGURE 36. OYSTER FARM USING SCOTTISH-MADE EQUIPMENT<sup>188</sup>

## 10.3. INTEGRATED AND NICHE SUPPLY CHAINS

### 10.3.1. INTEGRATED SUPPLY CHAINS

At the lower volume end of shellfish production, capture fishing and aquaculture tend to blur both in terms of the physical process and the data available. The production of scallops and crab products for example, can only be undertaken in some situations as they benefit from an economy of scale provided through proximity to larger scale aquaculture.

*Co-processing with wild shellfish products:* The Shetland-based company, Blueshell Mussels, process crabs alongside their mussel production – this demonstrates some of the synergies possible between aquaculture and fisheries, where methods of production are not strictly distinct and products can share routes to market. The crab processing is seen as viable only because of the mussel processing infrastructure. This echoes the larger scale co-processing of aquaculture and caught finfish.

### 10.3.2. INTEGRATED MULTI-TROPHIC AQUACULTURE (IMTA)

Integrated Multi-Trophic aquaculture (IMTA) is another way in which mussel production could become more attractive for investment from salmon companies, though mussel producers raised some concerns about the acceptability from consumers of mussels grown in an IMTA system.

Integrated multi-trophic aquaculture (IMTA) systems are being implemented by Loch Fyne Oysters Ltd (with scientific support provided by SAMS), with longlines placed in proximity to Atlantic salmon cages in order to grow sea urchins, queen scallops, seaweeds, oysters and mussels.

There are strategic implications to IMTA, since provides potential solutions to two issues in aquaculture relating to planning and development:



- 1) The desire for salmon companies to retain sites unused in order to protect nearby salmon production, while nationally there is a desire to use available sites to grow aquaculture production
- 2) The desire for mussel producers to attain sites and CAPEX for increased production

It is possible that IMTA could allow salmon companies to make use of consented sites by encouraging mussel production that may be moved should it be required. This would provide opportunities for increased community ownership of aquaculture production and benefit salmon companies in their efforts to demonstrate benefit for local communities.

### **10.3.3. SEAWEED**

In terms of new areas of development in Scottish aquaculture and the potential for contributing to the benefits of the industry, the production of seaweed for various uses has strong potential. Research programmes are being conducted by the James Hutton Institute and SAMS to consider the potentially high value of this industry and how it could apply to the Scottish context. However, the industry is at an exploratory stage and does not offer immediate benefit, though future benefits could include seaweed in food and as biofuel. The Scottish Government has undertaken consultation on seaweed policy in 2013.



**FIGURE 37. SEAWEED PRODUCTION IN SCOTLAND (PHOTO ©SAMS)**





## 11. COMPARATIVE INDUSTRIES

This section seeks to draw comparisons between aquaculture and other key industries in Scotland; namely energy resources, tourism, agriculture, forestry, recreational fisheries and capture fisheries. Additionally, a section to compare Scottish aquaculture to Norwegian aquaculture has been included to capture the many comparisons that were made in the qualitative research between the two countries. This highlights some of the differences in approach taken to managing the aquaculture sector as well as the obvious differences in scale. The main discussion focuses on the opinions of those interviewed in the case study locations but will also reflect upon the relative economic impacts of the sectors using available data.

The analysis highlighted that although it was difficult to always make meaningful economic comparisons between the sectors due to differences in scale and availability of data, the qualitative research provided some clearer comparisons across the industries and highlighted certain cross-cutting themes. A general observation across the industries (but most notably in tourism and capture fisheries) was that it is important to have a mixture of industries in the rural communities in which aquaculture operates in order to ensure job security and sustainability of the population, as recognised by the assessment of fragile areas and mixed blessing of 'intensity' of impact. In other words it should not be a case of "either/ or" when looking at these industries.

Having said that, the visual impact of the fish farms appears to be a particularly contentious issue for residents specifically because some think it may have a potentially negative impact on the tourism industry. Aquaculture facilities seem to be likened more to the industrialised renewable energy sector in terms of their visual impact, than they do to traditional farming practices; a perception which some claim is unfair. Nonetheless, it is a view that has developed from the restructuring and consolidation of the industry so that communities now appear to feel less engaged with the industry (a common theme in interviews) and its potential benefits. This should always be balanced against the benefit of more consistent and holistic management of sites which the same trend has brought about.

### 10.1 ENERGY RESOURCES

The two sources of energy which are of particular importance to Scotland are renewables and oil and gas. The energy sector as a whole is far larger than the aquaculture sector but comparisons are still illuminating.

#### 10.1.1 RENEWABLES

Scotland has made significant progress in switching from using finite energy sources towards using renewable resources; a process that has been driven by a keen focus on achieving challenging Government targets. Between 2000 and 2012, the electricity generated in Scotland by renewable sources increased from 12.2% to 40.3% of the gross annual consumption of electricity<sup>189</sup>. This has ensured that Scotland is running far ahead of other parts of the UK in terms of development of the sector. For example, the Scottish renewable electricity generation per unit of GVA in 2010 was valued at over 90,000 kWh compared to the UK total of roughly 20,000 kWh<sup>190</sup>.

In comparison to aquaculture the renewable energy industry has received much more capital investment in recent years. In 2012, total investment in Scottish renewables was £1.57 billion<sup>191</sup> whereas aquaculture received up to £100m. Aquaculture employs roughly a third of the number of





employees<sup>192 193</sup>: the relative disparity in investment between aquaculture and renewables should be considered in future government policies.

In the qualitative interviews, the majority of the comparisons with the renewable energy sector came from those in Argyll and Shetland. Individuals noted that the sectors are similar in the sense that the actual physical installations sometimes cause visual impacts. Hence both industries can be considered quite contentious.

*Oh aye, there's always, just like wind farms, there's always conflict.*

Hotel Manager, Skye

*I think you're always going to get, it's like off shore wind or wave or tidal (or onshore for that matter) there are people who object to these developments in principle... particularly with wind farms – hugely controversial – people either seem to love them or hate them. I don't think anybody's ever ambivalent about them. But the people that hate them, or in my experience, there are more people who seem to hate them in principle than there are that hate them because of where they're sited.*

Tourism Representative, Argyll

Those who do feel negatively about the installations often object on the grounds that they damage the natural environment from a visual perspective and some are concerned about the impact that this could have on other industries such as tourism.

*....all it would need would be a couple of articles in some bloomin' thing like the Sunday Times and people would then maybe avoid this place because their understanding of the place is 'it's spoilt' with wind farms. Whether or not it was is largely irrelevant, they are not going to come because they think it's spoilt. And the same thing would apply to fish farms.*

Community Council, Skye

But in reality, renewable energy installations, wind farms in particular, are considered to be more invasive visually than aquaculture installations.

*I do understand that if somebody puts a big salmon farm outside your big picture window it's slightly annoying. But I don't think fish farms in general are visually all that objectionable, they're very low lying, and it's pretty easy to look over the top of them. It's not like wind turbines 400 feet high right under your nose. A very different kettle of fish from that.*

Consultant, Argyll

Perhaps in order to compensate for this in some way, community benefits from renewables firms tend to be greater than for fish farms. However, there was a general consensus that this difference stemmed from the fact that the sectors have developed using different pathways – although the industries have similar structures now, the aquaculture industry was for a long period of time before consolidation, made up of small independent farms.

*In comparison, the wind farm industry is giving over mega-money to local communities. But that's something that has stemmed from that sector, there's the expectation that with renewable projects if you end up with a wind farm on your doorstep there will be some kind of community benefit ... There's no real expectation on the aquaculture industry that they should provide any sort of community benefit at all. Any more than there is, to be fair, on*



*any farmer...we don't get a lot of benefit from having them really, but it's kind of for the greater good.*

Local Council, Argyll

*There's a big push on if anybody's coming to set up here, particularly the larger companies, at an early stage must be able to negotiate a position where there's a community benefit fund set up to almost compensate Shetland for the fact that the resources are being used. That's never really been done with the aquaculture industry, I guess partly because it started off being an industry with many independent farmers where there was no need to set up such a thing and over time, very quickly, the bigger multi-nationals have come in and bought up what's here and by then it is too late, there's not much you can do about it at that stage.*

Local Council, Shetland

One individual suggested that a good way for the industry to give more back to the local community would be to invest in tourism-based educational opportunities which might boost the complementarity between the aquaculture and tourism sector (for more information see Section 10.2) whilst also ensuring local people have the opportunity to become more informed about the industry.

*'Cause obviously there is still big money in aquaculture. It would be nice if some of that would maybe, especially if it grew, that it was put back into, things like a visitor centre, that type of thing, something educational. And an organised trip to have a look around the cages and even on land. Yeah I could see that as a real positive.*

Tourism Representative, Shetland

### **10.1.2 OIL AND GAS**

The oil and gas industry is a very well performing industry which makes significant contributions to Scotland's economy. It is estimated to have generated £22 billion to Scottish GDP in 2012 and £10.6 billion in tax revenues in 2011-12 alone<sup>194</sup>. The sheer size of the industry makes it quite difficult to compare it with aquaculture (which may be the reason why no individuals chose to make comparisons between the two during the case study interviews). However, to put the two industries into perspective, the value of fresh salmon exports from Scotland in 2011 equated to 1% of the value of oil and gas exports in the same year<sup>195 196</sup>. Additionally, while the aquaculture industry employs around 2,800 individuals directly, and as many as 8,000 across the economy, while the oil and gas industry employs 200,000 people<sup>197</sup> across the economy. Shetland regional accounts make an interesting comparison between aquaculture and oil, where despite the new oil boom at Sullom Voe, aquaculture remains the bigger contributor in total revenue and GVA: including processing and associated services the total value would be even higher.

## **10.2 TOURISM**

Tourism is an industry which came up quite frequently during the interviews because it, like aquaculture, is very important for sustaining remote local communities in Scotland. Overall it is known to secure around 185,900 jobs<sup>198</sup>. The GVA of tourism stands at £3.1 billion<sup>199</sup>. It is therefore legitimate to consider whether aquaculture has a significant negative impact on tourism, and conversely whether it has a role to play in attracting tourism, for example as a learning activity or by providing locally sourced food for tourists.



Some interviewees, all of whom were from the Western Isles, did note that there was the potential for a conflict of interest between the tourism and aquaculture sector stakeholders because the fish farm installations could be considered to have a poor visual impact which would spoil the landscape for tourists. However many individuals suggested that in their experience tourists have not generally been negatively affected in this way.

*I have never, in five years doing this job, ever had a complaint about an aquaculture installation from anyone.*

Tourism Representative, Argyll

*No, there's no way salmon farming is going to put any tourists off. I wouldn't say there was any adverse effect on tourism in the slightest.*

Wildlife Photographer, Shetland

In fact, having the two industries working alongside one another in a remote location is often considered very beneficial for locals because the diversity ensures job security and keeps local families in the area.

*...we don't want things to be too visually intrusive obviously...but, if it's done properly then it's a valuable contributor to the local economy and society. It just adds to that rich fabric of life within the community.*

Education Representative, Western Isles

*...they might have an opportunity for a tourism business but it needs an income from somewhere else and the other person or member of the family is quite often working in fishing or aquaculture and you need that other employment otherwise you won't get enough range of employment for families ... it's not about what is more important and one thing being more important than another, it's about getting a mix of opportunities for people.*

Local Council, Argyll

The qualitative research highlighted numerous examples throughout all the regions of local people benefiting from or considering the inclusion of aquaculture in tourism activities. In this case, the supply of tourism services and aquaculture products are no longer considered substitutes but complements.

*... there's no reason why some of these things couldn't actually have an attraction value... How fascinated would you be? Especially if you were in a country that didn't have a fish farm.*

Tourism Representative, Argyll

Where aquaculture is already being incorporated into wildlife tours and tourism businesses, stakeholders have found that they have had quite varied responses from tourists.

*There's some people take it or leave it, you know? Other people are very interested in the thing but the thing they are mostly impressed with is the amount of fish that are actually out there. You know, you tell them there is about 30-40 thousand fish per cage, you know and then they go 'oh!'. A lot of them like seeing them jump about like that. But other people make wee comments about them damaging the environment and that sort of stuff.*

Tourism Representative, Skye



*Some people come here as a tourist and they're quite keen to go and look at a salmon farm and get involved and understand what it's about and there's others I guess that see it as a bit of a problem when you are looking at the beautiful voes of Shetland and there's a big salmon farm sitting in the middle of it. Yeah, I guess it's plusses and minuses for it.*

Local Council, Shetland

For more information on the tourism sector and how it links with the aquaculture sector, see the financial capital section (section 7.2.4).

### 10.3 AGRICULTURE

Agricultural produce originating in Scotland includes cereals, vegetables such as potatoes, and livestock. It is an industry that consumes a vast majority of land in Scotland and hence it is of greater value than the aquaculture industry. For instance, the GVA for salmon in 2012 was £166 million<sup>200</sup> compared to £844 million for agriculture<sup>201</sup>. Furthermore, the number of employees in 2012 in farming was 68,400<sup>202 203 204</sup>. This however may be a reflection of how much potential there is for aquaculture to develop: Young's noted that salmon is becoming comparable to chicken as a protein source in prepared meals, and if so it faces a potentially limitless level of demand.

Aquaculture feed can comprise between 10-15% of Scottish-grown wheat and beans, making a contribution of an estimated £20-25m in sales for agriculture farming via merchants such as W N Lindsay.

In consultation, a comparison of the sector to aquaculture was only raised in Argyll. The interviewees there, when considering the visual impact of fish farm installations, suggested that they are no different or more invasive than agricultural farms it's just that people are not used to them and hence may have some objections.

*I think local people certainly know that they are just part and parcel of keeping people in employment and producing food. You know, it's no real different to agricultural buildings at the end of the day. Farms aren't particularly attractive, most of them. They make a lot of noise and smell, but people put up with those.*

Local Council, Argyll

*I don't think the tourists are frightened away by fish farms; fish farming is a bit of a novelty as far as they're concerned. It's like saying they're frightened of our fields being full of sheep. Of course they aren't and they accept us more or less as we are, and sometimes they see a sheep in a field and they sometimes see salmon in some cages off shore. I don't think that has a huge impact positive or negative on the tourism industry.*

Consultant, Argyll

One of the Argyll interviewees commented on the fact that although the aquaculture sector is not very good at supporting community development projects, it is still more pro-active and successful than the agricultural sector in this respect.



*What they do do is over and above what the farming sector does. The farming sector doesn't really put anything back generally. Although it's the custodian of land or whatever, it doesn't really put anything back into the communities, you don't really see things being sponsored by First Milk or whatever.... [However] with the farmer, he's part of the community, he's a custodian of the land around where we live, he's doing something reasonably sustainable milking his cattle or whatever it is. There is a bit of a 'big business' issue with fish farms.*

Local Council, Argyll

## 10.4 FORESTRY

The area of land covered by woodland in Scotland is 1,410,000 hectares which equates to 45% of the UK's woodland<sup>205</sup>. Thanks to restocking cycles, the industry is able to harvest significant amounts of produce annually for the global market. For example, in 2012 7.9 million cubic meters of timber were harvested<sup>206</sup>. Forestry is an industry that mainly generates employment opportunities for Scottish people directly through planting, maintaining, harvesting, transporting and processing of the wood. It is estimated to employ between 10,253-13,190 full time equivalent jobs in this way<sup>207</sup>. The GVA associated with Scottish timber is £458.6 million<sup>208</sup>.

As with agriculture, some people in the interviews noted that there were few reasons why people should object to the visual impact of fish farms when they have been very happy to accommodate forestry practices (and the resulting dramatic changes to the landscape) for many years.

*I know that clear fell sites can be a bit ugly but it's a manufacturing, it's a farming, it's a harvesting process. Now you don't see the same dramatic changes on a cycle in aquaculture units – you see big black plastic circuits that are roughly the same in colour as the sea. I struggle with reconciling a need to preserve a pristine or world famous wilderness seascape if you like and the fact that maybe the only way for people to keep enjoying eating fish in 50 or 100 or 1000 years' time is to have them farmed. Why would you not make the use of the best natural resources?*

Tourism Representative, Argyll

One individual commented that we could be doing more to generate value from both of the sectors. Rather than exporting the raw materials it would be more beneficial to undertake more in-country value addition.

*At the moment we are just exporting our raw material, in the same way that we truck all our trees away.*

Local Council, Argyll

## 10.5 RECREATIONAL FISHERIES

Studies have recently started to be able to quantify the benefits that Scotland can accrue from people being able to use its fresh and sea water resources for recreational fishing.

*...in 2004 the University of Edinburgh did a bit of an EIA of the benefits of wild fishing for Scotland and what they found then was £1,800 is spent in the local economy for every rod-caught salmon in Scotland. And that's because people stay in hotels, buy petrol at the garage, send the wife and kids off to go on a shopping trip while they go off to fish and that kind of thing... So it does make*



*a contribution to the economy, and particularly in a place like Skye where it is largely a tourist based economy – if we can get people involved in fishing and then in spending in the economy it's got to be good.*

Fisheries Representative, Skye

Anglers in Scotland can expect to catch species such as sea trout, brown trout and rainbow trout. The sport is of particular value to rural Scotland and hence can be easily compared to aquaculture.

It has been shown that on a yearly basis, anglers spend about £113 million which ensures the employment of around 2,800 full time job equivalents in Scotland<sup>209</sup>. Therefore, the sector is of a fairly comparable size to aquaculture in employment though not in turnover or GVA (and may not have the full growth potential of aquaculture for the coming generations).

Many anglers reportedly do have a negative opinion of fish farms because of their concerns that the fish farms have on the wild stocks and the environment more broadly (as discussed in more detail in Section 7.2.7) and the fact that they can limit where angling takes place. Once again the concern is predominantly that this viewpoint might inhibit the development of the tourism industry.

*Well I think my own stance, and the stance of our board, would be that aquaculture has an important role to play in the conservation of wild stocks, so we are certainly not anti-fish-farming...But if you speak to anglers they would just like to see everything gone really. I suppose that it does have an effect on where groups of anglers would spend most of their time fishing. I would say that most of them would be deterred from spending time fishing in an area that had a lot of fish farm activity.*

Fisheries Representative, Western Isles

*But certainly in the late 80s, 90s there was a real crash in the number of rod catches of salmon. And that sort of coincided with the growth of aquaculture as well so people started to put 2 and 2 together and said there is a cause and effect here. I'm not entirely convinced – I think aquaculture is probably a factor but not necessarily the only factor.*

Fisheries Representative, Skye

However, quite frequently aquaculture companies have shown their support for angling, for instance by providing funding for restocking programmes or the work of angling trusts.

*That's the areas that we've concentrated on putting the sea trout stock that we have put in is the exclusion areas because we feel that at least fish are not going to get an immediate conflict with the farm fish. So to a certain extent that has worked, yeah.... I need to say that our programme of restocking is actually supported by the local industry in that they supply us with feed for our stock, for our broodstock.*

Fisheries Representative, Shetland

*The reality is that most of the trusts are getting some funding from aquaculture. I think in the years since we set our trust up, we've been running 4 years, we have had a total of £2500 from one aquaculture company.*

Fisheries Representative, Skye





## 10.6 CAPTURE FISHERIES

Scottish sea fisheries account for the production of around two thirds of the total fish caught in the UK<sup>210</sup>. Although the number of fishing vessels based in Scotland is known to be in decline, the value of landed pelagic, demersal and shellfish produce in 2012 amounted to £466 million<sup>211</sup>. This is now less than aquaculture in terms of turnover. In comparison to aquaculture it accounts for more fish, for instance in 2012 aquaculture produced nearly 170,000<sup>212 213</sup> tonnes of finfish whilst capture fisheries produced 295,501 tonnes<sup>214</sup>. Furthermore, although the number of employees based on Scottish fishing vessels was at its lowest recorded level in 2012 at 4,747, which still exceeds that of fish farming<sup>215 216 217</sup> on-site.

Inshore capture fisheries and aquaculture farms inherently are competing for saltwater resources in Scotland and hence you might anticipate that there would be a conflict of interest between the two stakeholders. The qualitative research highlighted that whilst the two industries historically have been able to develop alongside in harmony, as the operations of aquaculture have expanded some potential tensions have arisen.

*In the earlier years it developed in harmony with the wild commercial fishing industry 'cause it was kind of low impact and stocking densities were very low. Initially the price for farmed salmon was close too, as production levels were lower the price of salmon was very similar to wild caught salmon. As production increased the gap between farmed salmon and wild salmon widened... and now what they're doing is impacting on actual sites that commercial fishermen have been fishing. Other than the displacement from the ground then they're seeing the impact that's on the shellfish stocks in that general area... [for example] in Uist there were lobsters that were being stored for Christmas time and they were, they'd been there for years and a day after treatment of cages probably I would say ¾ of a mile away, the lobsters died.*

Commercial Fishing Representative, Western Isles

However, in many cases, the industries are considered to be complementary to one another because they mutually benefit from the development of service industries in rural parts of Scotland and the extra scale gained from acting as a united industry.

*I suppose, one of the main links from our point of view is the volume of aquaculture products being used in Shetland helps to maintain the supply chains that we depend upon, i.e. logistics like the ferry capacity, the transport networks and so on that our products also fit into. It makes a very compelling case for Shetland when you look at the total volumes including aquaculture and caught fish. So that's certainly a positive interface we have with the aquaculture sector... to a large extent we depend upon similar back up of ancillary industries and so on so again one complements the other there. There's been a good arrangement in Shetland for a long number of years in terms of engineering, all the other various associated chandlery, you know the supplies, marine supplies and what have you. Both sectors benefit again from the combined size and the throughput created. So yeah, it's part of the mix. We have a combined seafood industry in Shetland, it's a major part of the local economy here and again in a complementary fashion that adds a bit of weight in terms of our political clout.*

Industry Representative, Shetland





Aquaculture can play a catalytic and de-risking role for capture fisheries at the processing stage: farmed salmon can be described as a 'baseload' of volume for large processors and for distribution networks (as with DFDS Logistics), where white fish and shellfish can be distributed using the same cold chain. Similarly, Blueshell Mussels estimate they support the employment of around 50 capture fisheries staff through their processing of crab and scallop, which is dependent on their mussel supply chain.

Furthermore, over the years fish farming has frequently provided alternative career opportunities for fishing employees because of the high level of transferable skills attained from working in either of the industries. This has ensured that employees have greater job security in more remote areas of Scotland because of the increased diversity (as previously mentioned in section 10.2).

*From the training side you know many of the skills, or most of the skills that are required in the fishing industry and the aquaculture sector are very similar. And you get a fair number of transferability of people who are in the fishing going to fish farming and the other way around.*

Commercial Fishing Representative, Western Isles

*...the development of aquaculture came at a time where the fish catching sector was declining. You're talking about the period in the 1990s and through into the early part of this century... Had it not been for the aquaculture sector I think there would have certainly been bigger problems for the onshore, the ancillaries, the engineering firms would have struggled had it not been for the additional work provided by the aquaculture sector*

Industry Representative, Shetland

## 10.7 NORWEGIAN AQUACULTURE

Norwegian aquaculture has been mentioned in other parts of this report because it is not only the market leader in terms of salmon farming, it also has quite a different organisational structure and approach to aquaculture practices, and therefore it can provide an interesting contrast to the Scottish industry.

The aquaculture sector in Norway is of a high economic value and it produces 1.3 million tonnes annually<sup>218</sup> and contributes 60% of the total Norwegian seafood exports<sup>219</sup>. The higher quantities that are produced in Norway compared to Scotland mean that the industry directly employs significantly more people (8,500 employees<sup>220</sup>). Furthermore the total turnover in 2012 from the sector was £3,231 million in Norway<sup>221</sup> compared to £550 million in Scotland<sup>222</sup>. Both industries have set themselves ambitious targets for growth over the next 5-10 years<sup>223</sup>. Norway is aiming to reach 2.7 million tonnes of salmon and trout in production by 2025 which is equivalent to a \$62 billion contribution to Norway's GDP. Scotland on the other hand is hoping to achieve 210,000 tonnes of marine finfish production by 2020, the great majority of which will be salmon, which again demonstrates the differential in scale between the two industries.

As noted in Section 10 of this report, the UK imports more seafood products than it exports which is not true of Norway who is a net exporter<sup>224</sup>. Indeed, the Norwegian seafood industry is now successfully raising the profile of its seafood produce on the UK market. This is in part due to a highly effective marketing campaign<sup>225</sup> which has opened up an opportunity for the Norwegian Seafood Council to set up a London base<sup>226</sup>.



Following consolidation, the aquaculture industry in Scotland is now predominantly owned by large multi-national companies, whereas the Norwegian industry has maintained a large number of active producers in the industry: in 2008, 80% of production was owned by 23 companies, versus 5 companies in Scotland producing an equivalent proportion of total output.<sup>227</sup> During the qualitative research some individuals highlighted this difference and suggested that a less consolidated industry, as in Norway, might allow for more community benefits to be accrued from the fish farms because local residents would feel that they had more ownership of the industry's outcomes.

*...the industry in Scotland is owned by 5 companies, soon be owned by 4 companies. The industry in Norway is still owned by 100-150 companies... if we had the benefits of fish farming more evenly spread throughout the more remote and fragile parts of the highlands and islands, perhaps it would be perceived to be a more beneficial.*

Consultant, Argyll

Alternatively, Scotland could seek to promote the industry's reputation through raising awareness of the industry, promoting training that is specific to the sector and encouraging people to take pride in it as well as other sectors that are more obviously economically valuable.

*... I work as an agent for the Norwegian salmon in the UK and in Norway, it's totally different because it's like, oil is their main thing but they have all sorts to do with seafood, you know they have University degrees to do with the rearing of it, the marketing of it. Whole communities are built just round servicing fish farms, working on fish farms, you know, they don't seem to have any of these issues that we have. It's something that they've really embraced.*

Wholesaler, Skye

Some individuals noted that the Scottish industry has received far less overall support than the Norwegian industry in order to ensure that it's continually becoming more productive and innovative. Individuals in Argyll and Shetland particularly noted that the Norwegian Aquaculture industry has benefitted from relatively more investment in research and development.

*Norway is light years ahead of us in terms of providing money for research...*

Aquaculture Employee, Argyll

*...we see Norwegian companies in here now, they've had the money to get on and do things and we've been kind of hampered with lack of support.*

Education Representative, Shetland

*What it comes down to is that the Norwegian state and the Norwegian business community has grasped the opportunity to develop that market, they've developed the technology themselves, they've developed that market, they're extremely go ahead in terms of looking at where they're going next with that – they're ahead of the game.... As a nation we've missed the opportunity, our financial institutions have not backed the opportunity, and frankly we've lost out.*

Industry Representative, Shetland

Perhaps the greatest single difference between the Scottish and Norwegian salmon farming industries is the maximum biomass allowed at each site, which is largely a result of differences in



water depth, substrates and currents between Scottish lochas and Norwegian fjords. The limit in Scotland set at 2,500t per site and is regulated by the Scottish Environmental Protection Agency (SEPA), largely based on the assimilative capacity of the local marine environment<sup>228</sup>. In Norway aquaculture licenses are administered by the Directorate of Fisheries, with Maximum Allowable Biomass (MAB) set at 780t (900t in Troms and Finnmark<sup>229</sup>) based on allowing production of 65t per 1,000m<sup>3</sup> and a standard license of 12,000m<sup>3</sup><sup>230</sup>. However, there can be up to 5 allowable licenses per site, so a maximum total of 3,900t in the water at any one time, although most sites have between 2,340t and 3,120t maximum standing biomass<sup>231</sup>. The issues arising from the 2,500t limit in Scotland are discussed further in section 12.

These distinct comparisons are important to consider when making broader decisions about how the industry could be best organised and how actively the Government should seek to be involved.



## 12. DISCUSSION - PROSPECTS FOR FUTURE GROWTH

Scotland's growth aspirations for aquaculture are feasible. The following section identifies the key areas raised during the study that relate to the future growth of aquaculture in Scotland.

A multitude of opinions were expressed by interview participants regarding the future growth of aquaculture in Scotland. Some respondents felt that there were already too many salmon and mussel farms. However, the majority of respondents believed that the growth of the sector could only be good for Scotland as long as that growth was a result of an organic process. In discussion with aquaculture industry representatives in Scotland, both salmon and shellfish, it was explained that the Scottish product fills a niche market and that it would be important to not overstretch production and thus lose a quality product.

### 12.1. BARRIERS TO GROWTH

A number of barriers to growth were identified by interview participants including: lack of suitable sites, stringent legislation and a lack of government support.

A lack of suitable sites was the most discussed barrier to growth. A number of those involved in aquaculture planning explained that there was now a problem with finding suitable sites and that many areas were approaching capacity, in terms of number of sites. Particularly in Shetland it was felt that every voe had cages or mussel ropes in them and that the safe production sites had all been taken.

*We have to fundamentally appreciate that there are limits to the physical and environmental capabilities of the coastal bodies that we are actually working in... We can't actually ignore that there's a limit to what you can produce in a given area. Unless we have other areas that we can produce in, we are at the limits of capacity in some of the ones we've got at the moment.*

Industry Representative, Shetland

A couple of Shetland interviewees suggested that perhaps the West Coast of Scotland would be a better area for expansion, however on discussion with planners in these areas – the problem seemed to be the same.

*There's a problem with being able to find suitable sites now. We've got a lot of areas that are kind of approaching capacity which is why they are looking at more far flung places like Colonsay. A few years ago you would never have been looking at a site that's so exposed as Colonsay.*

Local Council, Argyll

Legislation was another barrier to growth raised by interview participants. A number of respondents felt that the hassle of getting through planning permission and the regulations which bind the process were preventing growth of the industry. It was suggested that other countries such as Norway and Chile may not have the same legislation and demands that are placed on the industry in Scotland. Indeed, one participant suggested that the regulatory burden placed on the industry had seen a huge change in the impact of regulation over recent years.

*I was involved with the early days of salmon farming both here and in Norway... Norway had all these incredible rules, I mean you couldn't even buy a plot of land in Norway without*



*including the Government in the valuation of the land... Now they've gone from there to here because they got rid of the regulation whereas we have done the exact reverse. We had relatively light regulation here and no regulation ten years before that to a regulatory burden which is really quite difficult for the salmon farmers to bear.*

Consultant, Argyll

A lack of government support for the aquaculture industry in Scotland was also proposed as a reason why Scottish production has not seen as much expansion as other producing countries. This was not so much in terms of political support, as it was felt that the current government had made clear their support for the industry, but rather in terms of financial support. It was suggested that Norway and Denmark (for onshore re-circulation systems) received a lot of money from the government to help support the industry, whereas it was believed that the industry in Scotland did not receive as much help. Views in Shetland differed from other locations as in the recent past Shetland Council had given some financial assistance for both fin-fish and shellfish farming.

*We've been lucky in Shetland I think in some respects, general support has been quite good. Oh, and I should say about Norway, their government will support them to the hilt. They've got plenty of oil money slopping around; whereas in Scotland that's not been the case. I mean, we see Norwegian companies in here now, they've had money to get on and do things and we've been kinda hampered with lack of support.*

Education Representative, Shetland

## **12.2. POTENTIAL AREAS FOR DEVELOPMENT**

Despite the identification of barriers to growth, interview participants also proposed a number of potential areas for development which could contribute towards the expansion of the aquaculture industry. These areas included: moving to more exposed and high energy sites, the use of new technologies and the farming of new species.

Given the limitations in terms of space available for aquaculture production, one way in which to address this could be to move aquaculture installations to more exposed and high energy sites; a point raised by a number of interviewees. This is not a new idea and although the industry is already looking into operating in more exposed sites, none of them yet are truly operating offshore. There are many limitations to operating further offshore, particularly in terms of cost and weather. It was also pointed out that there are limits to what can be produced within the current technologies that are available, but that perhaps this is an area that industry should be focusing upon developing and that the Scottish Government could assist with this process.

*I think it's an area we could put a lot of research into as an industry, even government if they had, they should be, I believe, giving grant opportunities, for people to experiment using existing suppliers on offshore locations, truly offshore locations, and starting initially just with the equipment. Involve the fish much later.*

Aquaculture Employee, Argyll

One respondent suggested that the aquaculture sector should be looking at using more innovative technologies. One such suggestion was the development of more onshore closed systems. It was proposed that a large cost in using this method related to pumping water ashore, yet that now with renewable energy being more freely available, this problem would be solved. In Argyll, one survey



respondent claimed that there was even a planning application underway for an onshore recirculation plant by a company which was being funded by the Danish Government.

*They think they are the dawn of the new industry. The way they presented it to me is that their proposals and their system is a lot more worked up than competitors. Other competitors, for want of a better word, within existing salmon companies are looking at this sort of thing. And they feel that somebody's going to perfect it and get it operating, and whoever that is, is going to clean up.*

Local Council, Argyll

Finally it was suggested that the way forward may be to look at farming new species. Halibut had been tried in the Western Isles but was too slow-growing, and it was pointed out that Shetland's experience with cod was not successful for a variety of reasons. However, it was suggested that with water temperatures increasing, perhaps it was time to start looking at farming other species which previously could not have been farmed in Scotland.

However, within that 5 year period, growth has been very irregular, and a drop in volume to 143,000t was expected in 2013. To project growth based on the past 10 years of production is simply misleading: the industry's characteristics, quality management and markets are all virtually unrecognisable compared to 10 years ago.

A preferred method of projecting growth would be to accept that its likely biggest barriers are:

1. **Consenting of new sites:** The planning process remains relatively passive, in that there is not a proactive searching and offering of available and suitable sites by authorities. This may change with the new Marine Spatial Planning approach, seen by almost all stakeholders as a good step, and echoing proactive planning by the Shetland Islands Council in the past, and informally through industry's 'swapping' of sites to meet their own production needs.

The larger producers are increasingly positive about the feasibility of growth through new approaches to community engagement. Offering island communities a vote in whether they wish to have fish farm sites, and the employment and infrastructure benefits that may accrue from them, has been successful in establishing new production volume for islands such as Barra, Colonsay and Muck.

2. **Technological limitations in introducing new, more exposed sites:** More exposed and high energy sites are deemed to be a necessary but achievable breakthrough for the industry if it is to increase production volume beyond the 2020 growth targets. One respondent designing equipment for such sites suggested that 'the next 30,000t over the next 5 years will come from these sites coming on-stream'. The technology is not yet perfected, but is deemed firmly viable, and unlikely to fail to transpire.

This is enormously significant for the industry: we can realistically predict where at least half of the growth of the target industry volume will come from. This is in addition to the 'regular' sites that continue to be consented.

As identified in the National Marine Plan Consultation, the potential for increasing the 2,500t biomass limit is of key importance for the growth of the Scottish salmon industry. Work is underway, funded by the Scottish Government and SEPA, to improve modelling abilities for larger sites which could increase the biomass limit and therefore remove this as



a barrier to growth for the Scottish industry. The findings of this work will be of great importance to the Scottish aquaculture industry as it could mean that sites of over 2,500t can be identified<sup>232</sup>.

- 3. Fish Health & Public Health:** As the past 5 years in Chile, the recent ISA occurrence in Scotland or the years of combatting and mitigating the effects of sea lice in Scotland, have demonstrated, disease events and parasites can disrupt production figures and damage the reputation of the industry. However, the industry should look past the current risks and anticipate other emerging fish health risks over time: if it is not sea lice or ISA, it will be something else.

Authorities may wish to support this risk mitigation further, bearing in mind that 'Brand Scotland' relies firmly on a quality image. This is understood by all parties, but could be supported through a variety of policy measures (see recommendations).

In shellfish (see 10.2) the SSMG co-operative model was effective in mitigating the impact of an algal bloom in key sites in Shetland in 2013 which threatened its ability to supply customers. This was overcome by the geographic spread of members which included those in Argyll who were able to provide volumes in lieu of Shetland members. Without such an industry structure, major supply contracts may have been threatened. In some respects, the large scale of the remaining salmon producers means that a similar risk management structure is available internally within each company.

The environmental impact of new sites is not seen by most as a key barrier to overcome, in that SEPA's requirements on standards are established early on in the consenting process. However, one of the larger salmon companies was critical of its site-by-site assessment model which does not take into account cumulative impact across an overall area; and that 'conservative' discharge consents meant that lice treatments were applied in insufficient quantities for effective control. Nevertheless, environmental impact and strong environmental standards, while they can be improved (as discussed in sections 6 and 6), have been recognised as 1) strengthening Scotland's product offering, whereby consumers demand and prefer strict environmental credentials; 2) reducing costs, since the benthic impact of farms is closely related to the efficiency of feed provision, which in turn is a key cost-reduction measure by industry; and 3) demonstrating a good neighbour policy with authorities and communities that are keen to see negative impacts minimised.

The planning of new sites is repeatedly cited as a significant barrier, but simply degrading the requirements for consent was *not* suggested by any party in consultation. Industry players regard the Scottish planning environment as more challenging, but remain committed to protecting the Scottish industry's quality reputation.

### **12.3. GLOBAL PRODUCTION**

Looking at basic figures for industry growth – production has comfortably exceeded 1 million tonnes / \$10 billion for the past 2 years, with Norway alone predicting 1.1 to 1.2 million tonnes<sup>233</sup>. Therefore it is easy to conclude that Scotland, producing effectively all of the UK volume, is being left behind.

However, the truth is more complex: Chile and Norway are geographically larger than Scotland in terms of coastline; and they are competing in a lower-value, lower-cost-base market where Scotland





would struggle to compete without threatening its strong high-value, niche market. Scotland's product differentiation has been recognised 1) in the recent European Commission ruling (see section 8.5), 2) in the market where it can command a premium, and 3) internally within salmon and mussel producing firms where Scottish production is still deemed profitable despite higher costs.

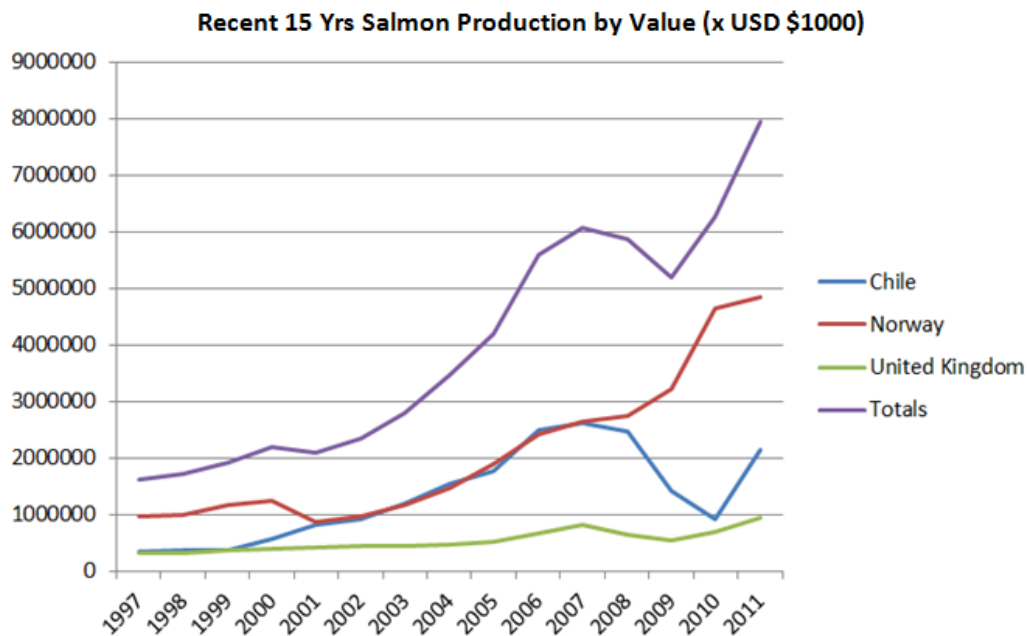


FIGURE 38. SALMON PRODUCTION BY VALUE (FAO FISHSTAT)

## 12.4. USEFULNESS OF GROWTH TARGETS

This protection of Scotland's quality premium over unbridled development has specific strategic consequences. Industry players are keen to see an organic approach to growth in Scotland, where current growth rates of 4-5% should allow increases in volume close to the 2020 target expectations, but the targets should not be an end in themselves. Challenges remain: much of the growth expected up to 2020 depends on a strategic shift in scale and positioning of sites, though this is likely to be achievable; and production is expected to have dipped slightly in 2013.



**TABLE 11. SCOTTISH AQUACULTURE GROWTH TARGETS AND PROJECTIONS**

MARINE FINFISH		SHELLFISH	
2012		2012	
Production	164,380 <sup>12</sup>	Production	6,525
Turnover (production only)	£550m	Turnover (production only)	£8.7m
Employment (production only)	1,118	Employment (production only)	358
Turnover across Scottish supply chain including processing and other suppliers	Over £800m	Turnover across Scottish supply chain including processing and other suppliers	£20m
Employment across Scottish supply chain	Over 4,000 employees	Employment across Scottish supply chain	Over 500 employees
GVA across Scottish supply chain	£265m	GVA across Scottish supply chain	Over £5m
2020 PROJECTION		2020 PROJECTION	
Production Target	210,000	Production Target	13,000
Turnover (production only)	£771m	Turnover (production only)	£17.3m
Employment (production only)	1,447	Employment (production only)	713
Turnover across Scottish supply chain including processing and other suppliers	£1.1bn	Turnover across Scottish supply chain including processing and other suppliers	£40m
Employment across Scottish supply chain	Over 7,000 employees	Employment across Scottish supply chain	~1,000 employees
GVA across Scottish supply chain	£345m	GVA across Scottish supply chain	£10-15m
<b>Full 2020 Benefit of Scottish Aquaculture (estimated), including growth stimulated in the wider economy:</b> To Scotland: est. £2bn, over 10,000 jobs (full and part time) To UK: est. 2.5bn, over 11,000 jobs (full and part time)			

**Though future trends in the industry are uncertain, it is expected that meeting the 2020 targets would bring the total economic activity from Scottish aquaculture to as much as £2bn across the Scottish economy.**

<sup>12</sup> Finfish production tonnage and production-only employment includes (in addition to salmon) rainbow trout produced in the marine environment (2,076t) plus small volumes of halibut and sea trout.



Achieving the targets by degrading the premium value that Scottish production can command, both in salmon and mussels (and other aquaculture species), would be a mistake for the industry, since consultation and analysis suggests this is what makes salmon production in Scotland attractive, viable and profitable. However, consultation with processors also suggests that there is a strong and unmet demand for Scottish salmon, even at current prices, and with large scope for volume growth if costs were reduced.

This seems well-founded and has consensus. The targets are welcome as an indication of commitment to the industry and recognition of its potential.

There is a wariness of using targets to force a square peg into a round hole, and damage Scotland's deserved quality reputation: but the cost of inaction appears to be increasingly high. The industry notes that Eastern markets are growing rapidly but only at a very small real volume, there is an increasing market in China<sup>234</sup> (and new markets such as India<sup>235</sup>) that may transform expectations of export demand. While Scotland seems possibly the best placed country in the world to take advantage of this 'high quality, luxury good' demand, it is likely that the lower-end domestic market that these volumes will displace will be picked up by Norway, Faroe Islands (in the UK market) or Chile (in the French market particularly). In other words, Scotland may climb up the quality ladder as desired, but the fundamental constraint on supply will mean it must sacrifice some of its current market to competitors. This is a significant loss of potential market share, since it would make Scotland more dependent on the vagaries of emerging markets. Given a relatively fixed supply, it is desirable to follow Scotland's high value strategy: but ideally a supply would be increased in line with industry targets in the belief that high value is still achievable.

Scottish salmon is more desired, and can command a premium – discussion with processors has identified the fact that there is 'unmet demand' for Scottish salmon at the current price. Above the current price, and currently in the absence of Scottish stock at the current price, people will substitute for the cheaper Norwegian & Chilean product. However, if Scotland were to produce more, even at the current price premium (and the price is more of a premium versus other countries rather than volume-based), Scotland could likely sell higher volumes and still achieve a premium. Therefore, given that supply is fixed, Scotland's strategy of maximising exports is entirely rational, but there is a strong argument to increase volume in the belief that the price premium will hold as long as the quality message does.

*The longer Scotland is uncompetitive in the larger volume UK market, the greater the acceptability of non-Scottish Salmon and the greater the pressure on that Scottish premium.*

It is likely that the industry ownership structure in Scotland does have a bearing on results since, from a Norwegian company owner's point of view, constrained Scottish production is acceptable as it can be mitigated by production elsewhere. From the 'Scotland Plc' point of view it is a lost opportunity. Once again, this is not the fault of current owners who are seeking to grow and maximise their internal company benefit through welcome investment in Scottish production, but of past economic strategies and policies. The good news is that there seems to be a great deal of consensus between policymakers and industry, only that policymakers will need to do the running because industry strategy is multinational and not always Scotland-specific.

It should be noted that these arguments are prone to considerable changes in circumstance in the industry, including growth of volumes in Norway and Chile, and even the politics of Norway's



awarding of a Nobel prize to Liu Xiaobo, which in turn influenced their loss of position as preferred supplier to China. Scotland should de-risk its market strategy for the same reason by maintaining UK market share along with established French and US markets.

In order to benefit from this growth in demand, Scotland should:

1. Ensure planning costs are proportionate and continue to reduce time delays by giving proactive support and predictability in the consenting process.
2. Embrace the community democracy approach to consultation, demonstrating as fully as possible the positive benefits and negative / neutral impacts of fish farm production.
3. Consider Scotland's market position with respect to rapidly changing global demand, and take strategic decisions regarding local and export markets through industry associations and organisations such as Scotland Food and Drink and SDI. This should include the potential benefits of Scottish seafood in health campaigns (omega 3 and healthy protein consumption), affordability of locally produced seafood, and availability of local provenance products for the tourist industry across Scotland. Is it advisable to have Scottish farmed seafood becoming unobtainable in Skye, or Glasgow or Edinburgh? This is not far-fetched, even in 2013, and may have a material impact on the feasibility of new sites when the connection with tourism and local provenance is severed.

#### **12.4.1. FINFISH**

Prospects for growth in salmon remain strong, but as noted above there are compelling reasons to protect *quality* of growth. Nevertheless, market demand in 2020 may be larger than it is now.

Significant growth in trout production, in particular marine-grown rainbow trout, is possible following the large scale salmon model, or through transforming the market-facing functions of the small-scale industry by recreating an effective Scot Trout / SSMG-style body. However trout faces the same consenting challenges as salmon, for example on Loch Etive.

#### **12.4.2. SHELLFISH**

Shellfish, similar to salmon, will benefit from maintaining competitive advantage through product differentiation – for example not by competing with the dredged and low-value mussels market. Shellfish producers appear to strongly benefit from the SSMG co-operative marketing model, and new value-addition lines within food processing should assist in developing growth, though price pressures are a worry, with a 40% margin over wholesale values increasingly hard to defend.

Some respondents noted the Shetland sites are now approaching carrying capacity (e.g. they may be hindered by spats no longer growing as efficiently) and new sites are becoming harder to come by. However, Shetland farms currently produce 69% of total Scottish volume. Mainland Scotland / Orkney sites should arguably now be emulating the volume of growth in Shetland, given the almost wholly benign impact on mussel farms on the environment (though they have some visual impact), and the benefit of a geographic spread of production.

One suggestion from a leading shellfish grower was to move away from the 2020 target, and focus on the biological carrying capacity on the supply side, and on growing the market appropriately rather than look at volume.

Integrated multi-trophic aquaculture (IMTA) could significantly open up the opportunities for mussel production in mainland and Shetland production. It remains to be established, however, whether



consumers would find it acceptable that mussels are growing from waste outputs from finfish sites. Public education on environmental and carbon footprint benefits may be a way of turning this into a virtue. IMTA (or rather, mixed-use aquaculture areas) could further be encouraged through a 'use-it-or-lose-it' approach to site licencing, whereby a salmon company occupying an unused site may be able to keep it at low cost by capitalising a local mussel farmer. This could assist in maintaining or securing good community relations, and catalyse consenting for salmon companies as much as it could benefit growth in shellfish figures.

Oyster production is noted as distinctly different to that of mussels, and while there is high-value in production, costs are also commensurately higher and volumes remain comparatively low.



## 13. KEY FINDINGS

### 13.1. SUMMARY

Scottish aquaculture is an engine of Scotland's rural economy, which in turn drives economic activity all across Scotland, from arable farmers in Fife to factory workers in Lanarkshire. There is an *intensity of benefit* for many rural areas, particularly in pockets of Argyll and the North Isles of Shetland, which should be acknowledged. Instead of fearing for their economic and social future, populations in these fragile areas are now driving economic activity in Lerwick and Larkhall, and even having some notable impacts in Livingston and Grangemouth. Nevertheless, this intensity brings its own risk when aquaculture is one of the few industries reaching into remote areas.

The *causality* between Scottish aquaculture production, and the Scottish location of other industries in large sections of the supply chain, is clear-cut. There is a geographic requirement about many of the activities in a way that multiplies the benefit of aquaculture. Because of this, only by looking across the whole value chain can we see the true benefits to Scotland of aquaculture production.

The argument to grow volumes remains strong, but multinational companies have to balance the interests of their Scottish operations alongside production in other countries. As a result there is a rationale for Scottish policy-makers to be more pro-active in the promotion of 'Brand Scotland', consenting of sites, stimulating technological development for more exposed sites, and exploring better finance options for smaller competitors. By reducing site allocation costs, while maintaining Scotland's impressive reputation for quality and standards, Scotland can provide a win-win for both multinational salmon companies and Scottish economic interest. Scottish-owned companies which seek to rise to the challenge of investing and taking on divested farms would benefit both the Scottish brand and diversity in supply.

The barriers to Scottish aquaculture growth can be overcome, and the will and justification from local communities is evident. It will contribute to the Scottish goals of solidarity, stable population and the creation of economic value in fragile and economically disadvantaged communities.

### 13.2. THE BENEFITS

- Perceived impact of aquaculture on human capital was biggest, largely in terms of availability of employment as well as the skills and experience which provide 'employment security'. Similarly, the results of the MSC question also pointed this way.
- Employment has been underestimated in terms of measuring jobs that are directly dependent on Scottish aquaculture, not just direct fish-farmers: production employs at least 2,800, and as many as 5,000 people including external processing and supplier services. In salmon production alone, there at least 2,200 employees including marketing, primary processing, management and ancillary staff.
- In shellfish, at least 358 are employed directly by shellfish growers across Scotland, and around 500 including processing. The majority are in Shetland where aquaculture is a significant employer and wealth creator.
- The aquaculture industry is worth at least £800m per year including production, equipment and supplies across Scotland. Its wealth generation goes far beyond this number.



- Financial benefit in terms of income to local ancillary businesses, particularly carriage (road transport and ferries) and tourism industry was the second most important perceived impact.
- The potential for aquaculture to help maintain rural and fragile communities through providing jobs for those of child-bearing age was the most commonly raised social capital benefit.
- The *intensity of benefit* to some communities should be recognised. For some communities like Yell in Shetland, aquaculture is the difference between being a highly economically powerful 'jewel in the crown' of Shetland on the one hand, and a vulnerable and possibly depopulating community were it to be absent.
- The intellectual capital associated with aquaculture production remaining in Scotland in a significant way can be exported, and back at home there is a 'skills ecology' that should be nurtured for further growth.
- The GVA of aquaculture per £1m invested in production is relatively low, but spending on manufacturing, engineering, agriculture and transport, with high multiplier benefits throughout the economy, is considerable. Consideration of direct employment alone suggests a strong benefit to Scotland. Feed supply is largely reliant on imported grain, but even here we can see some sales to Scottish arable farmers of £20m-25m.
- Negative opinions are generally low but most often relate to environmental impact of aquaculture, particularly in terms of wild fish and visual impact.
- Regarding future growth, some participants believed that there was already too much aquaculture development; however the majority believed that the growth of the sector would be beneficial to Scotland as long as that growth was an organic process.

### 13.3. IMPORTANCE OF KEY FINDINGS

The structure (or multiple structures) of the aquaculture industry, and above all their geographic spread, lead to specific conclusions and subsequent policy recommendations. The following section proposes ways by which the Scottish Government / Marine Scotland should view aquaculture development and offers ways in which to ensure continued benefit to Scotland.

- Quality and high value is Scottish aquaculture's trump card: but current volumes are more limited than they need be for every party concerned.
- Demand for Scottish salmon is potentially much larger than at present both in export and domestic markets, particularly at a more competitive price than is currently created by high compliance and volume-constrained supply conditions. However, constrained supply could lead to Scottish product being increasingly displaced by Norwegian product, rather than vice versa, leading Scotland into a high value but smaller niche than could ultimately be realised.
- The incentive to promote Scottish salmon over other countries' product is likely to be stronger for Scottish policy-makers and Scottish-owned companies than it is for multinational companies. This gives a good rationale for promoting Scottish production (including that of multinationals) through Scotland Food and Drink and industry bodies such as SSPO and SSMG.
- Large firms in aquaculture (mainly in salmon) have sought to professionalise an industry that was in the past beset by bankruptcies, disease events and standards that would no longer be acceptable and would harm industry growth. Their contribution should be recognised





alongside the recognition that the market is highly concentrated in ownership, and is now subject to divestment requirements under EU rules.

- The requirement to divest farms in rationalisation during takeovers between large firms should be seen as an opportunity to be creative with ownership models.
- Many of the remaining small salmon-producing companies, mussel farmers and successful food processors are hampered by the cost of entry into high investment expansion: risk-mitigation or better finance options are required if they are to remain successful and sustainable in competing with larger companies.
- There is a 'perception gap' between policy-makers and the public, possibly arising from the hard economic realities since 2008: though a diverse range of opinions were voiced, there is a degree of consensus that aquaculture production has brought highly valued human and financial capital to Highland and Island communities, and towns in the Central Belt. Environmental management has improved over the same period.
- Funding options: IMTA and more exposed and high energy sites as emerging strategic areas should be explored with supporting catalytic investment / soft loans or other R&D funding, and prioritised in the same way that technological development is in, for example, marine renewable energy.
- Streamlining the planning and consenting process is urgently required in both finfish and shellfish, without weakening Scotland's value proposition. A pro-active approach to consenting is appropriate and should be pursued by all actors.
- Recognise the value across the supply chain that is brought into Scotland: feed supply, equipment, transport, logistics, and processing not only contribute through other sectoral GVAs directly dependent on aquaculture production, but are knitted into the Highland and non-Highland economic regions.
- Recognise the value of investment brought to the Scottish industry through multinational financing and management, and learn from it: scope investment models where national wealth (through e.g. oil funds or an investment fund) can be reinvested in sectors such as aquaculture.
- Support more community engagement as 'core business', not just as CSR policy. There are established outgrower models (Bound Skerries) and new community engagement models (Colonsay, Barra) which could be developed into a coherent system for accelerated planning and community benefit / ownership structures.
- Fragile areas remain fragile, even when aquaculture production has provided essential income streams over 2 decades and looks set to provide further benefits in future.
- Increase value addition in Scotland for both improvements in Scottish health objectives and to improve acceptance of aquaculture production across the Highlands and Islands region. Ultimately this relies on increased volume which can supply the processors.
- Learn from Shetland's industry forum discussions to allow ferries to meet industry as well as social needs: in the long term this will improve the financial viability and position of public transport services.
- New export markets are hard to predict and growing from small volumes: but indications are that domestic and international demand could be multiples higher than at present.
- Skills and research exports e.g. Fusion Marine, Kames, Institute of Aquaculture, AutoDEPOMOD software: Scotland needs to market its intellectual capital – this is confirmed



by Stirling's MSc programme being largely international students coming here to learn because it is the best country in which to do so due to its English language and international outlook.

The 2020 targets for sustainable industry growth, namely to see production of marine finfish increase to 210,000 tonnes and shellfish increase to 13,000 tonnes, are considered with a degree of caution by stakeholders, insofar as they do not necessarily focus on and account for the value niche of Scottish product. However, Scottish interests are to marry this appreciation of value with the increased volume opportunities that are demonstrated across domestic and international markets.



## 14. POLICY IMPLICATIONS

### 14.1. LOCAL (COUNCIL) LEVEL

This report demonstrates that aquaculture provides positive benefits to remote and peripheral communities in Scotland. The key benefit according to this research is the provision of local employment although the extent of employment is subject to the scale and type of aquaculture industry and the modernisation of the sector. In terms of local policy development, particularly on the West Coast, Western Isles, Highlands and Northern Isles, growing and retaining meaningful and year round jobs is of principle importance, supported by policies that increase and retain skills in local populations. It follows that local policy initiatives, supported by the national policy framework 'Skills for Scotland: Accelerating the Recovery and Increasing Sustainable Economic Growth' will be the primary vehicle for linking skills development with the aquaculture sector, particularly as the sector matures and invests in innovation, specialisation, and expansion into new markets or means of production. We recommend the following policy action:

- Ensuring that local employment and economic development strategies respond to the emerging challenge and opportunity of aquaculture.
- Supporting aquaculture businesses to improve their understanding of the skills challenges and engaging in constant dialogue over new and emerging skills requirements.
- Connecting aquaculture industry needs with education and skills providers such as the University of the Highlands and Islands, and skills councils such as LANTRA (see [www.lantra.co.uk](http://www.lantra.co.uk)) to identify and implement appropriate skills strategies for aquaculture regions. Recent research by LANTRA identified that key skills for the sector included containment, predation management, animal health and welfare, food safety traceability, management skills, access to training, and guidance on funding and resources and the key skill gaps.
- Access to training is an important issue for remote island communities. With increased recognition and growth of the maritime economy, including sectors such as aquaculture and marine renewable energy, further development of vocational and tertiary training is necessary but needs to be delivered via flexible and realistic format for SMEs in remote locations. Opportunities for flexible and remote learning through appropriate institutions such as UHI will further develop and embed local skill sets in communities and respond to identified concerns of remote communities where aquaculture operations are based.
- The OECD in the report 'Designing Local Skills Strategies' ([www.oecd-ilibrary.org/education/designing-local-skills-strategies\\_9789264066649-en](http://www.oecd-ilibrary.org/education/designing-local-skills-strategies_9789264066649-en)) identifies that as business needs evolve demands are placed on local vocational education and training systems to adapt which can be difficult when educational institutions are centralised or lack the resources to adapt to business needs. This could be an important issue for the aquaculture sector in Scotland in light of the move towards alternative forms of production in terms of species, technical innovations or moving into the offshore environment.
- The responsibility for development of local and regional skills strategies lies with Skills Development Scotland: priorities concerning employment and skills will need to be identified for aquaculture, with local authorities, HIE and Scottish Enterprise all playing a role. For example, should the priority be on attraction of new talent, retention of existing



workforce, training young people, developing innovation clusters, or improving local institutions. While a successful strategy will involve a mix of the above, local authorities in particular will need to increasingly understand the 'skills ecology' surrounding aquaculture in their respective regions i.e. the supply of skills from the population and the demand from local industry.

- Local authorities will increasingly need to understand and influence education and training policy at a national level to ensure that skills needs are being met based on regional priorities and that partnership opportunities are being identified and pursued to improve employment and local growth in aquaculture. This links the traditional development control function of local authorities with industry development.
- Regional accounting exercises such as Shetland's are highly valuable.
- Argument for maintaining public services is complicated in remote areas: on the one hand, councils are expected to deliver public services to a rural population regardless of income, and those services costs can be seen to be recouped in part or in whole by the industry of those populations. As in the Yell and Unst island examples, it was argued that cutting a regular ferry route would be cutting a very profitable industry off from mainland Shetland. Conversely, this means that potentially optional public services must be maintained to support the industry.
- Local authorities will need to proactively respond to the regional marine planning agenda across a number of existing and emerging maritime sectors. Aquaculture's role as a relatively stable and established sector will benefit from more certainty in the planning environment and the shift to a 'Norwegian' model where planning approvals and decision times are reduced and areas for development are identified and open for licencing.

## **14.2. NATIONAL LEVEL**

Aquaculture is a critical industry for Scotland's maritime economy and is recognised as such at the national level. The Scottish Government supports Scotland's aquaculture industry to achieve sustainable growth targets, with due regard to the marine environment, by 2020 of:

- To grow marine finfish production sustainably to 210,000 tonnes (164,380 tonnes in 2012) and;
- To grow shellfish production (especially mussels) to 13,000 tonnes (from 6,525 tonnes in 2012)

A number of policy challenges remain for the sector as outlined in this document. At a national level a number of initiatives will be influential in steering sustainable aquaculture that maximises the benefits to Scotland and its communities. Policy challenges and opportunities at the national level include:

- Using Scottish Government departments, non-departmental public bodies and partner organisations (e.g. Scottish Enterprise & SDI, HIE, Scotland Food and Drink, SSPO, SSMG) to promote Scottish product on the basis of certification schemes, quality of production and environmental standards. This accepts the value brought by multinational companies but recognises their pan-national priorities.



- Learn from Norway and consider financing mechanisms to assist smaller firms to develop: noting that recent European Commission requirements for divesting of farms during recent consolidation bids will require capable, smaller firms to maintain market share.
- Take advantage of any opportunities offered by the Scotland – Norway Memorandum of Understanding on sharing best practice on aquaculture.
- The implementation of recommendations from the Ministerial Group for Sustainable Aquaculture (the former Ministerial Group on Aquaculture) will be imperative for industry growth. Of specific note, the Capacity working group has established a terms of reference that explores reforms to licencing and streamlined regulation. The project plan identifies existing site capacity, infrastructure, stakeholder engagement, planning, and diversifying SMEs as priority action areas. An important barrier has been the long license application periods of up to three years which increase uncertainty and risk for start-up businesses. This is largely due to numerous points of governmental contact required for approval. A 'Single Contact System' has shown, in Norway, to reduce application time to 6 months.
- Also of note is the MGSA Interactions working group that aims to facilitate ongoing discussion between the farmed and wild fish sectors, develop a blueprint for local engagement, and build on locational work to inform marine spatial planning (MSP). These initiatives, while early days, will be critically important to addressing several of the key challenges in the sector. Success will be driven by uptake of results to regional levels by local authorities with strong resourced central action.
- Outputs from recent FAO training workshops on spatial planning highlight issues that will undermine sustainable aquaculture expansion and influence the delivery of the recommendations from the Ministerial Group for Sustainable Aquaculture. The main obstacles for adequate aquaculture zoning processes, particularly in light of emerging MSP are:
  - Limited understanding of the concepts and processes to aquaculture zoning and carrying capacity estimates;
  - Lack of aquaculture master plans that include aquaculture zoning, and lack of political will and institutional interest to establish aquaculture zones;
  - Conflicts between aquaculture activities and other user interests in coastal zones;
  - Lack of institutional frameworks, including laws, regulations and norms for the allocation of space for aquaculture; and
  - A general lack of resources and training to support aquaculture zoning initiatives.
- Six regional plans will potentially guide aquaculture on the West Coast, Outer Hebrides and Northern Islands of Scotland. Ensuring consistency of regulation and management will be a considerable challenge - plans will be phased in at different times around Scotland with an indicative view that this will entail 2 plans per annum subject to resources. There is currently a lack of clear or specific guidance to what the plans will entail: from setup, institutional rules, extent of spatial zoning, regulatory impact and monitoring and enforcement. This is further complicated by the lack of a finalised National Marine Plan (currently in draft) that should set the strategic direction for aquaculture in line with other sectors in the marine sphere. While many initiatives (such as licencing reform) are progressing without a NMP, the



lack of an agreed national overview will reduce the effectiveness of inter-regional and inter-sector cooperation and slow down the identification of potential sites for new development.

- Shetland is an example of the devolved planning model proving effective: there is a willingness for the local council and community councils to look positively on development since, when the decision is in their hands, they can see the impact on local employment and income. However, in other areas the local voice that may shout loudest can often conflict with other local and national objectives. In this case the devolution of planning control has been less successful since it is not clear that the wariness taken in the localized planning process has served the wider local and national populations.

### **14.3. EU LEVEL**

In 2010, the value of EU aquaculture production was € 3.1 billion for 1.26 million tonnes. There is gap between the amount of seafood consumed in the EU and the amount produced by fisheries and aquaculture. According to the European Commission<sup>236</sup> the EU seafood market is supplied 25% from EU fisheries, 65% from imports and 10% from EU aquaculture. The EU Blue Growth Strategy and the Common Fisheries Policy reform program represent the main reform pathways for EU aquaculture. Scotland is a strong performer within the EU policy context and should maintain close engagement with EU policy development in order to maximise the opportunities that will emerge from the Blue Growth agenda.<sup>237</sup>

Many of the concerns at the EU scale echo the concerns facing Scottish producers at the national scale. For example competition over space and limited access to water in coastal areas and river basins are important obstacles to setting up, developing or even maintaining aquaculture production sites. Other issues such as fierce foreign competition and high labour and planning rules, particularly on environmental protection can generate disadvantages but importantly should be seen and developed as competitive advantages in the context of healthy and sustainable seafood. In the case of Scotland, working with these issues at a European scale may provide resources, ideas, collaborations and critically traction for resolving them in the domestic policy context.

The European policy context sets the backdrop for aquaculture planning and management in Scotland. In particular the Water Framework Directive (WFD), covering inland and coastal waters, and the Marine Strategy Framework Directive (MSFD), covering marine waters, are key considerations. The WFD presents a set of environmental objectives, including the achievement of good ecological and chemical status of surface water principally through River Basin Management Plans (RBMPs). The Directive has been in force since 2000 and in 2013 has repealed the Shellfish Waters Directive which will come under the remit of the WFD. RBMPs are the vehicle by which water quality and pollution issues are addressed in Scotland. The 1<sup>st</sup> phase of river basin planning runs from 2009-2015 and the second and third RBMP cycles run from 2015-2021 and 2021-2027 respectively. It is important that aquaculture continues to be integrated with the other uses of Scotland's natural water resources and that appropriate environmental objectives are set for internal and coastal waters and allow the industry sufficient room and water quality to expand, particularly in the case of shellfish farming and the repeal of Directive 91/492/EEC.

The European Commission Blue Growth Agenda represents a considerable opportunity for the Scottish aquaculture sector with a drive to increase production in line with the environmental standards set by the MSFD. It recognises an initiative to harness the untapped potential of Europe's



oceans, seas and coasts for jobs and growth. The agenda is specifically responding to the emerging threat of lack of marine space and the rapid technological process in working offshore across a number of industries. The Commission, as a part of the Common Fisheries Policy reform program, is using a method of 'open coordination' to improve aquaculture in the EU. This approach will employ non-binding strategic guides, multi-annual plans, best practice exchanges, and funding for research and development. A number of initiatives have grown out of the Blue Growth agenda that are of relevance to Scotland. They include:

- The future utilisation of the European Maritime and Fisheries Fund to support technical development of aquaculture including offshore development, co-locational opportunities and development of IMTA. Industry, government and SMEs should be prepared to engage to promote activity and access this funding stream.
- The Horizon 2020 programme for research and innovation will play an important role in unlocking the growth potential of European aquaculture. The current 2014/2015 round has research and SME funding for improving spatial planning for aquaculture, implementing an ecosystem approach, determining the carrying capacity of regional systems and planning the offshore maritime economy. We encourage SMEs and Scottish researchers to engage in this program and access resources to support industry innovation.
- The development of Strategic Guidelines on Aquaculture<sup>238</sup> in the EU highlights a step change in EU aquaculture policy. At the EU level the creation of the Aquaculture Advisory Council (AAC) aims to promote knowledge exchange between the Commission and Member States on aquaculture problems and opportunities. The role of the AAC will be to provide recommendations to policy-makers and to help them adopt evidence-based decisions. The Commission has identified the following areas of concern:
  - **Reducing administrative burdens.** This remains the top priority for the Commission. The recent national economic reports on aquaculture have collated a range of information on licencing across the EU. This will be used to support best practice identification and feed into the Commission High level Group on Administrative Burdens in 2014. In addition guidance documents will be prepared to assist industry in navigating the WFD and MSFD requirements and to illustrate how the requirements can drive product quality and sustainable practice.
  - **Improving access to space and water.** There are a number of initiatives to improve spatial planning for aquaculture both in the maritime and inland domains. The draft Directive on MSP and ICM is a key EU initiative under the Blue Growth Agenda and will be supported by best practice exchanges in 2014.
  - **Increasing competitiveness.** Reform of the Common Market Organisation (CMO) and the European Maritime and Fisheries Fund (EMFF) will provide funding and resources for aquaculture SMEs. Funding will potentially support marketing plans, links between R&D and industry, and vocational programs. This can potentially tie in with the education and training needs outlines in the local governance section.
  - **Exploiting competitive advantages due to high quality, health and environmental standards.** Member states will be required to produce multiannual national strategic plans based on the EU Strategic Guidelines covering the period 2014-2020 and will facilitate the sharing of best practice at the EU level. The commission will review EU labelling rules to ensure they are fully implemented in particular labelling regarding





freshness, provenance and commercial names and will launch a Communication on the strengths of EU aquaculture. Other EU and international initiatives such as organic certification will be supported by the Commission – Scottish industry should explore the opportunities in this sector for product differentiation and value adding.



## 15. ANNEX

### 15.1. QUESTIONNAIRE

#### COMMUNITY BENEFITS OF AQUACULTURE IN SCOTLAND

All information will be treated in the strictest confidence, and no individuals will be identified in the research results. The questionnaire should take no more than 5 minutes to complete.

##### Demographics

1. Survey undertaken \_\_\_\_\_
2. Gender (surveyor to complete)
  - a) Male ☐
  - b) Female ☐
3. Age
  - a) <25 ☐
  - b) 25-35 ☐
  - c) 35-45 ☐
  - c) 45-55 ☐
  - d) 55-65 ☐
  - d) >65 ☐
4. Education
  - a) High School ☐
  - b) College ☐
  - c) University ☐
  - d) Other ☐
5. Are you a resident or a visitor?
  - a) Resident ☐
  - b) Visitor ☐

##### Scottish Aquaculture

6. In your community, how has aquaculture impacted (please circle):

- |                                 |          |           |
|---------------------------------|----------|-----------|
| a) Employment/skills/education  | Negative | No change |
| Positive                        |          |           |
| b) Family and community life    | Negative | No change |
| Positive                        |          |           |
| c) Income/earnings for business | Negative | No change |
| Positive                        |          |           |
| d) Environment                  | Negative | No change |
| Positive                        |          |           |
| e) Infrastructure               | Negative | No change |
| Positive                        |          |           |

7. What is the most significant impact that aquaculture has had for this area?

**Thank you for your time in completing this questionnaire**

If you wish to be informed of the results of this survey, please enter your name and email and/or address:



## 15.2. INTERVIEW TOPIC GUIDE

### ASSESSMENT OF THE BENEFITS TO SCOTTISH COMMUNITIES OF AQUACULTURE AND GROWTH IN AQUACULTURE PRODUCTION

Interview aims to explore:

- Respondents understanding of how aquaculture benefits their community
  - To what extent are employment and income related to aquaculture?
  - To what extent are associated services dependent on aquaculture?

**\*\*USE 'HOW' INSTEAD OF 'WHY' TO EXPLORE TOPICS FURTHER\*\***

#### Introduction

- *Introduce self and project*
- *Explain*
  - *reasons for recording interview – concentrate on what being said*
  - *no right or wrong answer*
  - *length of interview – no more than 1.5 hours*
  - *voluntary nature of participation and right to withdraw*
- *Confidentiality and how findings will be reported*
- *Any questions they have*

#### Background

- Description of role played in community
  - Job
  - Other extra activities (i.e. social groups)
- How does role relate to aquaculture?

#### Awareness and Understanding

- What does 'aquaculture' mean to them?
- Is there a need for aquaculture?
- Where do you hear about aquaculture?
  - Work
  - Media
  - Family/friends
- Who are the key people in the community related to aquaculture?

#### Aquaculture related income

- Has aquaculture brought them any additional income (relevant to business)?
  - Increased visitors
  - Tourism
  - Additional pupils
  - Increased sales
- Has aquaculture lost them any income?



### **Aquaculture Jobs**

- Has aquaculture led to more jobs in the area?
  - Are the jobs unskilled or highly technical?
  - Dual-job holding
- Has aquaculture given jobs to local people or brought people into the area?
- Has aquaculture meant that jobs have been lost in the area?
- What jobs are available in the community if aquaculture didn't exist?
- What are the opportunities for youth employment?

### **Other Social Impacts of Aquaculture**

- Has aquaculture led to any other social costs or benefits?
  - Community projects
  - Community funding
  - Restricted use
  - Conflicts between marine users
  - Visual impact
- How has aquaculture impacted your sense of community?

### **Environmental Impacts of Aquaculture**

- Do you have any concerns regarding the environmental impact of aquaculture?
  - Medicines
  - Disease
  - Contaminants
  - Escapes
  - Sea Lice

### **Most significant impact**

- Most significant impact that aquaculture has had for area/community?

### **Further Scottish Aquaculture Development**

- Show image of graph
  - Why do you think this is happening?
  - Do you want to see Scotland keeping up with Chile/Norway
  - If no, why not?
  - If yes, how?

At end of interview:

- Thank respondent for participation in interview
- Provide reassurances about confidentiality



### 15.3. PUBLICITY MATERIALS USED

# Community benefits of aquaculture in Scotland

The Scottish Government are reviewing how the aquaculture industry contributes to the Scottish economy at all levels through an assessment of the benefits to Scotland of aquaculture and growth in aquaculture production. A key part of this is finding out how aquaculture impacts communities in Scotland including skills development, community life, income generation, the environment and infrastructure.

Community-level information will be gathered through questionnaires and interviews with our team. If you are interested in contributing please either visit our survey website at: [www.surveymonkey.com/s/G2Q289S](http://www.surveymonkey.com/s/G2Q289S) or contact us at the below email addresses.

**For further information contact:**  
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*For more information on Marine Scotland and HIE visit:*  
[www.scotland.gov.uk/topics/marine](http://www.scotland.gov.uk/topics/marine)  
[www.hie.co.uk](http://www.hie.co.uk)



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