Estimation of the Wider Economic Impacts of the Aquaculture Sector in Scotland

September 2020

Estimation of the Wider Economic Impacts of the Aquaculture Sector in Scotland

A report to Marine Scotland prepared by Biggar Economics
10th June 2020

Contents

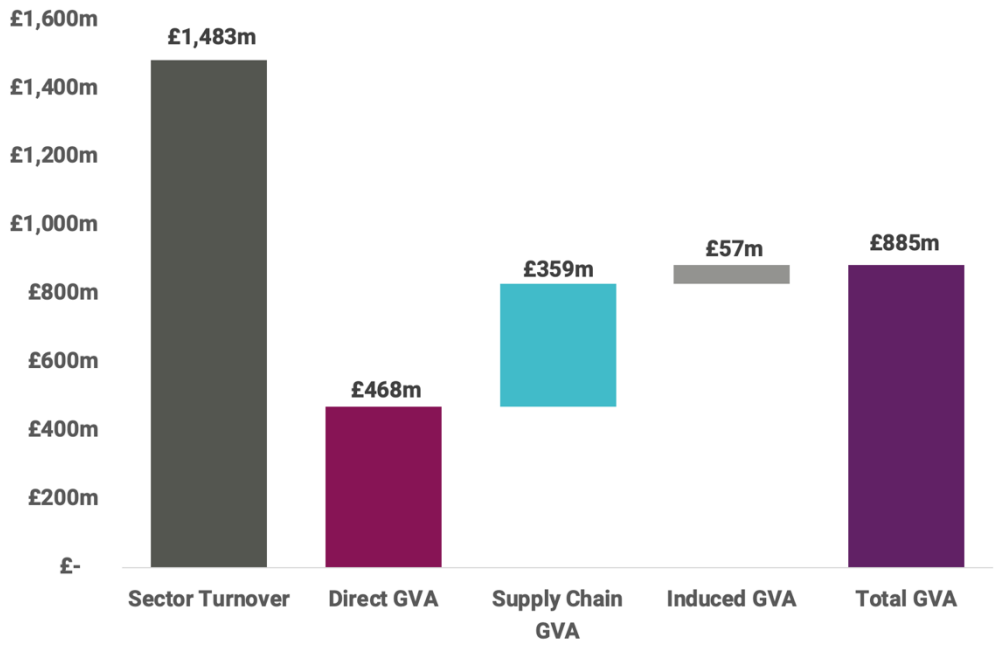
1. Executive Summary

The aquaculture sector in Scotland is an important provider of employment in rural Scotland and represents the UK's largest food export by value. This study considered the wider value that the sector had to the Scottish economy and the source of these impacts

In 2018 the aquaculture sector supported 11,700 jobs in the Scottish economy and generated £885 million Gross Value Added

In 2018 the aquaculture sector had a turnover of £1.5 billion. The turnover of the sector included a significant amount of transactions within the sector itself, such as the purchasing of aquaculture products by the processing companies. From this turnover, the sector generated £468 million direct Gross Value Added (GVA). A further £359 million GVA was generated in the supply chain of aquaculture companies and £57 million through the spending of staff salaries.

Figure 1-1 Turnover and Sector 2018 GVA by Source

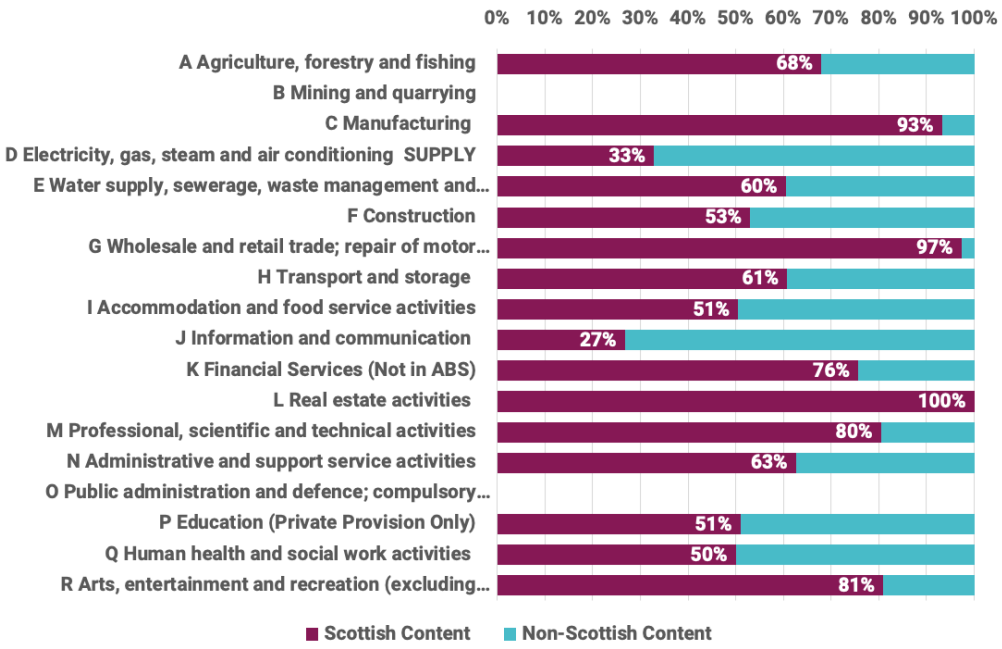


Source: BiGGAR Economics Analysis

The Aquaculture sector purchased 76% of its supplies from Scotland

The aquaculture sector spent £1.4 billion on supplies and capital investments in 2018. This includes spending taking place within the aquaculture sector. To avoid double counting, only the expenditure taking place outside the aquaculture sector was considered. This was estimated to be around £834.6 million in 2018. The single largest category of external expenditure was the purchase of feed for finfish production, which accounted for £290 million of spend. This was followed by expenditure on equipment and vessel rental, transport and veterinary services. The majority of these goods and services were purchased from Scotland.

Figure 1-2 Share of Supply Spending in Scotland by Sector



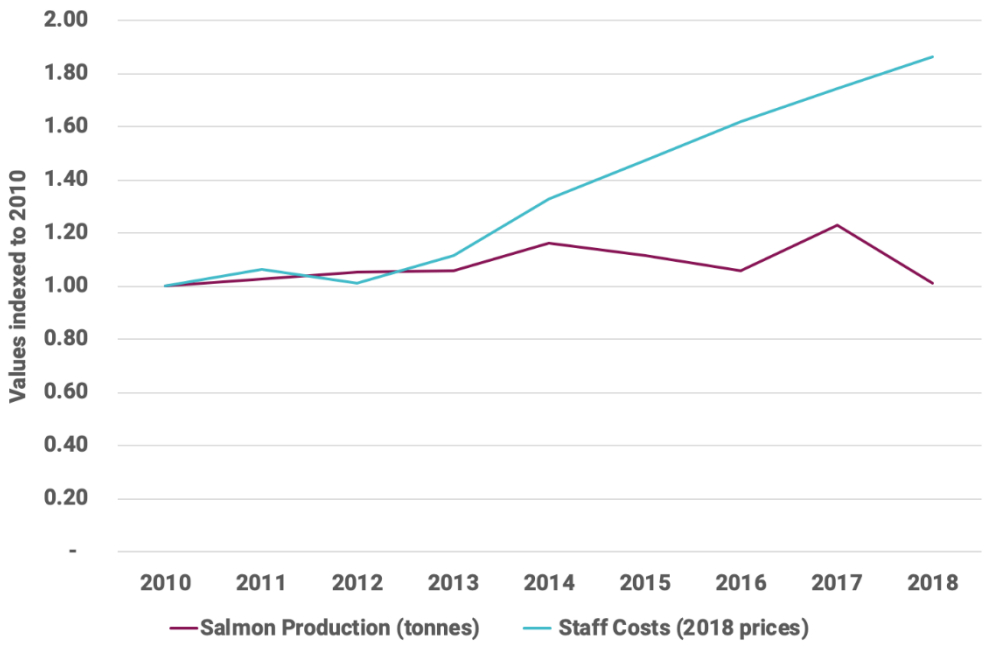
Source: BiGGAR Economics Analysis

Staff costs accounted for 12% of the turnover of the aquaculture sector

In total, the aquaculture sector paid £185 million in staff costs in 2018. Staff costs accounted for a significant portion of the direct GVA of the sector and are less responsive to fluctuation in the output of the sector than other contributors of GVA, such as company profits. Over time staff costs have grown following both trends in the number of jobs supported by the sector and in the workforce skills. Many of these highly skilled jobs, particularly those in finfish production, are markedly higher paid than other employment opportunities in the rural communities of Scotland where this

activity occurs and these jobs play an important role in attracting people and their expenditure to some fragile rural economies[1].

Figure 1-3 Change in Staff Costs and Production of Salmon Producers (2010 - 18)



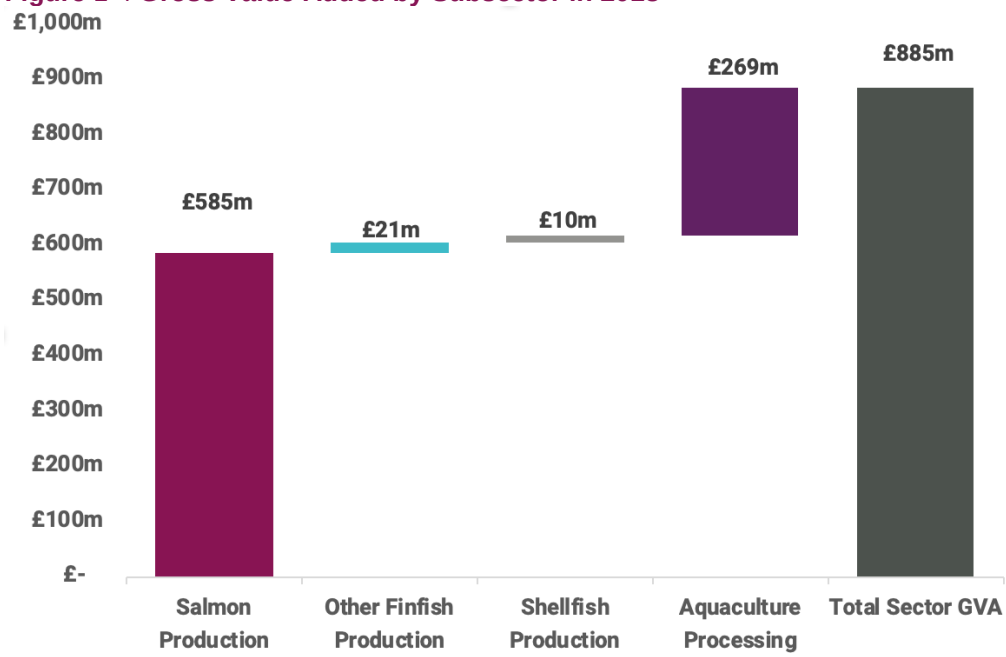
Source: BiGGAR Economics Analysis of Salmon Company accounts

The vast majority of impact came from salmon farming and the processing of aquaculture products

The four subsectors that are included in this analysis are of varying scales and contribute to the overall impact of the aquaculture sector in different ways. In 2018 the majority of the GVA of aquaculture was from the salmon production subsector, followed by aquaculture processing. Combined, these accounted for 96% of the GVA impact of the aquaculture sector.

[1] Scottish Sea Farms (2018), Impact Summary 2018, measuring ten years of farming Orkney waters, p.8. The relatively high level of pay in finfish production was a finding that also emerged from consultations with producers.

Figure 1-4 Gross Value Added by Subsector in 2018



Source: BiGGAR Economics Analysis

In 2018 the activities of the sector generated £94.1 million taxes paid to local, Scottish and UK Governments

The public sector benefits from the activities of the aquaculture sector through the tax revenues that it generates. It was estimated that in 2018 the sector contributed a total £94.1 million in taxation, including:

- £47.4 million in Corporation Tax;
- £18.1 million in Income Tax; and
- £28.6 million in National Insurance Contributions.

2. Introduction

This document is a draft final report for a study commissioned by Marine Scotland on estimating the wider economic impacts of the aquaculture sector in Scotland.

2.1 Study Background

In previous years there have been multiple studies which have considered the economic impact of the aquaculture sector to the Scottish economy. These studies have utilised Scottish Input Output multipliers, the assumptions of these multipliers predate the recent developments in the sector. In 2019, Marine Scotland commissioned BiGGAR Economics to undertake a study into the direct and wider economic impacts of the sector to Scotland to update these studies.

2.2 Study Objectives

The aims of the study were to support the ambitions of Scotland's National Marine Plan by enabling the accurate monitoring and evaluation of the impacts of the aquaculture sector.

The specific objectives of the study were to produce:

- estimates of the direct, indirect and induced impacts of the Scottish Aquaculture sector for 2018, including associated tax receipts; and
- an economic impact tool to enable Marine Scotland to robustly estimate impacts in future years.

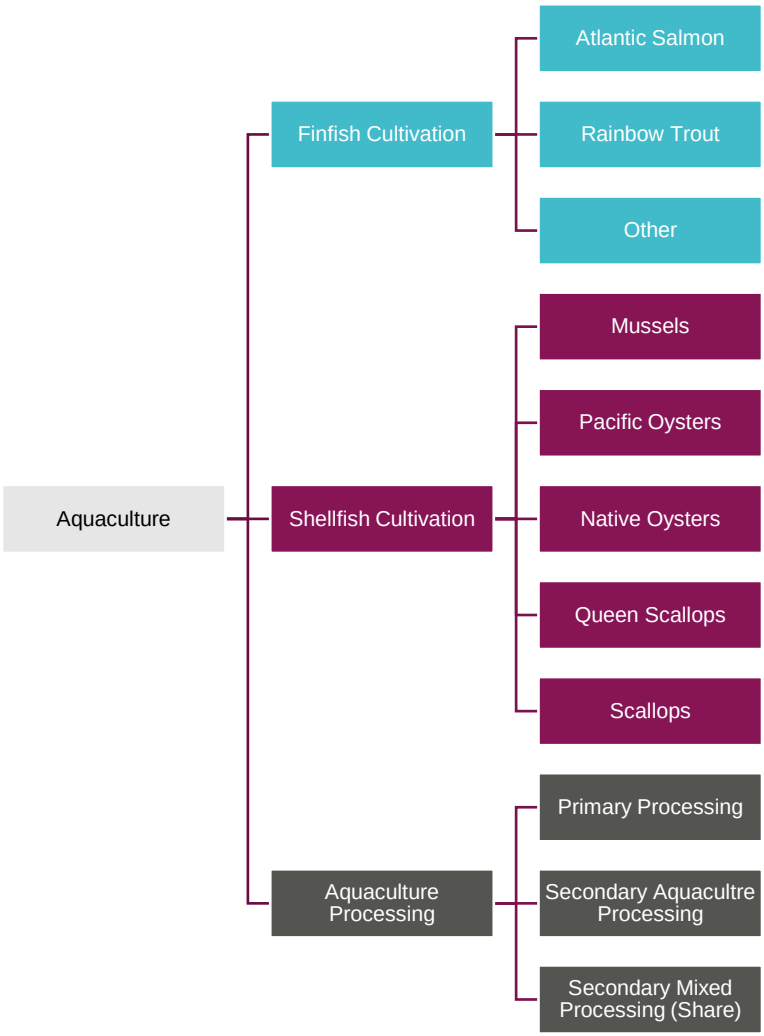
2.2.1 Sector Scope

Previous studies of the economic impact of aquaculture have defined the sector in different ways. The scope of the aquaculture for this study was defined as including the following activities:

- finfish cultivation;
- shellfish cultivation; and
- cultivated finfish and shellfish processing.

The aquaculture sector was defined in this way in the rest of the report, unless otherwise stated.

Figure 2-1 The Aquaculture Sector as defined in this study



2.3 Report Structure

The remainder of the report is structured as follows:

- Chapter 3 sets out the main results from the survey;
- Chapter 4 estimates the direct economic activity from Scottish aquaculture;
- Chapter 5 estimates supply chain impacts;
- Chapter 6 considers the impact generated by staff spending (induced impacts);
- Chapter 7 estimates the sector's fiscal contribution;
- Chapter 8 summarises the results from the quantitative exercise;
- Chapter 9 provides qualitative evidence emerged from consultations;
- Chapter 10 concludes; and
- Chapter 11 provides appendix material on the methodological approach followed.

3. Survey Evidence

To estimate the direct economic impact of the aquaculture sector in Scotland, BiGGAR Economics drafted a survey to be sent to organisations and businesses in the sector. This section discusses the evidence emerged from the survey that was sent to companies and sectoral organisations across the aquaculture sector in Scotland.

3.1 The Survey

BiGGAR Economics drafted a survey to be sent to organisations and businesses in the sector. The survey avoided the replication of information that was already available to Marine Scotland through their annual surveys of finfish and shellfish producers. A first draft of the survey was sent to Marine Scotland for review, comments were then addressed and the survey finalised.

The survey was circulated in January 2020. The decision to circulate after the Christmas period was taken jointly with Marine Scotland to account for the increase in activity and demand that the sector experiences prior to Christmas.

The survey was sent to the following organisations and businesses:

- British Trout;
- Association of Scottish Shellfish Growers;
- Scottish Sea Farms;
- Scottish Salmon Company;
- Mowi;
- Loch Duart;
- Grieg Seafood Shetland;
- Wester Ross Salmon; and
- Cooke Aquaculture.

Once sent, the survey was then followed up either by telephone, email or both to increase take-up and ensure that companies and organisations across Scottish aquaculture were fully aware of this exercise.

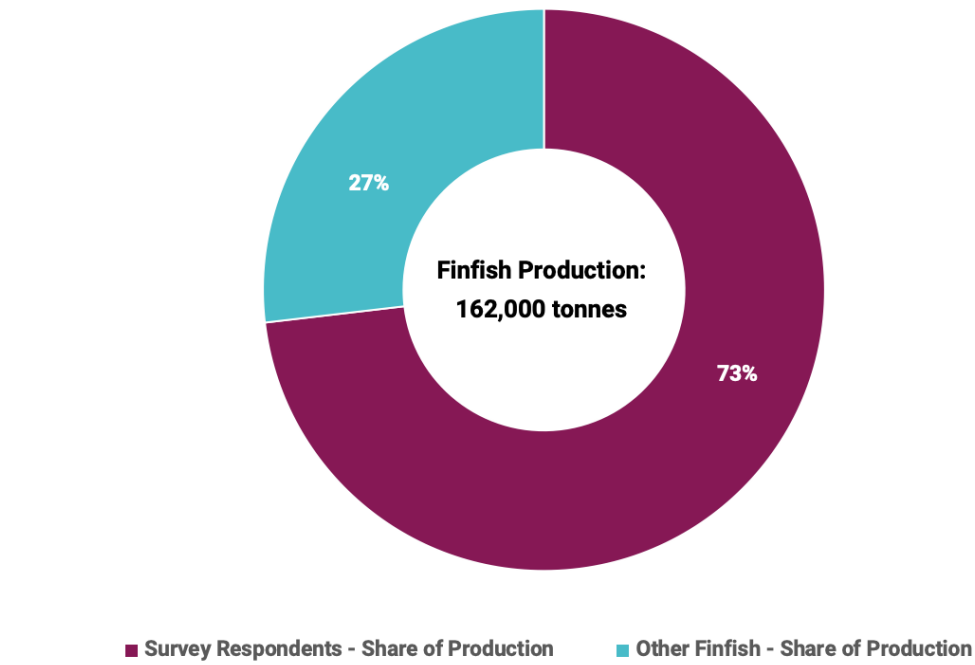
3.2 Survey Respondents

This engagement resulted in the following four companies filling in the survey:

- Mowi;
- Loch Duart;
- Scottish Sea Farms; and
- Scottish Salmon Company.

In 2018 these companies represented around 73% of finfish production in Scotland[2]. Their share of employment and turnover with respect to the finfish sector was similar. The type of expenditure undertaken by these companies was considered to be similar to that of other finfish production. For instance, fish feed costs would constitute a large share of spending of both salmon and trout producers.

Figure 3-1 2018 Share of Production - Survey Respondents vs Finfish Sector



Source: BIGGAR Economics

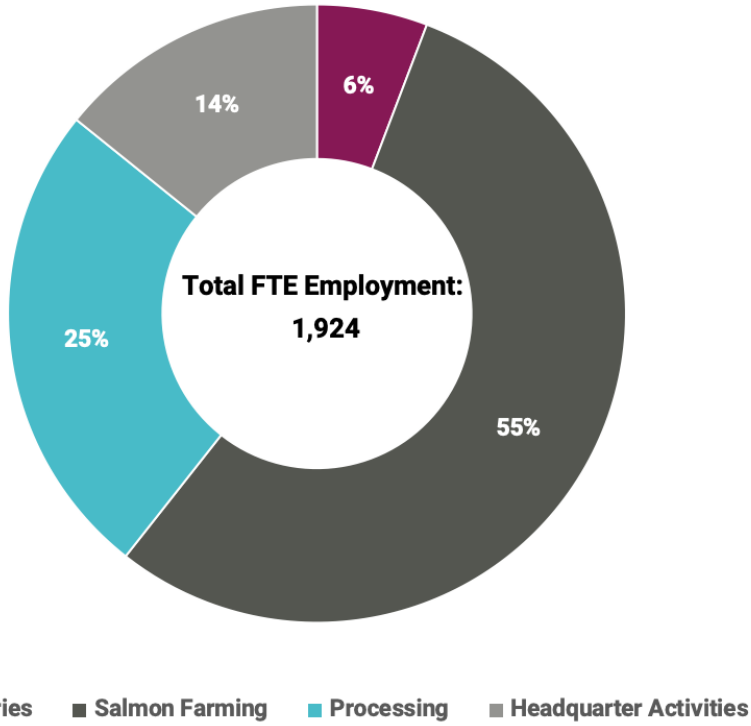
The survey respondents were active across a wide range of activities within the aquaculture sector, including:

- salmon farming;
- hatcheries;
- processing; and
- headquarter activities.

Salmon farming accounted for over 55% of the 1,924 jobs supported by these companies in 2018. Around 25% of total employment was in processing and the remainder was in headquarter activities (14%) and hatcheries (6%). Most of the processing activity supported by the companies surveyed was primary processing, as this processing (e.g. heading and gutting) tended to take place close to the farm sites. Spending in processing activity by these producers provided a reliable approximation of expenditure patterns in the broader processing of aquaculture products.

[2] Tonnes of live fish weight were estimated from the survey responses and the share of total output was based on Marine Scotland's 2018 Scottish Fish Farm Production Survey.

Figure 3-2 Employment by Activity – Survey Respondents (2018)



Source: BIGGAR Economics Analysis

Overall, the survey responses provided a good approximation of expenditure patterns across the finfish sector and aquaculture processing. Survey evidence was then complemented with the evidence collected through consultations and available literature for other aspects of the aquaculture sector.

3.3 Supply Spending

In 2018 the companies which responded to the survey spent a total £562.7 million in goods and services to support their activities. This included spending on capital goods such as the construction of new farms and plants or the purchases of specialised equipment.

To avoid double-counting supply spending, companies were asked to provide spending data exclusive of any transactions taking place within the same business. Expenditure would have been counted twice, if the value of the fish farmed and then processed within the same company had been included in the analysis.

Companies were asked to provide spending details on a range of items. These were then mapped to the relevant Standard Industrial Classification (SIC) level 2 codes, where possible. For reporting purposes spending was, however, aggregated at the industrial sections level.

This found that that in 2018 50.5% of spending from the survey respondents was within the manufacturing sector. This captures the relative importance of fish feed

within the supply chain of the companies surveyed. The manufacture of fish feed accounted for 72% of all surveyed spending within the manufacturing sector[3].

In 2018, survey respondents spent £245.3 million in products and services from the agriculture, forestry and fishing (3.7%), construction (14.9%), transport (5.4%) and administrative and support services (19.4%) sectors.

Spending in the aquaculture sector was mostly linked to the purchase of fingerlings, while construction spending included most capital expenditure. Spend on administrative and support activities included insurance, consultancy and accounting.

Table 3-1 2018 Survey Respondents' Average Supply Chain Spend by Sector

Sector	Share
Agriculture, forestry and fishing	3.7%
Mining and quarrying	0.0%
Manufacturing	50.5%
Electricity, gas, steam and air conditioning SUPPLY	0.7%
Water supply, sewerage, waste management and remediation activities	0.4%
Construction	14.9%
Wholesale and retail trade; repair of motor vehicles and motorcycles	1.9%
Transport and storage	5.4%
Accommodation and food service activities	0.1%
Information and communication	0.2%
Financial Services (Not in ABS)	1.4%
Real estate activities	0.0%
Professional, scientific and technical activities	1.1%
Administrative and support service activities	19.4%
Public administration and defence; compulsory social security	0.0%
Education (Private Provision Only)	0.1%
Human health and social work activities	0.0%
Arts, entertainment and recreation (excluding gambling)	0.1%
Other service activities	0.0%
Total Reported Supply Spend (£ million)	**562.7**

Source: BiGGAR Economics Analysis

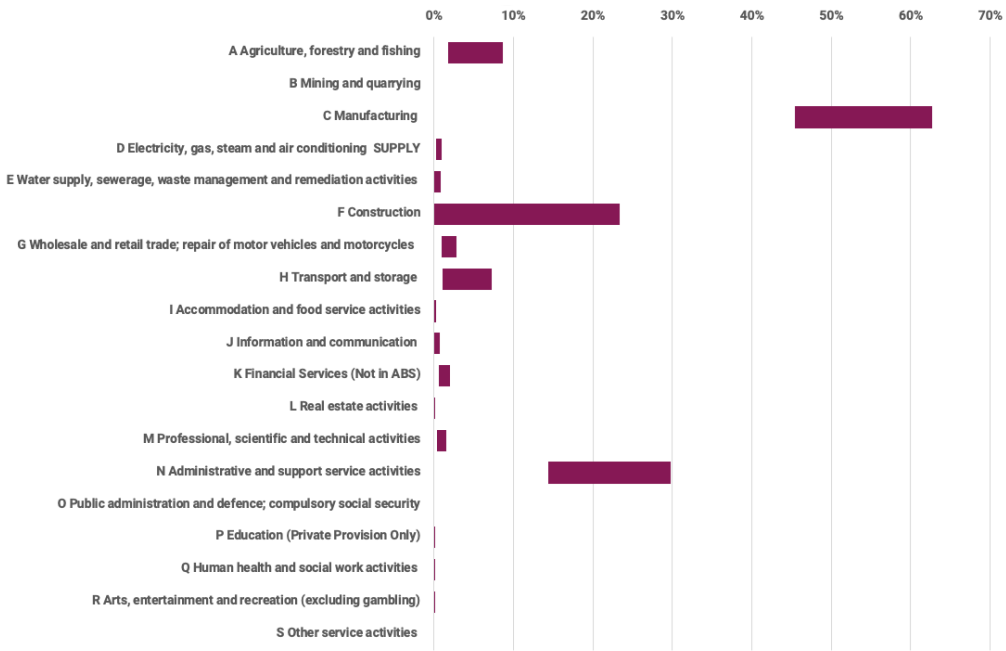
Across the companies surveyed there was some variation in the share of their spending benefitting any given sector. For all respondents, the largest area of supply chain expenditure was within the manufacturing sector. Expenditure in manufacturing ranged between 45% and over 63%.

The largest difference in supply expenditure was recorded over construction spending, which ranged between 23% and 0% of respondents' spending. This reflected the different stages the companies were at in the capital investment cycle.

[3] Fish feed is reported at within the 'Manufacturing' category for clarity. The analysis uses more granular industry data that is specific to animal feed production and reflects the fact the majority of raw materials are purchased from outside Scotland.

The spread was largest across the main sectors of supply spending as shown in Figure 3-3. Variation in expenditure is expressed as the distance between the maximum and minimum share of spending.

Figure 3-3 Range in Supply Chain Spend Across Survey Respondents



Source: BiGGAR Economics Analysis

Based on the information provided, it was possible to estimate supply chain expenditure per Full-Time Equivalent (FTE) job supported. This ranged between £530,000 per FTE and £750,000 per FTE.

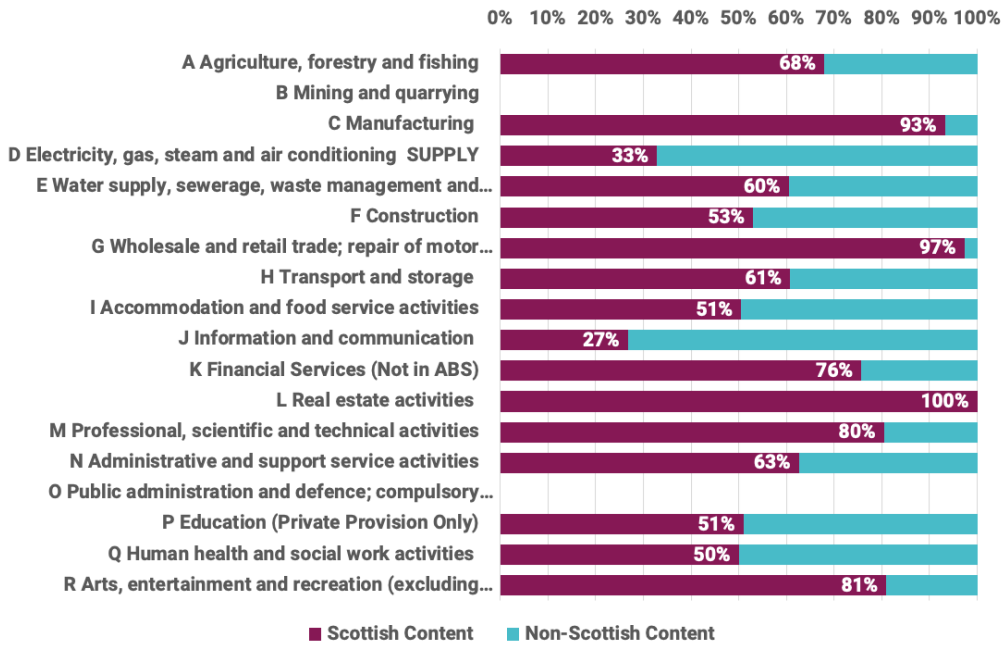
Survey respondents also provided data on the share of expenditure taking place in Scotland. It was estimated that in 2018 producers spent £437.6 million in Scotland. This is shown in Figure 3-4. Among the main sectors of spending, construction had the least Scottish content (53%). Around 93% of spending in manufacturing took place in Scotland.

The manufacturing spend included spending on fish feed, the main variable cost for companies producing Atlantic salmon[4]. While fish feed is purchased from Scottish suppliers, its production relies on raw materials that are often sourced from outside the UK. Analysis of the Input-Output tables suggests that around 61% of intermediate use (supplies) for this sector are imported. The main inputs in the production of fish feed for salmonidis include fish oil, fish meal, rapeseed oil, soy meal and wheat[5].

[4] To classify feed spending correctly, the SIC classification of the primary product of two large feed producers – Ewos Limited and Biomar Limited – was considered. The primary activity of Ewos Limited, as reported by Companies House, is '01629 - Support activities for animal production not elsewhere classified", whereas that Biomar Limited "10910 Manufacture of prepared feed for farm animals". To establish which sector would be the most appropriate, turnover per job and staff costs per job were estimated from the annual accounts of the two companies and then compared to that from the following candidate sectors: 01 Crop and Animal Production, hunting and related activities; 10 Manufacture of Food Products; 20 Manufacture of Chemical and Chemical Products; and 10.91 Manufacture of prepared feed for farm animals. The sector that matched the companies the closest was "10.91 Manufacture of prepared feed for farm animals'..

[5] Marine Harvest (2018), Salmon Farming Industry Handbook, p.57.

Figure 3-4 Share of 2018 Supply Spending in Scotland by Sector



Source: BiGGAR Economics Analysis

3.4 Summary of Survey Evidence

The four respondents to the survey constituted around 72% of finfish production in 2018 and therefore provided a comprehensive insight into the sector's supply chain. Similarly, the respondents also provided data on their processing activity which can be used to estimate the supply chain activities of other processors. Manufacturing, fishing, transport, administrative and support activities and construction were the sectors where most of supply spending took place. The largest opportunity for the Scottish supply chain was manufacturing of fish feed production, whereas construction and parts of manufacturing equipment tended to take place outside of Scotland.

4. Direct Economic Activity

This section considers the economic impact that was directly attributable to the aquaculture sector in Scotland in 2018.

4.1 Direct Employment

In 2018 the aquaculture sector directly employed 6,260 people.

The companies that are active in this sector include those which do both production and processing activities. The direct employment by subsector which is outlined in Table 4-1 has extracted processing employees from companies which predominantly do production activities and categorises these as processing employees.

The level of employment, and direct GVA, within the aquaculture processing sector was estimated using shares of employment in the fish processing sector that was either predominately associated with the output of either sea fisheries or aquaculture. Many of those employed will work in mixed facilities that process both aquaculture products and those from sea fisheries. Therefore, the level of employment in this sector is an estimate.

In 2018 processing employed 3,970 people or over 63% of the total employment supported by the aquaculture sector in Scotland. This included individuals who work in primary processing for finfish production companies. Salmon production contributed to a further 29% of employment, whereas other finfish production and shellfish production employed the remaining 8% of the sector's workforce.

Table 4-1 Direct Employment by Aquaculture Subsector in 2018

Sector	Direct Employment (Headcount)
Salmon Production	1,800
Other Finfish Production	200
Shellfish Production	300
Aquaculture Processing	3,970
Total Employment	**6,260**

Source: BiGGAR Economics Analysis, note figures may not sum due to rounding

4.2 Direct Gross Value Added

The direct Gross Value Added contribution made by the Scottish aquaculture sector was estimated by adding the value of staff costs to the profits generated by the companies operating in the sector. This methodology was preferred over subtracting operational expenditure from turnover. This was because companies in their annual

accounts report cost of sales which cover an entire production cycle instead of a fiscal year, the chosen methodology is easier to update and replicate.

In this way, it was estimated that in 2018 the aquaculture sector directly contributed £468 million Gross Value Added (GVA). A breakdown of the sector contribution by subsector is provided in Table 4-2[6].

Salmon production contributed around 54% of the direct GVA that was generated by the Scottish aquaculture sector. In 2018 aquaculture processing accounted for £196 million direct GVA or 42% of the sector's direct contribution. Other finfish and shellfish production accounted for £22 million GVA.

Table 4-2 Direct GVA by Aquaculture Subsector in 2018

Sector	Direct GVA
Salmon Production	£251m
Other Finfish Production	£14m
Shellfish Production	£8m
Aquaculture Processing	£196m
Total GVA	**£468m**

Source: BiGGAR Economics Analysis, note figures may not sum due to rounding

4.2.1 Gross Value Added and Gross National Income

It should be acknowledged that the Gross Value Added (GVA), which is estimated in this study is different from the Gross National Income (GNI)[7]. The latter considers the value of production that is generated by companies and workers from Scotland. This is worth mentioning since some of the largest companies within the aquaculture sector are owned outside Scotland. When there is foreign ownership of an activity, the difference between the two measures is mostly dependent on the relative split of direct GVA between staff costs (mostly taking place in Scotland) and the returns accruing to capital (going abroad to the owners of this capital). These shares in turn depend on how capital intensive a sector is. The share of staff costs as a proportion of Direct GVA ranged from 31% in salmon production to 72% in shellfish production. These values will fluctuate significantly between years.

The economic impact of sectors and organisations are typically measured in terms of Gross Value Added, rather than Gross National Income, and therefore the GVA approach was used in this study.

[6] The direct GVA figures in this assessment are directly comparable to those published in the Marine Economic Statistics due to the inclusion of Aquaculture Processing. In addition, the latest figures published in the Marine Economic Statistics are for the year 2017, rather than 2018. In comparing the two estimates, it would suggest that the direct GVA of the production element of aquaculture decreased by around 12% between 2017 and 2018. This drop is reflected in the decrease in turnover of the main salmon producing companies.

[7] The importance of the relationship between GVA and GNI/GNP in the context of the aquaculture sector emerged from consultations with Professor Hervey Gibson.

5. Supply Chain Impact

This section estimates the economic impact that is associated with spending on the goods and services which supports the operations of the aquaculture sector in Scotland.

5.1 Supply Chain Expenditure

The Scottish aquaculture sector stimulates economic activity through its spending on goods and services. This expenditure, be it operational or on capital, supports the turnover and employment of those businesses where money is spent.

It was estimated that in 2018 the Scottish aquaculture sector spent £834.6 million externally in its supply chain. Based on the findings on Scottish supply chain content, it was estimated that around £634.7 million were spent in Scotland. The level of estimated expenditure, both globally and within Scotland, is shown in Table 5-1. As with the survey respondents, the largest component of expenditure is within the manufacturing sector.

Table 5-1 Supply Chain Expenditure of the Aquaculture Sector in 2018

Sector	Expenditure in Scotland (£ million)	Total Expenditure (£ million)
Agriculture, forestry and fishing	20.5	30.0
Mining and quarrying	-	-
Manufacturing	374.7	409.1
Electricity, gas, steam and air conditioning SUPPLY	2.7	6.5
Water supply, sewerage, waste management and remediation activities	2.5	3.9
Construction	63.3	119.2
Wholesale and retail trade; repair of motor vehicles and motorcycles	15.9	16.3
Transport and storage	31.1	52.8
Accommodation and food service activities	0.5	0.9
Information and communication	0.6	1.8
Financial Services (Not in ABS)	9.2	12.0
Real estate activities	0.1	0.1
Professional, scientific and technical activities	7.1	8.9
Administrative and support service activities	105.8	171.8
Public administration and defence; compulsory social security	-	-
Education (Private Provision Only)	0.3	0.7
Human health and social work activities	0.1	0.2
Arts, entertainment and recreation (excluding gambling)	0.4	0.5
Other service activities	-	-
Total Reported Supply Spend	**634.7**	**834.6**

Source: BiGGAR Economics Analysis

5.2 Supply Chain Impact

Having established the sectors where supply spending took place, it was then possible to estimate the economic activity that was supported by this expenditure. To allow for a more detailed analysis, procurement data were used to map supply chain expenditure at a Standard Industrial Classification (SIC) level 2. To estimate Gross Value Added (GVA) and direct employment, the turnover in each sector for each of the aquaculture subsectors was divided by the relevant Scottish turnover per GVA and turnover per job ratios from the Scottish Annual Business Statistics (SABS)[8].

It was then necessary to account for the indirect and induced impact that were generated across the supply chain. The former refers to the economic activity that is supported by suppliers of the aquaculture sector purchases of goods and services. The latter refer to the economic impact generated by the employees of businesses across the supply chain spending their salaries and wages in the economy. To estimate the indirect and induced GVA and employment impacts it was necessary to

[8] Scottish Government (2019), Scottish Annual Business Statistics (SABS).

apply GVA and employment Type 1 and Type 2 Scottish multipliers from the Scottish Input-Output Tables[9][10].

In this way, it was estimated that in 2018 the Scottish aquaculture sector through its supply chain spending contributed £359.4 million GVA and supported 4,250 jobs across Scotland.

Table 5-2 Supply Chain Impact of the Aquaculture Sector in 2018

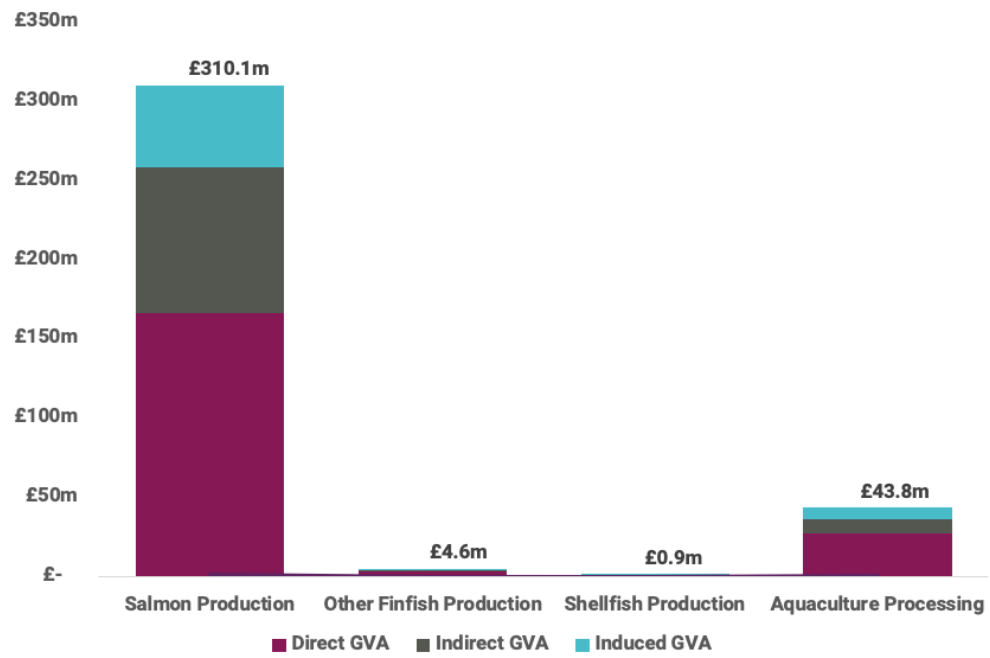
	GVA (£ million)
Direct	196.2
Indirect	102.5
Induced	60.6
Total	359.4
	Employment
Direct	2,700
Indirect	970
Induced	580
Total	4,250

Source: BiGGAR Economics Analysis. *Totals may not add up due to rounding.

Within Scottish aquaculture, in 2018 salmon production contributed around £310 million GVA or about 86% of the total contribution made by the sector's supply expenditure. The processing of aquaculture produce contributed 12%, whereas the remainder 2% of impact was attributable to spending taking place as a result of shellfish production or other finfish production.

[9] Scottish Government (2019), Scottish Input-Output Tables.
[10] The Input-Output tables treat animal and fish feeds as a single category. While this is not ideal, as fish feed constitutes such a large part of the supply chain, the import/domestic supply chain split of the overarching category was considered broadly similar to that of fish feed manufacturing and therefore the use of the statistics from the overarching category was considered acceptable.

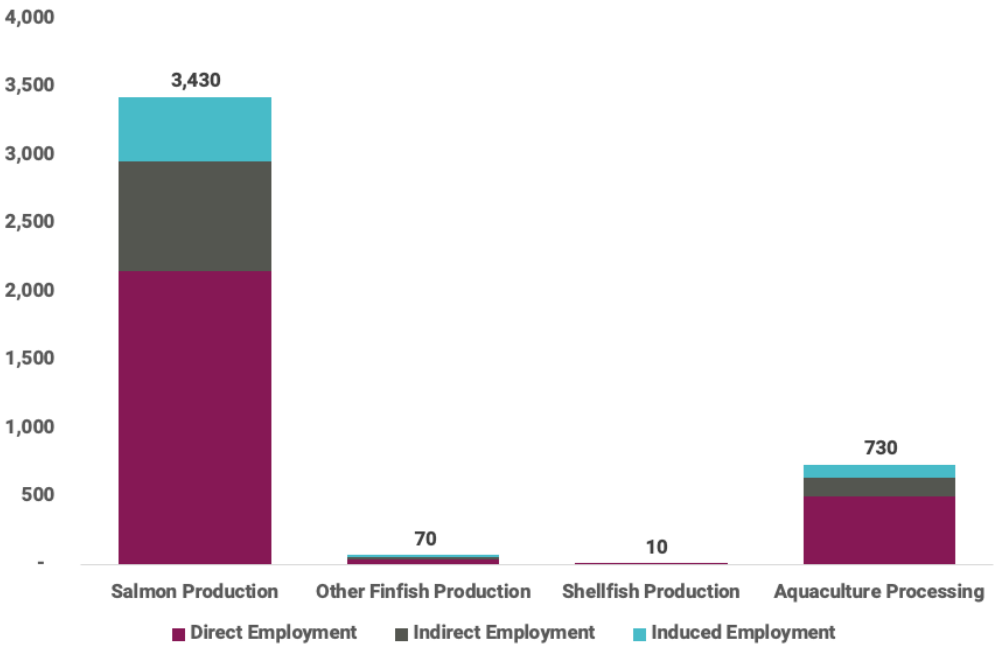
Figure 5-1 Supply Chain GVA Impact by Aquaculture Subsector, 2018



Source: BiGGAR Economics Analysis

In 2018, salmon production supported 3,430 jobs or about 81% of the employment associated with supply chain spending. Aquaculture processing accounted for 17% of the employment supported through supply chain spending, whereas finfish and shellfish contributed around 2% of employment.

Figure 5-2 Supply Chain Impact Employment by Subsector, 2018



Source: BiGGAR Economics Analysis

6. Induced Impacts

This section considered the economic impact that the staff of the Scottish aquaculture sector had in 2018 through the spending of their salaries and benefits.

6.1 Total Staff Costs

Employees in the Scottish aquaculture sector by spending their salaries and wages in the Scottish economy generate economic activity. This expenditure supports Scottish businesses and allows them to expand their employment and activities.

As estimated in the section on the direct impact of the sector, the total employment directly supported by Scottish aquaculture in 2018 was 6,260 and included:

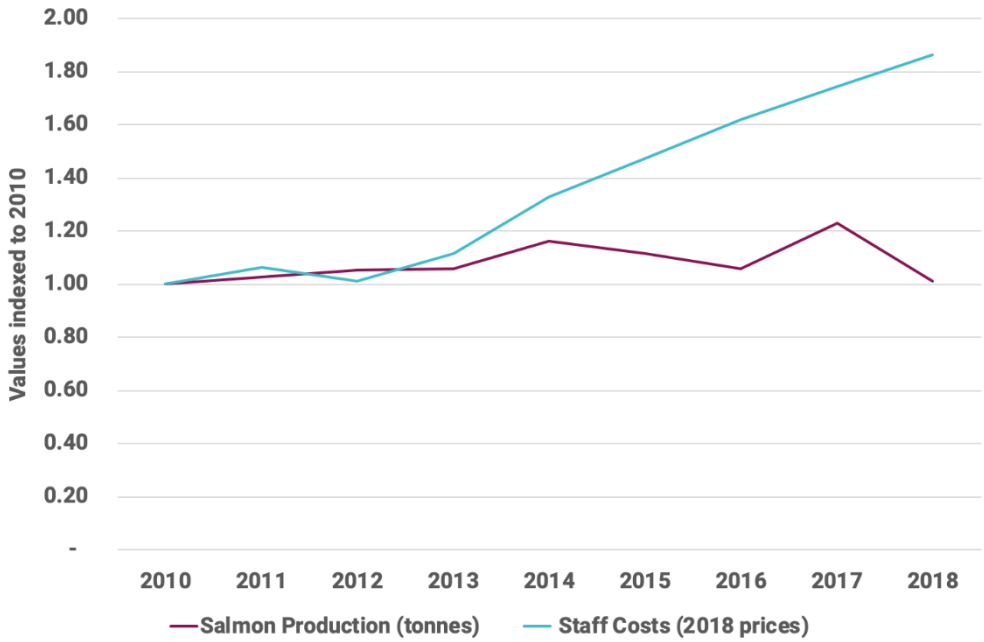
- 1,800 in salmon production;
- 200 in production of other finfish;
- 300 in shellfish production
- 3,970 in aquaculture processing.

The survey data collected suggest that most of the employment in the sector is full-time and around 97% of the workforce being in permanent jobs. This evidence supports previous findings in other surveys of the sector, including the Scottish Fish Farm Production Survey 2018[11] and the 2016 Seafood Processing Industry Report[12]. Shellfish production has different employment patterns, with a larger share of the workforce being employed part-time[13].

The level of pay in the aquaculture sector is not as directly linked to the output of the sector as other aspects of GVA are, such as profits. Figure 6-1 shows the trend in both the production of salmon and the staff costs paid by salmon producing companies. This shows that despite significant fluctuations in annual production of salmon, the value of staff costs has continued on its trend of growth. This is because companies in the sector can find it difficult to recruit and therefore staff are retained during dips in production.

[11] Marine Scotland Science (2019), Scottish Fish Farm Production Survey 2018.
[12] Seafish (2016), 2016 Seafood Processing Industry Report.
[13] Marine Scotland Science (2019), Scottish Shellfish Farm Production Survey 2018.

Figure 6-1 Change in Staff Costs and Production of Salmon Producers (2010 - 18)



Source: BiGGAR Economics Analysis of Salmon Company accounts

To quantify the induced impact of Scottish aquaculture, it was first necessary to estimate the total annual staff costs paid by companies within the Scottish aquaculture sector. The companies taking part in the survey reported around £75.4 million in 2018 staff costs, including expenditure on temporary agency workers. Around 21% of this spending went to staff operating at the companies' secondary processing facilities.

Staff costs were then scaled up based on the share of the salmon production. The approach followed to scale impacts is explained in detail in 11.2.2. Staff costs for processing of aquaculture for the companies for which survey data were not available were estimated by multiplying the remainder of employment in the sector by £24,300, an estimate of staff costs per head based on a 2018 study by Seafish[14].

To estimate the total staff costs paid by the production of other finfish, the analysis considered the accounts of companies operating in this area and the value of staff costs reported. The staff costs per job of these companies were then multiplied by the number of people employed in the sector in 2018.

As emerged from the consultations, the shellfish sector is more reliant on part-time employment than finfish. To estimate the staff costs paid by the sector, the annual turnover for the sector as estimated by Marine Scotland[15] was weighted by 58%, the share of turnover of staff costs and owner earnings according to recent evidence from Poseidon[16].

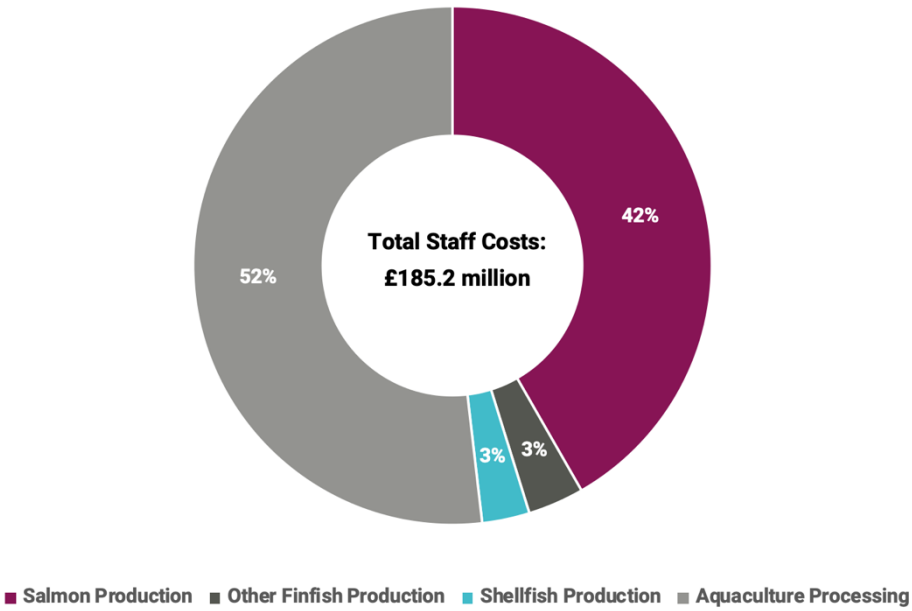
The staff costs in each subsector was added up to estimate the total staff costs paid by Scottish aquaculture. In 2018, these costs amounted to around £185.2 million.

[14] Seafish (2018), Seafood Processing Enquiry Report.
[15] Scottish Government (2019), Scottish shellfish farm production survey 2018
[16] Poseidon (2017), Scottish Shellfish Development Critical Mass.

6.2 Pay in Context

In 2018 around 52% of the staff costs paid by the aquaculture sector in Scotland was paid by processing firms. The salmon farming sector paid around £77.3 million in staff costs, whereas the combined staff costs of other finfish and shellfish production was around £12.0 million or 6% of the total staff costs paid by the sector.

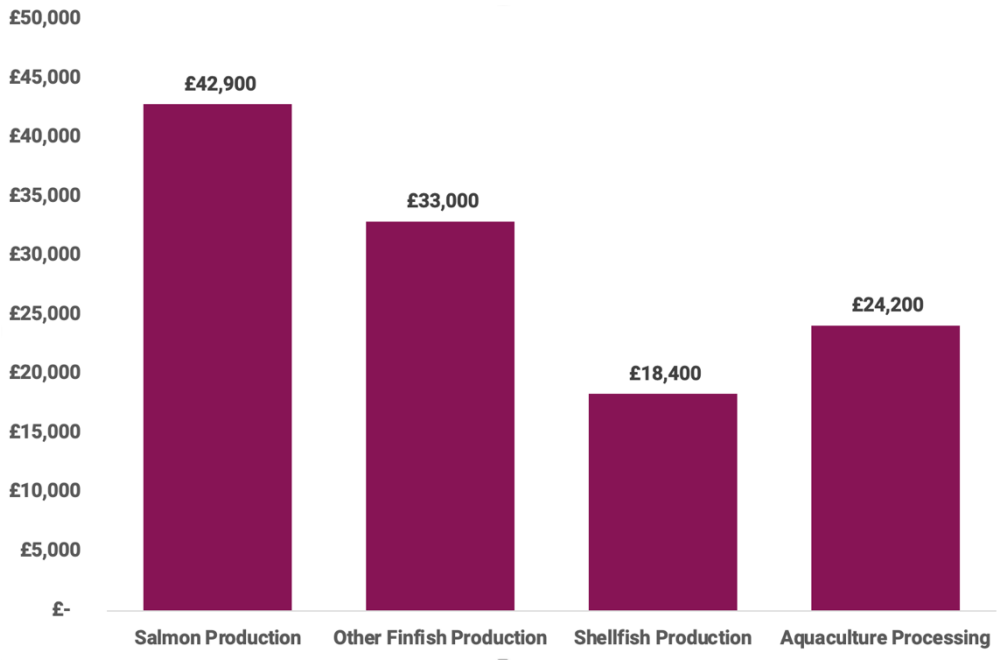
Figure 6-2 Staff Costs Paid by the Aquaculture Sector in 2018



Source: BiGGAR Economics Analysis

Based on the direct employment supported by each subsector of Scottish aquaculture, it was possible to estimate staff costs per job. In 2018 salmon production had the highest staff costs – around £43,000 – followed by the production of other finfish (£33,000). The relative higher staff costs of the finfish sector reflected its highly skilled workforce. Shellfish had the lowest staff costs, around £18,400, which was consistent with the relatively larger share of employees working on a part-time basis.

Figure 6-3 Staff Costs per Job by Aquaculture Subsector in 2018



Source: BiGGAR Economics Analysis

Scottish Sea Farms - Orkney

Providing employment and supporting rural economies

The contribution made by the industry in supporting employment and economic activity in the context of vulnerable rural economies is exemplified by Scottish Sea Farms (SSF)' impact in Orkney[17].

In 2018, SSF undertook a study into the economic impact that the company had in Orkney after ten years of operations. As part of this, the study compared the value of jobs that they directly supported to the average across the local and national economy. This found that average pay in the company, £37,215, was significantly higher than the average for Orkney, £26,260, and for Scotland, £27,404.

Figure 6-4 Annual Salaries reported in Scottish Sea Farms, Orkney and Scotland

Source: Scottish Sea Farms, Impact Summary 2018

This report also highlighted the high skill level of the fish farm workforce. Courses which teach these skills are taught through local providers, such as Orkney college and each employee works towards their own personal development plan. The highly skilled nature of this work is one reason why the sector pays above average salaries.

In addition, it funds and engages in a series of local projects, including around £228,265 spent in grants benefitting local communities or activities forming the future workforce.

[17] Scottish Sea Farms (2018), Impact Summary 2018, measuring 10 years of farming Orkney waters', available at: https://www.scottishseafarms.com/media/1588/orkney-impact-summary-2018.pdf

6.3 Economic Impact

It was estimated that in 2018 the staff costs of companies within the aquaculture sector generated around £57.1 million GVA and supported 1,190 jobs in Scotland. Details on the approach followed to estimate these impacts are presented in the methodological appendix.

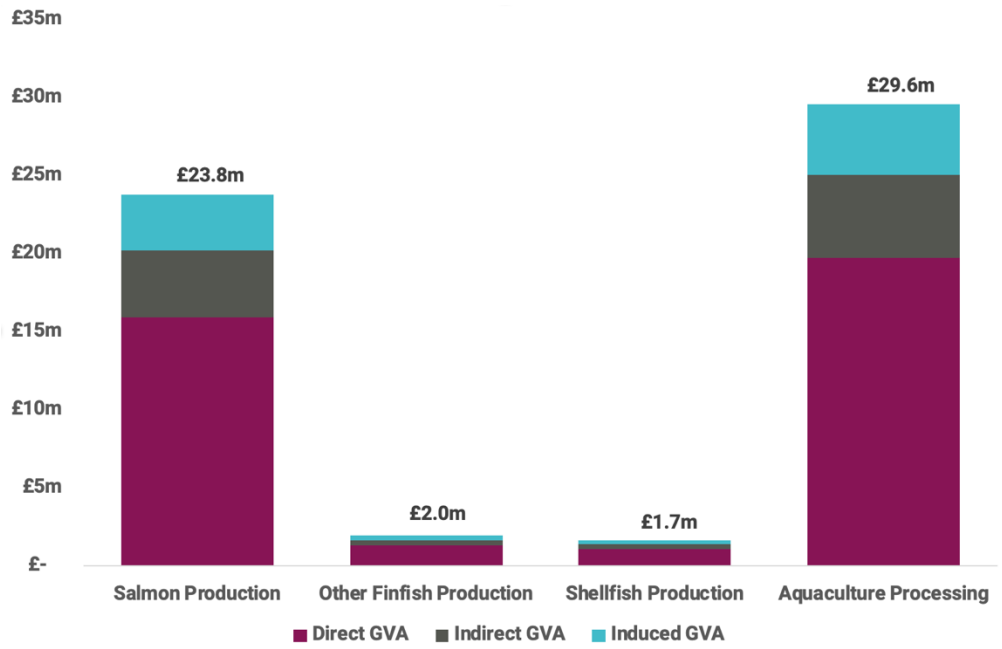
Table 6-1 Induced Impact from the Scottish Aquaculture Sector in 2018

	GVA (£ million)
Direct	38.2
Indirect	10.3
Induced	8.7
Total	**57.1**
	Employment
Direct	820
Indirect	210
Induced	170
Total	**1,190**

Source: BiGGAR Economics Analysis

The total induced economic impact split within the aquaculture sector broadly reflected the employment and total annual salaries paid across the sector. The processing sector generated around £30 million GVA as a result of spending in the broader economy from its employees and was the sector making the largest contribution through induced impacts. Salmon production accounted for around 42% of 2018 total induced GVA, equivalent to £24 million GVA. Other finfish production, including trout farming, and shellfish contribute around £4 million GVA in induced impacts.

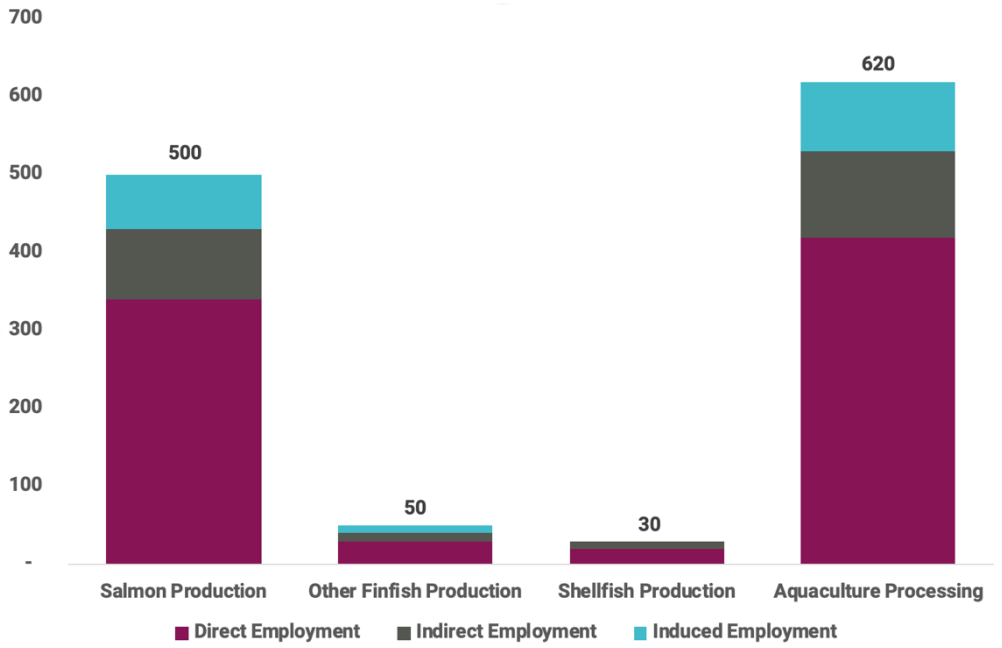
Figure 6-5 GVA Impact from Staff Spending by Aquaculture Subsector in 2018



Source: BiGGAR Economics Analysis

In 2018 the aquaculture processing sector accounted for 620 (52%) of the 1,190 jobs supported by the spending of staff employed within the sector. Around 42% of employment was supported by spending from employees in salmon production, 500 jobs. 80 jobs were supported by other finfish and shellfish production.

Figure 6-6 Jobs Impact from Staff Spending by Aquaculture Subsector in 2018



Source: BIGGAR Economics Analysis

7. Fiscal Impacts

This section considered the fiscal contribution that was made in 2018 by the Scottish aquaculture sector. It considers Income Tax, National Insurance Contributions and Corporation Tax.

7.1 Corporation Tax

The aquaculture sector makes an annual contribution to public finances through the payment of Corporation Tax. The contribution made by salmon production, aquaculture processing, other finfish production and shellfish production was considered in turn.

To estimate the Corporation Tax paid by salmon producers, taxes on profits for the SSPO members were sourced from their 2018 annual accounts[18]. These were then scaled up to account for the remaining share of the sector. In this way, it was estimated that in 2018 salmon producers contributed £42.5 million in Corporation Tax.

To estimate the Corporation Tax contribution of the processing sector, the analysis relied on data from Companies House on the taxes on profits paid by:

- Mowi Consumer Products UK Limited;
- Marine Products Scotland Limited;
- Nolan Seafoods;
- Farne Salmon & Trout Limited;
- Lions Speciality Foods Limited; and
- Aquascot.

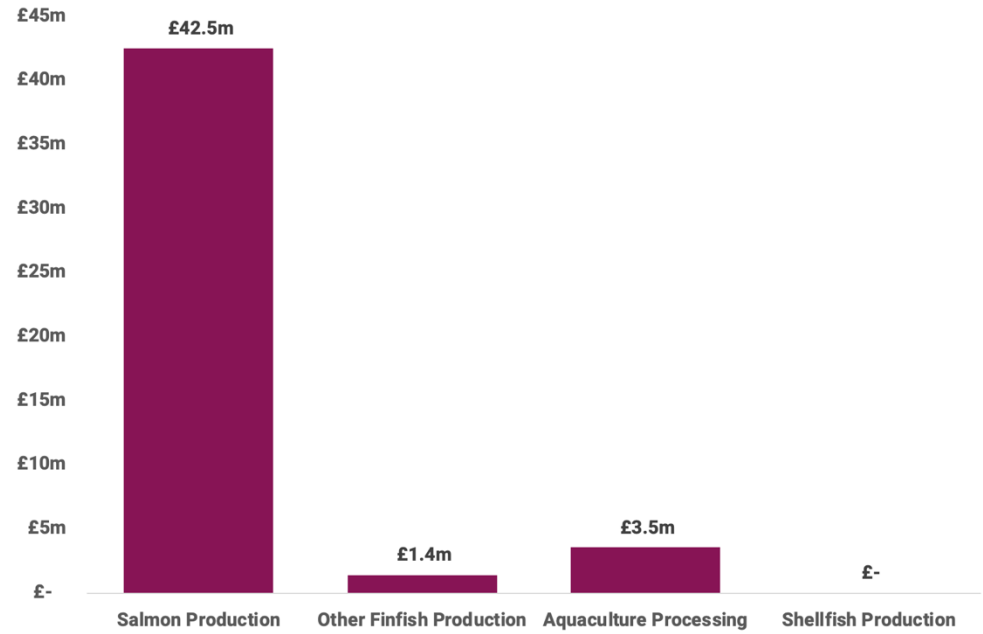
Where the businesses considered were not exclusively processors of aquaculture products their profits were weighted by the share of production that was attributable to aquaculture. In this way, it was estimated that in 2018 these producers accounted for around 48% of the sector's turnover. The remainder of Corporation Tax for the processing of aquaculture was imputed.

The Corporation Tax contribution of other finfish producers was modelled based on salmon production. The largest producer of other finfish did not report any corporation tax paid in 2018 and this was therefore taken into consideration in the analysis. For this reason, to estimate 2018 profits in the production of other finfish, the share of profits per turnover for salmon production was multiplied by the turnover from other shellfish products. The 19% rate of Corporation Tax was then applied.

It was assumed that the shellfish sector made a minimal contribution towards Corporation Tax in 2018. This assumption was based on a review of accounts published in this subsector and the ownership structure of the sector and on its employment structure.

[18] UK Government (2019), Companies House, available at: https://www.gov.uk/government/organisations/companies-house

Figure 7-1 Corporation Tax Contribution by Aquaculture Subsector in 2018



Source: BiGGAR Economics Analysis

7.2 Income Tax

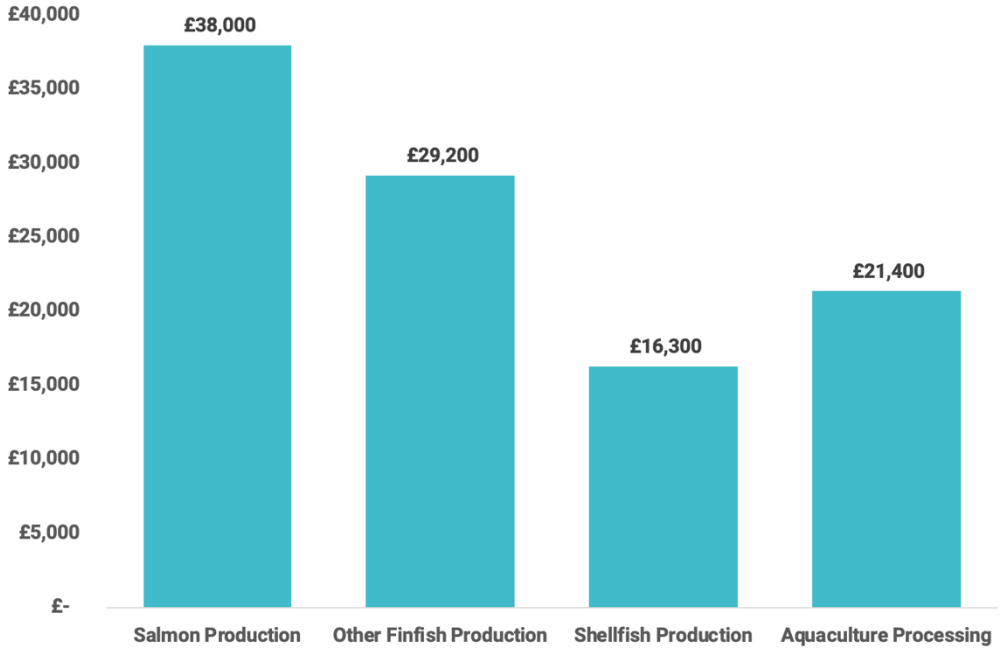
To estimate the income tax contribution made by those employed in the aquaculture industry, it was first necessary to estimate the average salary paid in each of its subsectors.

Staff costs were the starting point in estimating the income tax contribution made by employees. To isolate the gross wages paid by the companies in the sector in 2018, it was necessary to establish the share of staff costs that was paid out in salaries and wages. Based on an analysis of the accounts of representative companies across aquaculture processing, salmon production and other finfish production, it was established that gross wages corresponded to about 88% of staff costs.

At this point, the staff costs for each of the subsectors of Scottish aquaculture were multiplied by 88%. The total gross wage costs obtained in this way were then divided by the number of employees working in each subsector to obtain an estimate of the average salaries and wages paid.

These were in line with the average staff costs estimated in the previous chapter. In 2018 finfish and, in particular, salmon production was associated with the highest gross salaries and wages.

Figure 7-2 Gross Salaries and Wages by Aquaculture Subsector in 2018



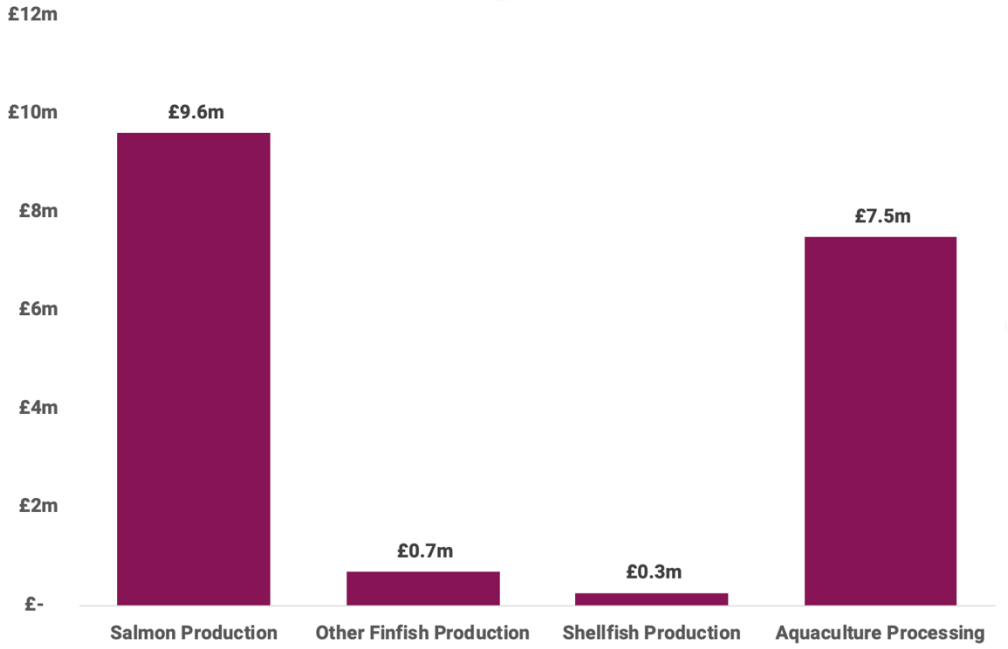
Source: BiGGAR Economics Analysis

At this point, the income tax contribution associated with these average wages was estimated and then scaled by the number of people employed in each sector. In this way, it was estimated that in 2018 the aquaculture sector's employees contributed around £18.1 million.

In 2018, the largest income tax contribution was made by salmon production. This was associated to the higher salaries and wages paid on average by the companies operating in this subsector. Aquaculture processing contributed a further £7.5 million.

The level of employment and pay is lowest in the shellfish production subsector. This subsector also includes the highest proportion of companies with one or two people. For the purposes of this analysis it was assumed that the earnings associated with these companies were paid as salaries and the individuals were employed by the incorporated organisation. This was done to reflect the larger concentrations of employment in Shetland based mussel producers and the number of incorporated companies in this subsector.

Figure 7-3 Income Tax Contribution by Aquaculture Subsector in 2018



Source: BiGGAR Economics

7.3 National Insurance Contribution

The contribution made by the sector through the payment of National Insurance was estimated based on employees' payments and employers' contributions.

To estimate the contribution made by employers, staff costs by sector as estimated in the previous section were multiplied by 8%, the average share of National Insurance contributions with respect to total annual costs for the companies taken as representative of the sector.

In this way, it was estimated that in 2018 employers across the aquaculture sector paid £15.3 million in National Insurance contributions.

The estimation of the National Insurance contribution paid by the sector's employees was similar to that of income tax, estimated in the previous section. The average salaries and wages paid in each sector were used to estimate the National Insurance contribution of the average employee. These were then scaled up based on each sector's direct employment.

In this way, it was estimated that in 2018 employees and employers in the Scottish aquaculture sector contributed a total £28.6 million in National Insurance contributions.

Table 7-1 Aquaculture Sector - Contribution Towards National Insurance, 2018

	£ million
Employers National Insurance Contribution	15.3
Employees National Insurance Contribution	13.3
Total	**28.6**

Source: BiGGAR Economics Analysis

In 2018 salmon production was the subsector within Scottish aquaculture that made the largest contribution towards National Insurance, around £14 million. The remainder mostly arose from aquaculture processing. Most of the difference between the contribution of the two subsectors came from employer's contribution, which was larger because of the larger number of people employed in aquaculture processing. The contribution of salmon production employees was relatively larger due to the higher salaries paid in the sector.

Figure 7-4 National Insurance Contribution by Aquaculture Sector

Source: BiGGAR Economics Analysis

8. Summary of Impact

In 2018 the aquaculture sector contributed to the Scottish economy around £885 million Gross Value Added and 11,700 jobs.

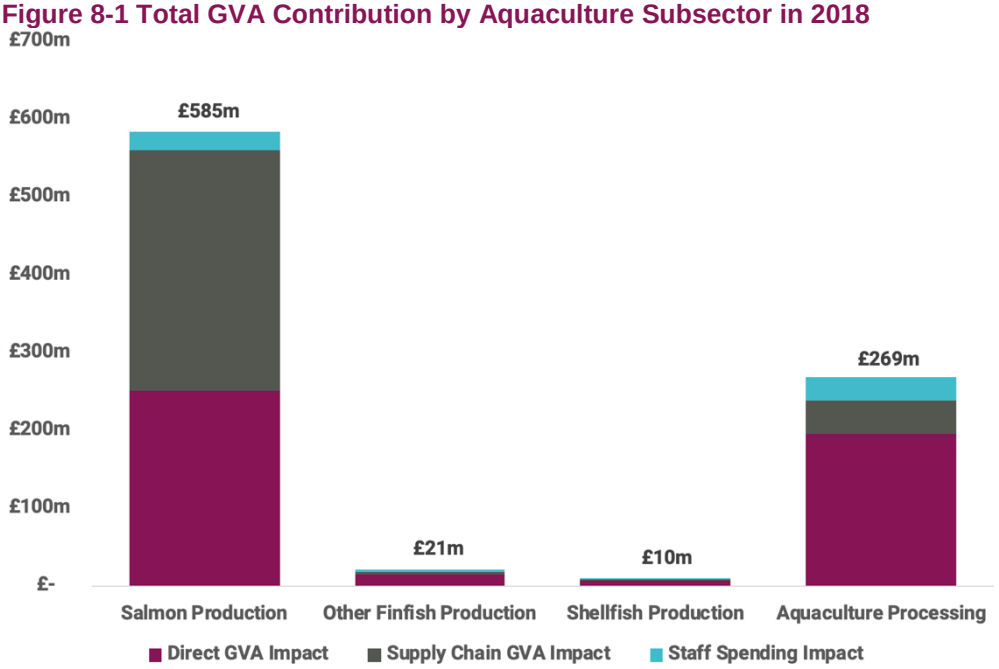
8.1 Economic Impact

This study estimated that in 2018 the aquaculture sector contributed to the Scottish economy around £885 million Gross Value Added (GVA) and 11,700 jobs. In particular:

- the sector's direct economic contribution was £468 million GVA and 6,260 jobs;
- the impact associated with spending across the supply chain was £360 million GVA and 4,250 jobs; and
- staff costs generated £57 million GVA and supported 1,190 jobs.

A breakdown of the GVA contribution made by each subsector is provided in Figure 8-1. Salmon production was responsible for 66% of the 2018 GVA impact. This reflected the sector's relative size within Scottish aquaculture as well as it being a high-skilled, relatively high-paying sector. Salmon production's supply chain impact was even larger, around 86% of total supply chain impact. Aquaculture processing contributed around £269 million GVA, mostly resulting from the value that the sector directly added to the economy. Other finfish and shellfish production contributed around £31 million GVA.

Figure 8-1 Total GVA Contribution by Aquaculture Subsector in 2018

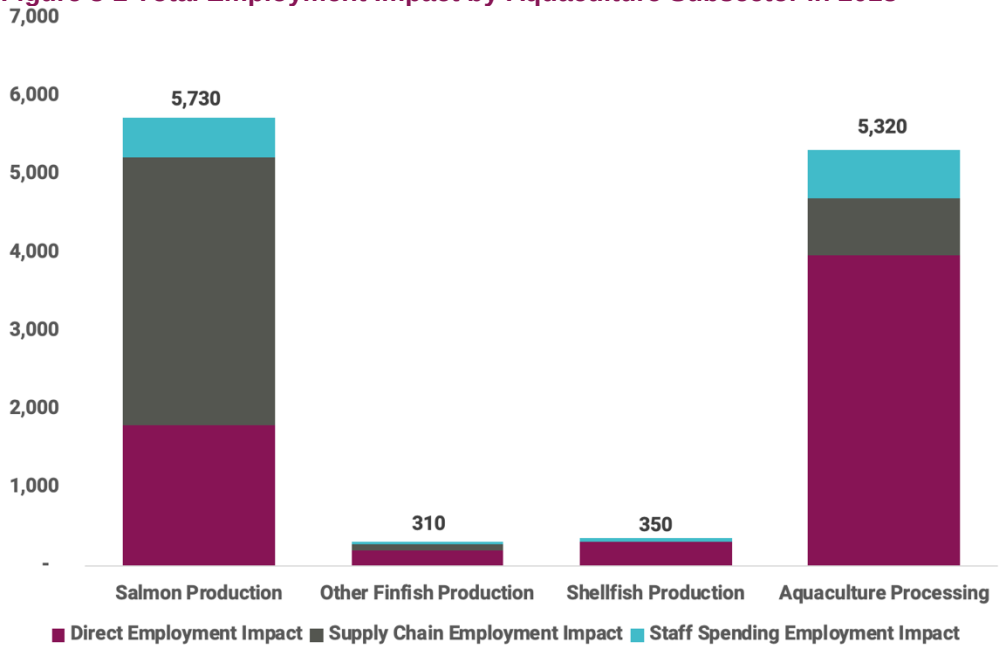


Source: BIGGAR Economics Analysis

In 2018 the sectoral contribution in terms of employment supported was less skewed towards a single subsector within Scottish aquaculture. About 94% of the total employment supported by the aquaculture sector throughout Scotland came from salmon production and aquaculture processing. In particular, aquaculture

processing, being a labour-intensive sector, had the largest direct employment contribution, 3,970 jobs. Shellfish production supports more employment than other finfish production, though it featured a larger share of part-time work.

Figure 8-2 Total Employment Impact by Aquaculture Subsector in 2018



Source: BiGGAR Economics Analysis

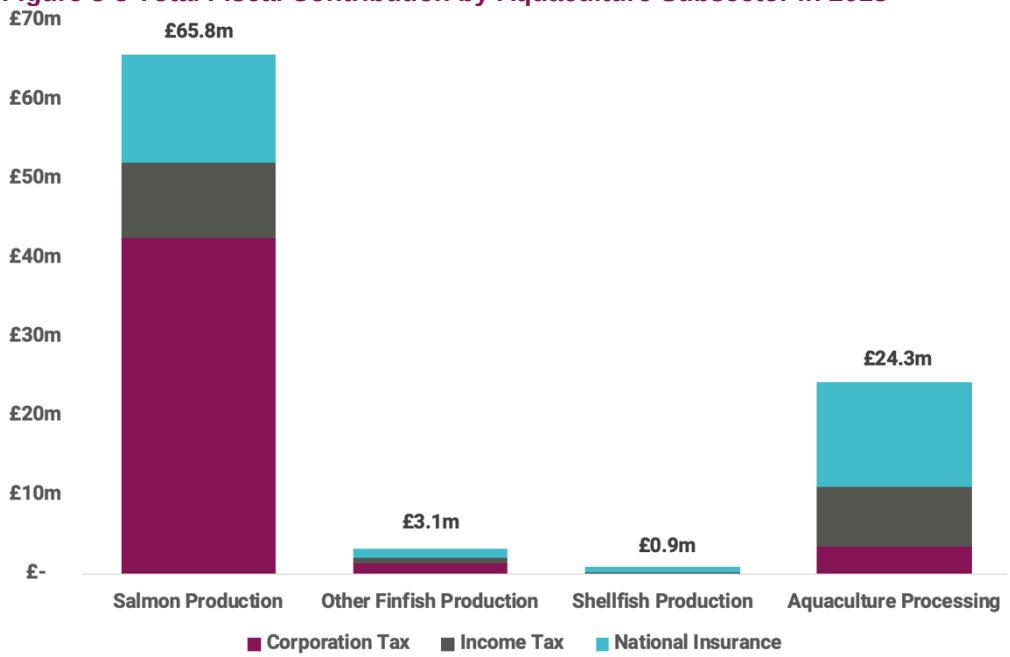
8.2 Fiscal Contribution

The Scottish aquaculture sector also contributed to public finances through taxation. It was estimated that in 2018 the sector contributed a total £94.1 million in taxation, including:

- £47.4 million in Corporation Tax;
- £18.1 million in Income Tax; and
- £28.6 million in National Insurance.

Salmon production accounted for most of the contribution of the sector to public finances, especially as a result of the Corporation Tax paid by the companies in the sector. Income tax and National Insurance contributions were similar in size for aquaculture processing and salmon production. This was because the lower number of employees in salmon production is offset by the larger earnings and taxes paid by its employees compared with those working in the processing sector. The tax contribution from shellfish and production of other finfish was around £4 million, or around 4% of impact.

Figure 8-3 Total Fiscal Contribution by Aquaculture Subsector in 2018



Source: BiGGAR Economics

8.3 Multipliers

Based on the GVA and employment estimates for the sector it was possible to estimate the equivalent Type 1 and Type 2 employment and GVA multipliers for the sector. These figures allow to estimate the total impact of a £ of direct GVA and of a direct job supported by the sector.

It was estimated that in 2018 the Type 1 GVA multiplier for the Scottish aquaculture sector was 1.77 and the Type 2 multiplier for the Scottish aquaculture sector was 1.89. The Type 1 employment multiplier was 1.68 and the Type 2 employment multiplier was 1.87.

In Table 8-1, the multipliers estimated as part of this study are compared to the existing multipliers from the 2016 Scottish Government Input-Output Tables. The multipliers estimated as a result of this study are relatively lower.

Table 8-1 Multipliers, Scottish Aquaculture Sector

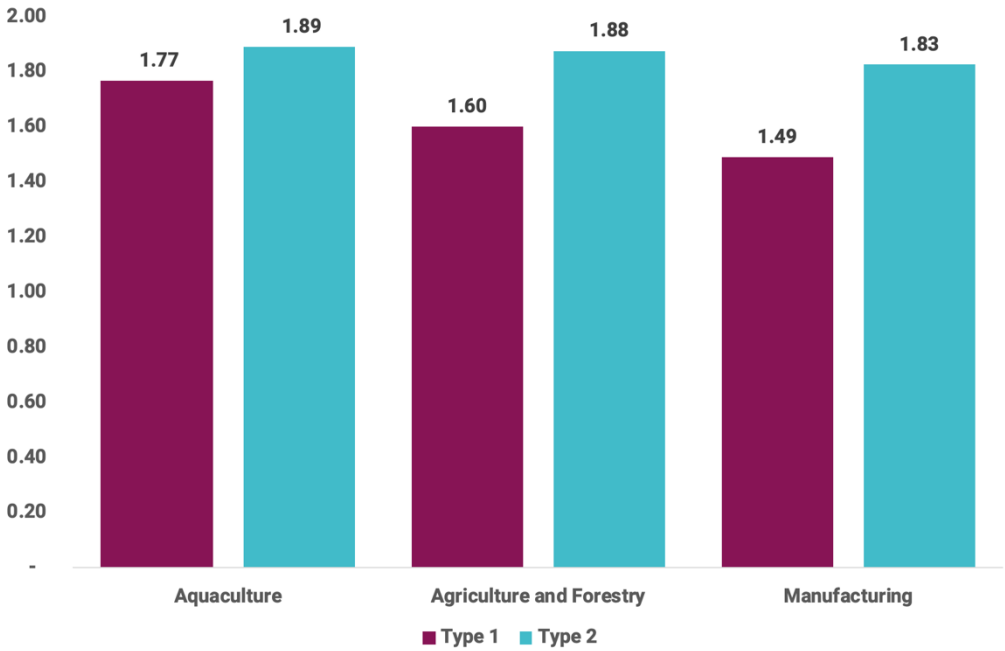
	Existing Multiplier	GVA Multipliers
Type 1	2.19	1.77
Type 2	2.57	1.89
	Existing Multiplier	**Employment Multipliers**
Type 1	1.94	1.68
Type 2	2.23	1.87

Source: BIGGAR Economics Analysis and Scottish Government (2019), Leontief Type 1 Table; Scottish Government (2019), Leontief Type 2 Table.

The multipliers of the aquaculture sector estimated in this study were broadly comparable to those of agriculture and forestry and manufacturing sectors. The latter were estimated by averaging the multipliers of the industrial sectors belonging to a

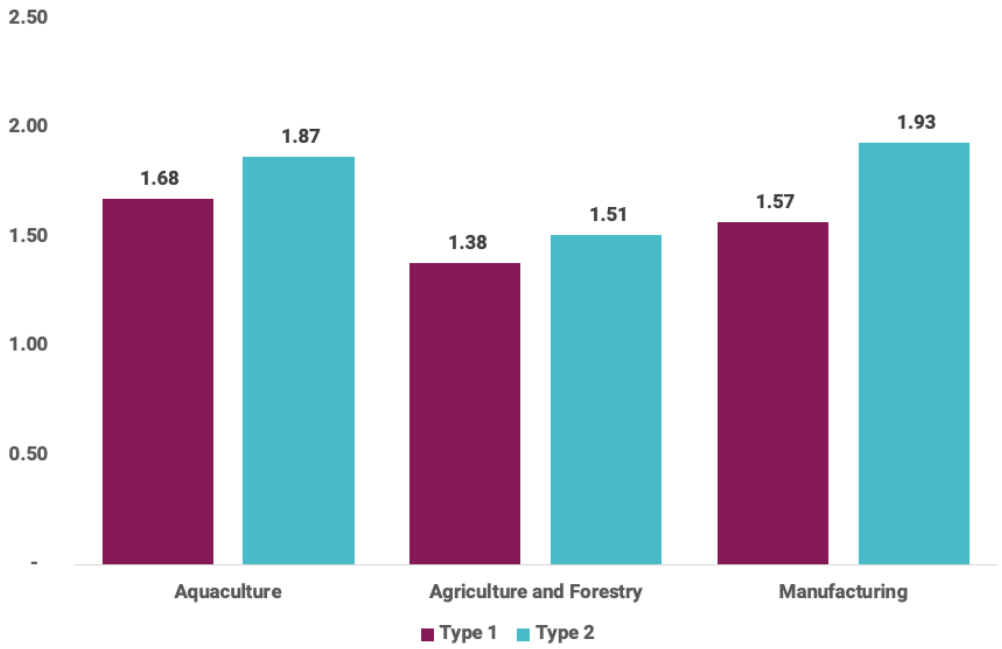
single section of the Standard Industrial Classification (SIC) codes (e.g. A 'Agriculture, forestry and fishing' and C 'Manufacturing'). Aquaculture was excluded from the averaging of sector A.

Figure 8-4 GVA Multipliers Comparison



Source: BIGGAR Economics Analysis

Figure 8-5 Employment Multipliers Comparison



Source: BiGGAR Economics Analysis

9. Consultations

This section sets out the key themes and findings from consultations with businesses and industry bodies across Scottish Aquaculture.

9.1 Consultees

The initial consultees were proposed during the Project Inception Meeting. In this meeting it was agreed that the consultation programme should cover public sector agencies, industry bodies and the industry representatives selected from the case studies. The agreed organisations to consult with were:

- Scottish Salmon Producers Organisation;
- Shellfish Growers Association;
- British Trout;
- Scottish Government Input Output Team;
- Scottish Aquaculture Innovation Centre;
- Highlands and Islands Enterprise;
- Marine Scotland Science;
- Scotland Food and Drink;
- Scottish Seafood; and
- Seafish Scotland.

BiGGAR Economics worked with the Steering Group to identify the most appropriate individuals within these organisations to contact regarding this study. Initial contact was made with each individual via email and then followed up with by a telephone call in order to arrange a time to discuss the project.

Of the agreed consultees, four have been removed from the list:

- Marine Scotland Science has been removed from the list as the initial discussions with the key contact concluded that industry members would be in a better position to give an industry perspective;
- Scottish Aquaculture Innovation Centre has been removed from the list as after initial discussions with the key contact, they left the employment of the SAIC prior to an arranged meeting and their expertise has not been replaced in time;
- Scotland Food and Drink has been removed from the list as no key contact has been provided and team discussions concluded that industry members would be in a better position to give an industry perspective;
- Seafish Scotland have been removed from the list because no key contact has been provided and analysis of the differences in supply chain and employment profiles of Seafish companies, as compared to aquaculture companies, concluded that the differences between the sectors are significant.

The majority of consultees highlighted that the best data would be held by the companies directly involved in the aquaculture sector. Therefore, the following companies were added to the consultation programme:

- Loch Duart; and
- MOWI Scotland.

In addition, BiGGAR Economics consulted with Professor Hervey Gibson, who explored this topic independently in 2019.

9.2 Thematic Analysis

This section sets out the key themes that have emerged during the consultation programme and in the answers to the survey's open-ended questions. Where information was not publicly available and considered commercially sensitive, reference to individual businesses was not made.

Consultations have provided qualitative evidence over:

- production cycles, challenges and market trends;
- vertical integration and consolidation;
- supply chain;
- workforce; and
- regulatory barriers.

9.2.1 Production Cycles, Challenges and Market Trends
Within the global salmon market, Scottish Atlantic salmon is considered a premium product. This is because of:

- the specific environmental conditions existing in Scotland (e.g. water temperature);
- higher welfare standards;
- the product's relative scarcity (around 8% of global production); and
- Scottish salmon being a niche product with lower stocking.

These characteristics have contributed to the price of salmon more than doubling between 2012 and 2019, when it has increased from around £2.50/kg to over £6.00/kg. However, over the same period production costs doubled, driven mainly by increases in health care costs.

Production of Atlantic salmon is normally a two to three-year process and volumes tend to be relatively stable. However, production may be affected by risks to fish health. Potential problems are usually identified during the summer since the period between August and October, when the seas are warmer, is when fish is most susceptible to disease. For precautionary reasons, salmon may then be harvested early, when it weights between 3/4kg rather than 6kg. Fluctuations in the production process of this kind happen rather frequently and occurred both in 2017 and 2019.

Fluctuations affect the annual impact of the sector as a year with a larger harvesting will be followed the year after by lower production due to early harvesting. While not affecting production, if considered over a two-year period, these fluctuations influence the economic impact from employment, as over-time is paid when over-harvesting takes place. This is not offset in periods when production is lower, due to the scarcity of the skills needed in this sector. Supply spending is mostly unaffected by these fluctuations since most costs are fixed, though early harvesting translates into lower feed costs.

Changes in the economic impact associated with the sector will take place only with an increase in farm sites, through which the sector's impact would be scaled. Fluctuations due to changes in the product's value and the disease environment are unlikely to affect the industry's long-term impact. Trout production is likely to expand in the future as both Dawnfresh and Kames have ongoing planning applications.

The sector is technologically advanced and has seen technological innovations including in recent decades the move from big to small pens, automatic feeding and

mechanical lice control. Most producers see technological improvements as the main future driver of productivity in the sector.

Some producers have reported Brexit as a cause of concern. This is mostly due to the trade framework under which they will operate.

9.2.2 Vertical Integration and Consolidation
The consultations suggested the emergence of two trends that are shaping the market structure of the aquaculture sector in Scotland:

- vertical integration; and
- consolidation/amalgamation.

Vertical integration refers to the process through which a business produces goods or services that were previously bought in from suppliers. Activities that already tend to be integrated within salmon production include hatcheries and processing. Larger companies may also have their own veterinary and transport departments. In general, the extent of vertical integration as well as the type of activities integrated seems to depend on a company's size.

Both MOWI and Cooke Aquaculture have recently undergone vertical integration, while other producers are considering doing so. MOWI has established a feed plant on the Isle of Skye, that, once fully operational, will provide almost all the feed necessary for its farms. Cooke Aquaculture has recently created the Northeast Nutrition Limited, following its acquisition of the former Skretting fish feed mill in Invergordon. The integration of fish feed in their activities has significant implications for these companies since feed is their main supply chain cost.

Vertical integration and consolidation will change the market structure of the aquaculture sector and have repercussions on the supply chain

Across the aquaculture sector, there has been a reduction in the number of sites or companies. The number of companies in the shellfish sector has decreased over time due to amalgamation, whereas there has been a reduction in the number of sites producing Atlantic salmon. The reduction in the number of businesses may represent the emergence of economies of scale, with larger businesses having cost advantages due to their size. However, there remains no large producer in the shellfish sector and the Crown Estate is now seeking to address this lack of large-scale sites.

While changing where the economic impact takes place and the companies benefitting from it, vertical integration is unlikely to affect the overall economic impact of the aquaculture industry in Scotland. However, this may disrupt existing companies that are part of the supply chain. Consolidation, where leading to economies of scale, has on the contrary, the potential to increase the sector's future economic impact.

9.2.3 Supply Chain Trends
Spending in the supply chain makes an important contribution to the industry's impact and is seen by Highlands and Islands Enterprise (HIE) as a major opportunity for Scotland.

Producers in the aquaculture industry incur two types of costs:

- capital spending; and
- operational spending.

Operational spending includes those annual costs that are linked to a single production cycle, whereas capital spending encompasses spending on machinery, boats, maintenance and repairs.

‘Spending in the aquaculture sector’s supply chain is a major opportunity for Scotland’.

The relative importance of the contribution from these types of spending varies according to each subsector within Scottish aquaculture and is broadly proportionate to the subsectors’ size. Supply chain spending has the largest impact for Atlantic salmon production and producers are well aware of the impact of this spending and where possible tend to source from locally.

The main difference emerged across the industry concerns the origin of operational and capital spending. The former has a relatively large share of Scottish content, whereas the latter is mostly sourced from outside the UK.

Feed is the largest variable cost across the production of finfish species, though it is not incurred by shellfish producers. Feed for Atlantic salmon is mostly sourced from Scotland, when this is not already vertically integrated. Trout feed, however, is mostly supplied from abroad and is mostly produced in Europe.

Other companies that provide services for salmon producers include:

- Gael Force, the production of which includes pens, mooring systems, feeding barges and feeding systems;
- Inverlussa which provides services including vessel hire, installations and treatments; and
- the Fish Vet Group, which provides the aquaculture sector with veterinary products.

Spending on capital goods includes the purchase of machinery, boats, cages and any associated maintenance and repairs works. Most of these products and services are provided by businesses outside the UK. These goods tend to come from Iceland, Denmark and Scandinavia, with some of the producers having operations in the UK. However, the engineering skills required to install and use the equipment are then available in the UK and supplied by local businesses.

The shellfish sector is associated with a minimal supply chain impact. Capital, when purchased, comes from outside the UK, though it is common practice to lease vessels from larger producers.

The findings over the sources of supply spending from the sector, alongside the data received by survey respondents, formed the basis of the modelling of supply spending impacts.

9.2.4 Workforce and Local Impacts

The extensive use of technology deployed within the aquaculture sector has meant that the sector has a highly skilled workforce. This is unlikely to change in the future as it is expected that in this sector technological progress will be accompanied by an increase in high skilled jobs.

The high level of skills and the difficulty of replacing them has also an impact on firms' decisions during periods when production is low as a result of the fluctuations in production described above. During these periods, businesses retain their workforce and focus on skills development, training and maintenance at the fish farms.

Data for the companies that filled in the survey provide a snapshot on the composition of the workforce in the Atlantic salmon sector. Over 93% of the employment in the companies surveyed was permanent. Seasonal workers, employed through agencies, are usually employed during peak times and for the processing of fish products.

Technological progress has resulted in an increase in the number of in highly skilled jobs

Between 39% and 47% of the workforce are less than 35 years old. The Atlantic salmon sector is a source of well-paid employment relative to employers in the local areas where it operates and there is potential for career progression. For instance, an 18 years-old can expect a starting salary of around £20,000 as an operative and, through training and experience, can become a farm manager and earn around £40,000.

The sector is male-dominated with survey respondents reporting that 82% or more of their workforce is male. Up to 10% of the workforce is from the European Economic Area (EEA).

The shellfish sector is likely to have a workforce featuring a different age breakdown. In this part of the sector, activity takes the form of a hobby and as a result there is a higher concentration of retirees and 60+.

The importance of motivated staff and communities for staff to live in has also been highlighted as an important factor and a potential future challenge. This is because of the rural nature of the places where businesses in the sector operate. Companies have an overall interest in thriving local communities and make a contribution to local development, as evidenced by Loch Duart's community benefit scheme, the Salmon Pool Fund.

9.2.5 Environmental Impacts

Aquaculture, both finfish and shellfish, is a relatively low carbon intensive way of producing animal protein. As a result, it is likely to have an important role in future global food chains and to witness an increase in future demand from more environmentally-conscious consumers.

The production process and its reliance on the marine environment is particularly susceptible to changes in environmental conditions. Warmer seas and their associated environmental impacts are widely seen as a potential medium-term threat. Partly as a result of this, the sector has been careful to limit and mitigate its environmental impacts.

This has often been achieved by adopting technological solutions to environmental problems. The deployment of technology to avoid or mitigate the environmental impacts associated with feed and fish excrement leaving salmon cages provides a recent example of this trend. Higher animal welfare has, in turn, translated in a premium on the value of Scottish salmon.

Shellfish farming has particularly beneficial environmental impacts and is seen as a net carbon absorber. For instance, it was suggested that a hectare of shellfish farming can capture the equivalent of the annual CO2 emissions of a 4x4 vehicle. In addition, shellfish production does not require any medicines or feed, which further limits shellfish environmental impact. Trout farming has a relatively lower environmental impact than salmon production as trout are better convertors of food and sea lice is less of a problem for this animal produce.

9.2.6 Regulatory Barriers

Regulatory barriers are widely seen as a constraint towards the expansion of the aquaculture sector in Scotland. The main constraints identified were:

- rules on state aid that limit financial support from public agencies; and
- planning.

Because of state aid rules, HIE and other public bodies can only provide financial support to small and medium enterprises (SMEs). For this reason, only two of the seven salmon producers can receive financial support from HIE. Under state aid rules, large companies can receive only up to €200,000 over three years. However, fish production has additional restrictions that lower the limit of financial support allowed to between €20,000 and €30,000.

Restrictions on the financial support that public sector bodies can provide to the sector have influenced their interaction with larger producers. As a result, engagement with large businesses tends to focus on staff training and development. For instance, HIE supported the provision of the skills required for the MOWI feed mill in Skye.

Planning constraints the expansion of finfish as well as shellfish. For instance, most of the best sites for trout farming are already exploited and there are difficulties in expanding freshwater sites. In this context, the sector would advocate a one stop shop approach to planning. The cost of licences for shellfish sites – up to £20,000 – and the associated requirements for a sanitary survey make expansion and entry into the shellfish market complicated.

9.3 Summary of Consultations

The consultations exercise has contributed to our understanding of the industry and of its impacts on the Scottish economy. The following conclusions were relevant to the modelling exercise:

- the sector employs a highly skilled workforce and pays relatively high wages in comparison to other employers in rural Scotland (induced impacts);
- operational supply chain expenditure tends to take place in Scotland, whereas capital spending is more likely to occur abroad;
- the sector, due to animal health challenges may experience fluctuations in production as fish may be taken to the market earlier; and
- the sector is experiencing vertical integration and amalgamation. Vertical integration is not going to change the overall impact of the sector. Amalgamation may lead to higher impacts were scale be reached.

Other findings include:

- regulatory barriers are often seen as a constraint to the development of the sector;
- the sector provides high-quality jobs across rural economies;

- changes to the environment are seen as potential medium-term threat to the sector's viability; and
- compared to other producers of animal protein the sector has a relatively lower environmental impact.

10. Conclusion

The aquaculture sector makes an important contribution to the Scottish economy. A technologically-intensive sector, Scottish aquaculture supports rural economies.

This study provided up-to date evidence to Marine Scotland over the role played by the Scottish aquaculture sector and its subsectors - salmon production, other finfish production, shellfish and aquaculture processing - on the Scottish economy. It considered both the sector's economic contribution and broader trends within the industry.

The quantitative analysis found that in 2018 the aquaculture sector directly employed 6,260 people across Scotland and contributed around £468 million direct Gross Value Added (GVA). These impacts can be exclusively attributed to the sector. As a result, when referring to the direct contribution that the aquaculture sector makes to Scottish Gross Domestic Product (GDP), this is the figure which should be referenced. In total the sector contributed around £885 million GVA and 11,700 jobs across Scotland. In 2018 this included supply-chain and induced impacts. These are impacts associated with, rather than the direct product of, the aquaculture sector. They include purchases down its supply-chain as well as the spending of people employed in the sector. Counting indirect and induced impacts for each industry across the economy would lead to double-counting and an overestimate of GDP. The inclusion of these impacts is justified as they provide evidence to the wider impacts the sector has through its activities. Scottish aquaculture also contributed £97 million to public finances through taxes, including Corporation Tax, Income Tax and National Insurance contributions.

The analysis found that the scale of impact varied depending on the aquaculture subsector considered. Overall, the contribution from salmon production and aquaculture processing were the largest.

Fish products tend to be lower carbon emitters than other protein-based food products. As a result, they are likely to form an increasing share of protein consumption in the future by more environmentally conscious consumers. The increase in demand may translate in the growth of the sector and be favoured by the consolidation taking place across the sector. Action may, however, be required to address structural limits to an expansion of the sector's supply, including in the planning system and the availability of new sites. The processing sector's growth may be affected by the availability of EEA workforce decline as a result of post-Brexit changes in the immigration system.

Alongside differences in the economic impact made by each subsector, qualitative differences emerged across finfish, shellfish and processing. Differences within the production of salmon and the production of other finfish products are less sizable.

Finfish and, in particular, the production of salmon, are capital-intensive activities. Technology has over time been deployed extensively in areas including animal health as well as the monitoring of fish development. However, the high level of technology and technology adoption has not come to the detriment of employment but has supported relatively high skilled jobs, which have benefitted their workforce with relatively high wages. Within the sector, processing of aquaculture remains a

labour-intensive activity and pays on average lower salaries than finfish production. The shellfish sector in Scotland takes the form of a part-time activity.

The aquaculture sector and, in particular salmon production, make an important contribution to the Scottish economy through spending on supplies. Supply chain expenditure constitutes a large opportunity for the Scottish economy. In 2018 salmon production contributed considerably to purchases of goods and services from Scotland. In particular, feed, the main variable costs in this subsector, is mostly sourced from Scotland. On the contrary, capital expenditure and, in particular, expenditure on machinery occurs mostly outside Scotland, in the Nordic countries, Iceland and Denmark.

Finally, the aquaculture sector makes an important contribution to the local economies in Scotland where it operates. The production of finfish and shellfish takes place in rural economies with a declining and relatively older population. To retain their workforce producers have put resources in making the local economies attractive and in contributing to a strong community life. These efforts are exemplified by some of the salmon producing companies having community benefits funds.

11. Methodological Appendix

This section sets out how GVA and employment impacts across the report were estimated.

11.1 Measuring Economic Impact

To express the economic contribution made by the Scottish aquaculture sector, the analysis relied on two widely accepted measures of economic contribution: gross value added (GVA) and jobs.

- GVA is a measure of the value that an organisation, company or industry adds to the economy through its operations. The analysis uses the production approach to measuring this contribution, where the GVA is equal to the value of production less the value of the inputs used; and
- employment (jobs) is measured in terms of headcount jobs supported unless stated otherwise.

One of the reasons these measures are so widely used is that they provide a convenient way of capturing the entire economic contribution of an organisation in a single number.

The quantifiable outputs from this study have been rounded.

11.2 Economic Impacts

The total GVA and employment contributions made by an organisation come from three sources: the direct, the indirect and the induced effect.

The direct impact captures the contribution to economic activity that an organisation can claim as being exclusively its own. It is given by an organisation's direct GVA which is represented by its staff costs plus profits, and the number of people it employs.

Economic activity generators do not live in a vacuum and, as a result, they have an impact on other economic entities. This is captured by an organisation's indirect and induced contribution to economic activity and is measured using economic multipliers from the Scottish and UK Input-Output tables.

11.2.1 Direct GVA

To estimate the sector's direct GVA, it was necessary to estimate profits and staff costs, where possible, or to use the difference between turnover and non-staff operational costs otherwise.

The direct GVA for the salmon production sector was estimated by sourcing profits and staff costs from the companies' accounts.

To estimate the direct GVA of processing companies, it was first necessary to estimate staff costs and profits. Staff costs for those companies not included in the survey were estimated by multiplying an estimate of the sector staff costs provided in a 2018 report by Seafish to the share of direct employment in the sector not covered

by survey respondents[19]. Profits were estimated based on the share of profits to income of the salmon sector, weighted by the data in the Seafish report[20].

The direct GVA for the shellfish sector was estimated by taking the difference between its turnover and operational expenditure, due to the difficulty in estimating profits for the sector given businesses' size. The turnover was sourced from the Scottish Government's 2018 Scottish Shellfish Production Survey. The supply spending from the shellfish sector was estimated based on production data from the 2018 Scottish Shellfish Production Survey and the 2017 Scottish Shellfish Development Critical Mass Model.

Due to similar data limitations, the same process was followed with regards to the estimation of the direct GVA from other finfish. In that case, the turnover taking place in the production of other finfish was estimated by multiplying the production volumes by the value of trout production per tonne. The value of trout production was estimated using the turnover and production figures of the larger trout producing companies. Operational expenditure was then subtracted from turnover.

11.2.2 Supply Chain Impact

The method used to estimate the impact of the supply chain expenditure drew from both the survey data undertaken as part of this study and other relevant survey data that has been published by other organisations.

The survey evidence on procurement was the starting point for estimating the supply chain impact of the aquaculture sector and provided a detailed breakdown of spending. The first step in assessing the economic impact from supply chain spending was to estimate how much spending in goods and services took place in Scotland. To achieve that, it was necessary to impute the spending for those companies and subsectors that were not represented in the survey.

The companies that filled in the survey accounted for around 72% of the turnover of Scottish salmon companies. Supply spending from salmon production was imputed by scaling the expenditure recorded.

It was estimated that around 43% of Scottish aquaculture processing was represented by the companies filling in the survey. The remainder of the estimation of supply chain expenditure relied on a breakdown of turnover between raw materials, spending on energy, other operating costs, labour costs and profits[21].

The spending not accounted for in the survey was imputed by weighting the total spending on energy and other operating costs by the share of employment in the sector excluded from the survey. Raw materials were not included when considering the supply chain of aquaculture processors because either they came from finfish/shellfish producers in Scotland or from abroad. In the first case, accounting for them would have led to double-counting.

To estimate the supply chain expenditure supported by the production of other finfish species, it was assumed that companies in this sector had similar spending patterns as salmon producers. Namely, the largest component of operational expenditure was feed, followed by services such as veterinary and business support. This assumption was based on evidence from the consultations exercise. This also highlighted that although the spend profile was similar to that of salmon production, there were some key differences. In particular, while the majority of salmon feed was procured from within Scotland, the feed for trout in 2018 was typically imported. The breakdown of

[19] Seafish (2018, Seafood Processing Enquiry Data.
[20] Ibid.
[21] Seafish (2019), Cutting Edge.

the supply chain was then estimated by weighting the share of each component of the supply chain by the total supply chain expenditure for the sector which was estimated to be around £8.1 million, based on data on trout production from the Scottish Rural College (SRUC)[22]. This data suggested that supply chain expenditure was equivalent to 51% of turnover in the trout production sector, which is lower than the comparable figure for the salmon production sector.

Expenditure in the shellfish supply chain was assumed to be similar to that of the processing sector. From consultations significant differences emerged between the supply spending of finfish and shellfish companies. For instance, shellfish companies do not require any animal feeds to support their production. Similarly, veterinary expenses are not as significant. As a result, the sectors' supply chain expenditure - £1.8 million – was assumed to be similar to that of the processing supply chain. The analysis was based on production data from the 2018 Scottish Shellfish Production Survey[23] and the 2017 Scottish Shellfish Development Critical Mass Model[24].

11.2.3 Induced Impacts Estimation

The total annual staff costs paid by employers in the aquaculture sector was the starting point in the estimation of the induced impact generated by the sector. In order to estimate how much of this impact took place in Scotland, it was necessary to assume how much of the spending from people employed in Scotland takes place in Scotland. Based on internal analysis on ONS data from the Annual Expenditure Survey, it was estimated that around 70% of expenditure takes place in Scotland. To estimate direct GVA and employment, this spending was then divided by the turnover per GVA and turnover per job of the Household Expenditure sector. Indirect and induced impacts were then estimated by applying Type 1 and Type 2 employment and GVA multipliers to the direct impacts.

[22] SRUC (2019), Trout for the Table, available: https://www.sruc.ac.uk/info/120184/fish_farming/242/trout_for_the_table/4
[23] Scottish Government (2019), Scottish shellfish farm production survey 2018.
[24] Poseidon (2017), Scottish shellfish development critical mass model.

Scottish Government
Riaghaltas na h-Alba
gov.scot

This publication is available at **www.gov.scot**

Any enquiries regarding this publication should be sent to us at

The Scottish Government
St Andrew's House
Edinburgh
EH1 3DG

ISBN: 978-1-80004-031-1 (web only)

Published by The Scottish Government, September 2020

Produced for The Scottish Government by APS Group Scotland, 21 Tennant Street, Edinburgh EH6 5NA
PPDAS758726 (09/20)

w w w . g o v . s c o t