

# **An Independent Review of Innovations in Scottish Aquaculture Since 2018**

**Final Report for**

**Salmon Scotland in Partnership  
with the Sustainable Aquaculture  
Innovation Centre**



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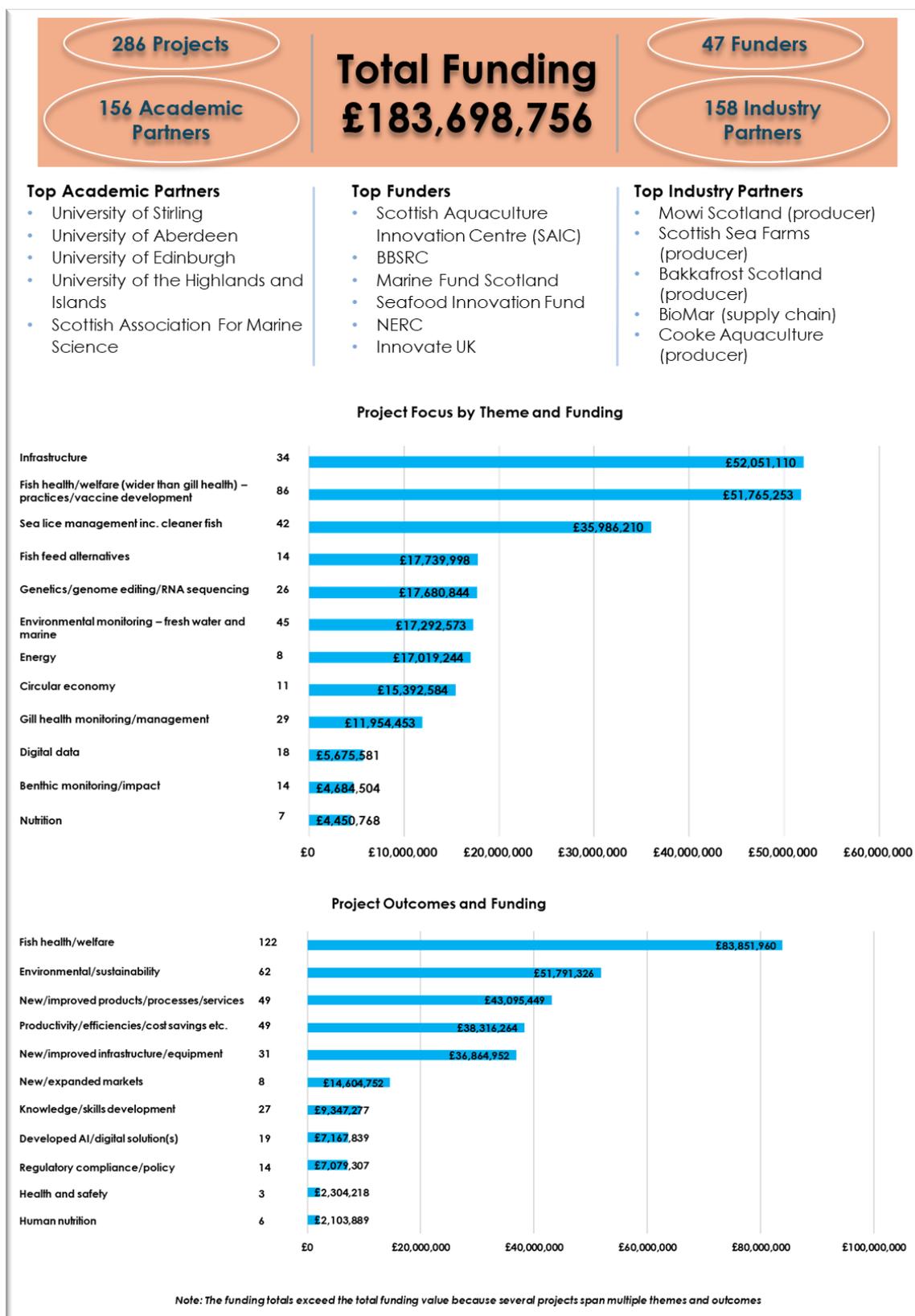
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## Executive summary

Since 2018, Scotland's salmon aquaculture sector has seen substantial innovation and investment, supported by strong collaboration between industry, academia and public funders. The infographic below brings together project data sourced from the Scottish Aquaculture Innovation Centre (SAIC), supported by desk-based research and interviews with industry, academic, and funding stakeholders. It covers salmon related innovation with a public funding component dating back to 2018. Projects funded directly by companies have been excluded due to commercial sensitivity, therefore the actual level of total investment is likely to be much higher.



This activity has strengthened Scotland's position as a global centre for aquaculture science while supporting sustainability, productivity, and regulatory improvement across the sector.

Innovation has expanded across every major challenge area. The largest share of investment has focused on fish health and welfare, with over £51m supporting vaccine development, diagnostics, welfare tools, and disease prevention research. Substantial progress has been made in sea lice management, where biological controls, novel treatment technologies, and AI-enabled detection systems have broadened the suite of available solutions. Scotland has also taken major steps forward in genetics and breeding, including multimillion-pound genomic programmes that accelerate selective breeding for disease resistance.

Environmental monitoring and sustainability remain central themes, with advances in eDNA-based seabed assessments, modelling tools such as NewDEPOMOD, renewable energy systems, and circular economy approaches. These innovations support Scotland's regulatory ambitions and help reduce environmental impacts across the production cycle.

The evidence demonstrates that industry-academic collaboration has strengthened markedly, with almost three quarters of researchers reporting that members of their research team have moved on to work in industry in Scotland. Most researchers also describe increased industry involvement since 2018, with projects contributing to new methods, commercial products, additional grant income and enhanced workforce development. The additionality of the funding is very high, with the majority of researchers stating that they would not have been able to develop the research or technology at all without this support. Companies highlight clear benefits from R&D activity, including improved productivity, better fish health, new products and services, sustainability gains, and business growth. Many report their turnover and employment levels would have been lower without this innovation activity.

Despite the progress, challenges persist. Regardless of overall funding being of significant value, it is often fragmented and short-term, limiting continuity from early stage science through to commercial adoption. Regulatory processes can be slow and complex, creating barriers to trialling new technologies. Gaps in specialised infrastructure, particularly pilot scale marine test facilities often require companies to work overseas. Skill shortages in areas such as data science, engineering and fish health are also emerging constraints. However, the successes and progress evidenced in this report demonstrate a culture of resilience and persistence to drive forward research and innovation for the benefit of the sector amongst industry, academia and funders despite the challenging context.

Looking ahead, both industry and academia strongly agree that continued and more strategic investment in collaborative innovation is essential. Future support needs to be long-term, coordinated, and capable of backing both foundational science and higher technology readiness level (TRL), near market innovation. Stakeholders also highlight the opportunities to streamline regulation, modernise infrastructure, expand skills pipelines, and strengthen communication of scientific evidence to the public.

Overall, Scotland's aquaculture innovation system is dynamic, increasingly integrated and globally relevant. With strategic support, improved regulatory pathways, and targeted investment in skills and infrastructure, the sector is well positioned to build on its achievements and enhance its competitiveness, resilience and contribution to Scotland's economy in the years ahead.

**Frontline**  
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# 1 Introduction

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## 1.1 Project requirements

Salmon Scotland, working in partnership with the Sustainable Aquaculture Innovation Centre (SAIC), commissioned Frontline to assess the scale and nature of innovation across the Scottish salmon aquaculture sector across industry and academia since 2018.

## 1.2 Context

Over the past five years, the sector has not experienced major change in terms of new start-ups, with only a small number emerging. Growth has remained limited, particularly in production volumes, continuing the 'flatlining' trend that has been discussed for several years. A significant contributing factor is regulation, which shapes the pace and direction of innovation. Many of the innovations the sector is exploring such as advances in fish health, welfare, and environmental understanding are closely linked to overcoming regulatory barriers. These developments are essential for unlocking future growth.

Despite the lack of strong production growth, there has been substantial development activity across the sector. This includes work to establish new farms, improve existing ones, and, in some cases, consolidate operations. Strategically, the industry is moving toward a more diversified approach to marine farming. Key trends include transferring larger smolts to sea and shortening the marine phase, along with increasing the use of sheltered 'nursery' sites before fish move to farms in more exposed locations. Freshwater facilities are also expanding their capacity to grow fish to larger sizes prior to sea transfer.

Looking ahead, the sector may see more 'post-smolt' systems – closed, semi-closed, offshore beyond three nautical miles or on land-based seawater facilities used as an intermediate stage before fish enter sea pens. Together, these shifts reflect a broader move toward a more varied and adaptable marine farming model.

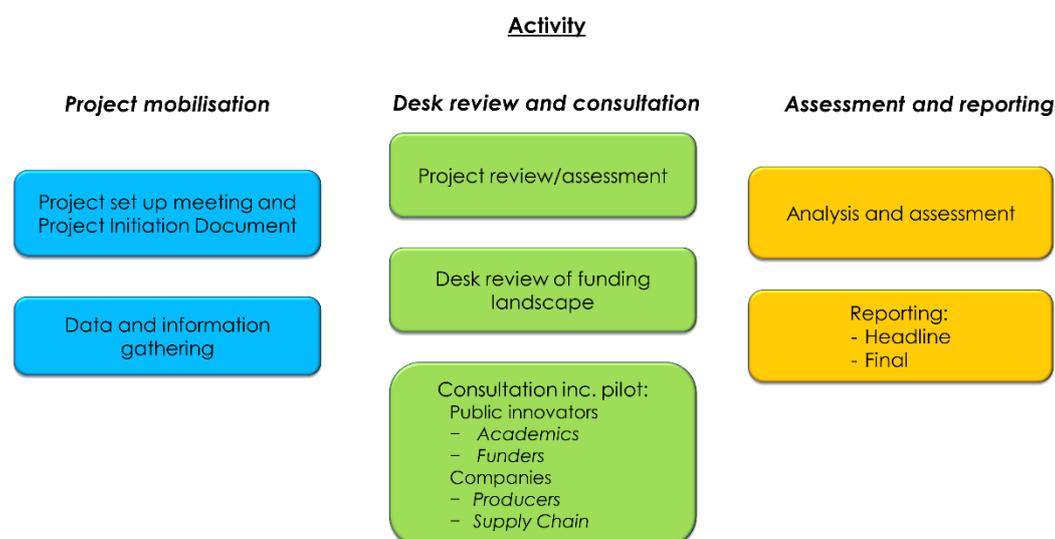
The academic landscape is also undergoing significant change as many senior researchers retire or move on, leaving early career researchers struggling to build networks and understand who is working where.

Brexit has further reduced access to European funding and collaboration, contributing to uncertainty across the UK research environment. This financial and structural instability is pushing academics towards retirement or other sectors, limiting collaboration, increasing pressure to publish and generate income, and making it difficult to balance project delivery with preparing new proposals. At the same time, capacity constraints within both academia and industry are hindering effective research support and participation.

It is acknowledged there is a lack of current data on the number of academic researchers and their support staff who work in aquaculture across Scotland. However, plans are being drawn up by SAIC to reconnect and foster new relationships with the aquaculture academic community to better intelligence on projects and shape future opportunities within the sector.

## 1.3 Our approach

The approach to this research was developed in consultation with Salmon Scotland and SAIC following an initial set up meeting to reflect the wider research, development and innovation (RD&I) across salmon industry and academia. The approach is summarised below:



The research was informed by interviews with:

- 22 public innovators from 14 different organisations (across funders and academic institutions)
- 30 individuals from 29 different companies (across producers and the supply chain)

The report is structured as follows:

- **funding landscape overview** – analysis of the funding landscape within Scottish salmon aquaculture
- **project baseline overview** – an overview of projects (with a public funding component) delivered in relation to innovations in Scottish salmon aquaculture since 2018
- **researcher findings** – analysis of how academic researchers engage with, deliver, benefit from, and are supported by innovation and research funding in Scottish salmon aquaculture since 2018
- **company findings** – analysis of how businesses operating in the Scottish salmon aquaculture ecosystem engage in, benefit from, and are influenced by research, development and innovation (RD&I) activity
- **qualitative feedback on the aquaculture innovation and research landscape in Scotland** – analysis of perceptions, experiences, and opinions from public innovators and industry representatives about the effectiveness of Scotland's aquaculture research and innovation landscape

Appended are:

- **case studies** – real world, evidence-based examples that illustrate how innovation, collaboration and funding have translated into tangible outcomes in Scottish salmon aquaculture
- **a list of consultees**

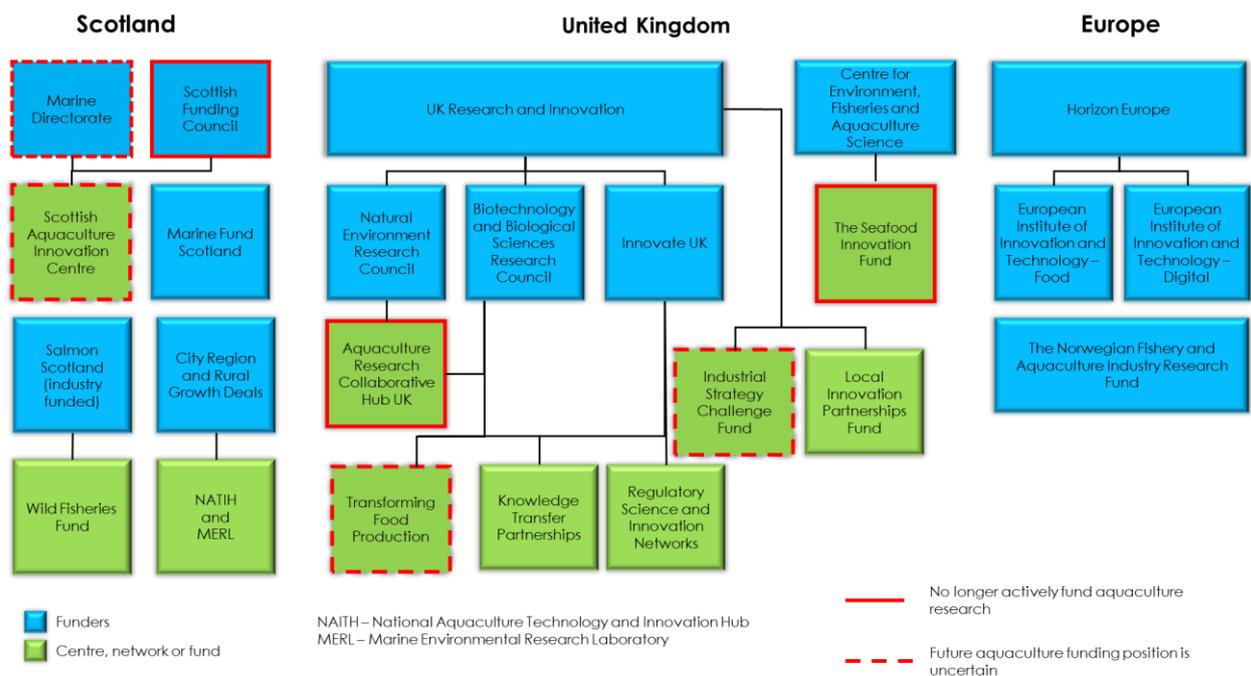
The information presented in this report is supported by a database of 286 projects covering salmon related innovation and R&D with a public funding component dating back to 2018.

## 2 Funding Landscape Overview

This section presents the findings from a desk-based review of the current innovation funding landscape across Scotland, rest of United Kingdom (rUK) and Europe. The figures referenced relate to total project funding, which typically combines contributions from both funders and industry partners. Where available the total project value and the specific funder contribution have been presented.

The funding landscape consists of a range of funders and funded organisations. Some of these entities are no longer operational, while others are approaching the end of their funding cycles with no confirmed successor programmes. This context is illustrated in the diagram below and discussed further in the sections that follow.

### Funding landscape since 2018



### 2.1 Trends in aquaculture funding

Aquaculture funding in the UK has seen significant growth and diversification in recent years, with increasing emphasis on sustainability, innovation and industry-academic collaboration:

- **sustainability** – funding is increasingly tied to environmental outcomes. Projects that prioritise disease reduction, welfare improvement, and emissions mitigation are increasingly favoured, with a strong emphasis on enhancing climate resilience – particularly through strategies to manage harmful algal blooms and ocean acidification<sup>1</sup>
- **technological innovation** – support is growing for AI-driven monitoring systems, novel hatchery and culturing strategies, and microbiome engineering and disease prediction models<sup>2</sup>
- **industry-academic partnerships** – recent funding rounds (e.g. BBSRC's £4.6m Sustainable Aquaculture Partnerships for Innovation fund in 2024) require at least one industry partner per project, co-investment from businesses (minimum 10% cash or in-kind) or joint efforts in areas like plankton monitoring, light exposure for disease control, and red seaweed cultivation<sup>3</sup>

<sup>1</sup><https://www.globalseafood.org/advocate/aquaculture-researchers-secure-funds-to-enhance-fish-health-and-welfare-amid-climate-change/>

<sup>2</sup><https://www.ukri.org/news/multimillion-fund-will-boost-innovation-in-sustainable-aquaculture/>

<sup>3</sup><https://www.ukri.org/news/multimillion-fund-will-boost-innovation-in-sustainable-aquaculture/>

Since 2018 the Scottish salmon aquaculture sector has seen significant investment (or commitment to invest), spanning public grants and research council programmes. A breakdown of the key organisations who are involved in funding, supporting and coordinating aquaculture innovation in Scotland is provided in the sections that follow.

## 2.2 Marine Directorate

### 2.2.1 Description/role

The Marine Directorate is the Scottish Government body responsible for both marine and freshwater fisheries science, including aquaculture and salmon related research. Its remit covers scientific research, regulation, innovation, monitoring, and policy development across Scotland's aquaculture sector.

### 2.2.2 Funding to date

It funds projects mainly through Marine Fund Scotland (MFS), Scotland's central grant mechanism for marine, fisheries, aquaculture, and salmon related innovation (described in Section 2.3).

## 2.3 Marine Fund Scotland (MFS) previously the European Maritime and Fisheries Fund (EMFF)

### 2.3.1 Description/role

The Marine Fund Scotland (MFS) was launched in 2021 as the successor to the European Maritime and Fisheries Fund (EMFF). It is a Scottish Government initiative aimed at supporting the development of a sustainable and innovative marine economy. It supports Scottish salmon aquaculture by funding innovation, sustainability and coastal community development. The current funding round completes in March 2026.

### 2.3.2 Funding to date

EMFF salmon specific funded projects between 2016 and 2021 are estimated to be between £3–5m, based on itemised grants to salmon producers and technology developers<sup>4</sup>. Examples include:

Technology/ Intervention	Partners	Project value	EMFF contribution
Thermolicer	Scottish Sea Farms	£2,500,000	£450,000
Permaskirts (lice skirts)	Mowi Scotland	£635,000	£127,000
Hydrolicer Workboat 2	Mowi Scotland	£757,088	£136,275
Ace Aqua System	Scottish Sea Farms	£350,000	£175,000
FW Treatment Solutions	Loch Duart Salmon	£315,295	£135,576
Cleaner Fish Nursery	Otter Ferry Seafish	£904,309	£452,154

<sup>4</sup><https://scottishaquaculture.com/projects/capital-investment/details/emff-1-non-medicinal-interventions-and-operational-innovation/>

As of the end of 2025, MFS has awarded over £55m in grants (330 projects) since 2021, leveraging more than £121m in total investment across Scotland's marine economy<sup>5</sup>.

Recipient	Project value	MFS contribution	Focus
Vonin Scotland	£7.2m	£1.1m	Phase 2 of net station at Kyleakin, Skye (salmon farming infrastructure)
Landcatch Natural Selection	£4.4m	£661,000	Expansion of smolt supply site at Ormsary, Argyll and Bute
Aquagen Scotland	£615,960	£308,000	Recirculation system for salmon ova production at Holywood, Dumfries
Pulcea	£223,574	£198,573	Development of safe sea lice treatment for salmon with gill disease
Applecross 4 (AP4)	£7m	£2m	Aims to revolutionise the Scottish aquaculture process, specifically regarding the rearing of larger juvenile salmon within land-based freshwater sites

The 2025–26 funding round is set to close in March 2026 with continuation beyond this point uncertain.

## 2.4 The Sustainable Aquaculture Innovation Centre (SAIC)

### 2.4.1 Description/role

The Sustainable Aquaculture Innovation Centre (SAIC) was established with £11.1m in 2014 from the Scottish Funding Council as one of Scotland's Innovation Centres<sup>6</sup>, with a mission to accelerate sustainable growth in aquaculture particularly in Atlantic salmon farming. It was created to:

- bridge the gap between academic research and commercial aquaculture
- fund and support collaborative innovation projects that address industry challenges
- reduce the environmental footprint of aquaculture while increasing its economic impact

In 2024, SAIC secured a further £1.5m funding package, made up of<sup>7</sup>:

- £500,000 from the Scottish Government's Marine Fund Scotland
- £1m in transitional funding from the Scottish Funding Council

<sup>5</sup><https://www.gov.scot/news/marine-fund-scotland-2025-26-launches/#:~:text=%E2%80%9CSince%202021%20the%20Marine%20Fund,evolve%20and%20flourish%20to%20apply.>

<sup>6</sup><https://www.sfc.ac.uk/blog-69724/>

<sup>7</sup><https://www.sustainableaquaculture.com/news-events/saic-secures-1-5-million-funding-package-from-the-scottish-government/>

## 2.4.2 Funding to date

Since 2018, SAIC has supported 96 aquaculture innovation projects, with a combined project value to date of almost £68m and involving project partners from academia and industry. Some examples are provided below with a more detailed breakdown provided in Section 3.

Project	Project value	Partners	Focus
HAB Alerts for Scottish Finfish Aquaculture	£1.1m	SRUC Scottish Sea Farms SAMS Mowi Scotland	Real time modelling, monitoring and prediction of harmful algal blooms
BactMetBar	£2.1m	University of the Highlands and Islands Scottish Sea Farms Salmon Scotland Scottish Environment Protection Agency Mowi Scotland Marine Directorate of the Scottish Government	Using eDNA metabarcoding as an alternative to macrobenthic assessments
Ace Aquatec ADD	£1.4m	University of St Andrews Scottish Sea Farms Ace Aquatec	The impact of a low frequency acoustic deterrent on seal predation in salmon aquaculture
Complex Gill Disease	£2.5m	Wester Ross Fisheries Ltd University of Glasgow SRUC Scottish Sea Farms Salmon Scotland Nevis Marine Mowi Scotland Loch Duart Grieg Seafood Hjaltland Cooke Aquaculture Bakkafrost Scotland	Identifying gill health actions
Wrasse	£7.6m	University of Stirling Scottish Sea Farms Mowi Scotland BioMar	Scaling up production and implementation of farmed cleaner fish in the Scottish salmon industry

## 2.5 Salmon Scotland

### 2.5.1 Description/role

Salmon Scotland plays an essential funding and coordination role in the Scottish salmon aquaculture ecosystem particularly through its leadership of the Wild Fisheries Fund, which supports conservation, habitat restoration and wild salmon protection efforts.

Salmon Scotland represents the commercial salmon farming sector and advocates for sustainable practices, regulatory reform, and constructive engagement with wild fish stakeholders. It is financed by the salmon farming sector, and its funding initiatives complement public sector support from Marine Fund Scotland.

## 2.5.2 Funding to date

The primary source of funding is the Wild Fisheries Fund, a five-year programme (2021–2026) that will invest up to £1.5m in projects supporting wild salmonids<sup>8</sup>. The fund is focused on delivering practical on the ground actions, particularly across the west coast and islands, aimed at helping to reverse the decline in wild fish populations. Although not designed as a research programme, several funded projects demonstrate strong elements of innovation. These are typically small in scale but high in impact, for example, pioneering hatchery work involving live gene banking, which represents a novel approach for Scotland.

In addition to these smaller projects, the fund has provided major support to the West Coast Tracking Project, a partnership between the Atlantic Salmon Trust, Fisheries Management Scotland and the Marine Directorate. This initiative tracks smolts during their early marine phase and represents a significant contribution to innovation and evidence gathering. The Fund has also supported a diverse range of local projects addressing habitat restoration, wild farmed interactions and essential infrastructure improvements.

## 2.6 City Region Deal and Wolfson Foundation

### 2.6.1 Description/role

The National Aquaculture Technology and Innovation Hub (NATIH) is a flagship facility at the University of Stirling, set to open in 2026. Funded through the Stirling and Clackmannanshire City Region Deal it will:

- advance fish health, welfare, and environmental sustainability
- support industry–academic collaboration for applied research
- drive skills development for Scotland's blue economy
- translate scientific breakthroughs into commercial aquaculture solutions

### 2.6.2 Funding to date

£17m has been invested in the facility by the UK Government via the City Region Deal with a further £1m additional support from the Wolfson Foundation<sup>9</sup>.

## 2.7 The University of Stirling's Marine Environment Research Laboratory (MERL)

### 2.7.1 Description/role

The Marine Environment Research Laboratory (MERL) at the University of Stirling has received significant salmon related funding, particularly for cutting edge research into fish health and parasite control. MERL serves as a marine trial facility located at Machrihanish on the Kintyre Peninsula, offering controlled conditions for testing salmon health interventions and welfare innovations. Its role has been significantly strengthened through recent public and research council investments. This funding positions MERL as a key site for marine aquaculture innovation, complementing Stirling's freshwater research at Buckieburn and the £17m National Aquaculture Technology and Innovation Hub (NATIH).

### 2.7.2 Funding to date

Project	Funding	Partners	Focus
Oral Vaccine for Sea Lice in Salmon	£1.5m BBSRC (via UKRI)	Moredun Research Institute, University of Stirling	Immunological response to salmon lice
MERL Facility Upgrade	£3.84m (Rural Growth Deal)	UK Government, Argyll and Bute Council	Infrastructure for marine aquaculture research

<sup>8</sup><https://www.wildfisheriesfund.co.uk/about#:~:text=The%20Salmon%20Scotland%20Wild%20Fisheries,strong%20focus%20on%20community%20involvement.>

<sup>9</sup> <https://www.stir.ac.uk/news/2025/08/natih-community-benefits/>

## 2.8 UK Research and Innovation (UKRI)

### 2.8.1 Description/role

UK Research and Innovation (UKRI) coordinates aquaculture funding through its constituent councils, specifically:

- Biotechnology and Biological Sciences Research Council (BBSRC)
- Natural Environment Research Council (NERC)

UKRI also supports Knowledge Transfer Partnerships (KTPs), which are primarily funded and delivered through Innovate UK (IUK), the UK's national innovation agency; as well as having operated the Transforming Food Production programme run chiefly through IUK and BBSRC, which formally ended in March 2024. UKRI also directly delivered the Industrial Strategy Challenge Fund (ISCF), which concluded in March 2025.

### 2.8.2 Funding to date

BBSRC and UKRI have developed a £4.6m Sustainable Aquaculture Partnerships for Innovation fund, announced in May 2024, which will support 10 collaborative projects<sup>10</sup>. These projects have been announced but are yet to commence, and the programme brings together academia and industry to address key challenges in aquaculture, including disease prevention and animal welfare.

UKRI in partnership with IUK, offer KTPs which facilitate business-academic collaborations, including those focused on aquaculture, to drive innovation and growth (discussed further in Section 2.12). Each KTP is funded up to 67% for SMEs<sup>11</sup>.

They also delivered the ISCF, a national innovation programme launched in 2017, with £2.6bn in government investment<sup>12</sup>.

Examples of UKRI projects are listed below. The overall list is provided separately in the supporting research project database.

Project	Project value	Focus
Insectrial Revolution	£10m completely funded by ISCF	Shaping the future of sustainable protein
Deep Branch Bio (aka REACT First)	£3.5m completely funded by ISCF	The UK's first scalable route to the sustainable generation of protein capturing the carbon dioxide from bio-energy generation: using microbes to convert CO <sub>2</sub> from industrial emissions turning them into high value proteins

In addition, there is also the Local Innovation Partnerships Fund (LIPF), a £500m UKRI led initiative, running from 2026 to 2031, designed to spur regional innovation and economic growth across the UK<sup>13</sup>. It supports 'triple helix' partnerships between civic authorities, businesses, and universities, structured around two strands: an earmarked strand allocating at least £30m to each devolved nation and selected English regions; and a competitive strand offering up to £20m per region for emerging innovation clusters<sup>14</sup>. The fund aims to strengthen local innovation ecosystems, boost job creation, support skills development, and channel investment into areas of regional strength in science and technology.

<sup>10</sup> <https://www.uktech.news/climate-tech/ukri-aquaculture-fund-20240517>

<sup>11</sup> <https://iuk-business-connect.org.uk/opportunities/knowledge-transfer-partnership-ktp-2026-2027-round-1/>

<sup>12</sup> <https://www.ukri.org/wp-content/uploads/2026/01/UKRI-220126-ISCF-FinalImpactEvaluation.pdf>

<sup>13</sup> <https://www.ukri.org/what-we-do/browse-our-areas-of-investment-and-support/local-innovation-partnerships-fund/>

<sup>14</sup> <https://www.ukri.org/what-we-do/browse-our-areas-of-investment-and-support/local-innovation-partnerships-fund/>

## 2.9 The Natural Environment Research Council (NERC)

### 2.9.1 Description/role

The Natural Environment Research Council (NERC) plays a role in aquaculture, particularly through joint initiatives with BBSRC and other partners. NERC's focus is on supporting research that ensures the sustainability, health, and productivity of aquaculture systems. This includes funding research on various aspects of aquaculture, from genetics and health to environmental impacts and sustainable production practices<sup>15</sup>.

### 2.9.2 Funding to date

In general, NERC's funding has been through the UK Aquaculture Initiative with BBSRC as noted above.

## 2.10 The Biotechnology and Biological Sciences Research Council (BBSRC)

### 2.10.1 Description/role

The Biotechnology and Biological Sciences Research Council (BBSRC) plays a role in advancing the Scottish salmon aquaculture ecosystem, particularly through funding that targets fish health, environmental sustainability, and cross-sector collaboration.

Through its co-leadership of the UK Aquaculture Initiative with Natural Environment Research Council (NERC), BBSRC has funded interdisciplinary projects that bridge academic understanding with commercial application – focusing on health, welfare, feed innovation, and environmental resilience<sup>16</sup>. Investments in genomic programmes like AquaLeap<sup>17</sup> and the Prosperity Partnership with Mowi<sup>18</sup>, alongside disease resilience projects such as ROBUST SMOLT<sup>19</sup>, RIFE-SOS<sup>20</sup> and Genolice, as well as offshore farming research led by the Scottish Association for Marine Science (SAMS), have helped establish a robust research ecosystem linking leading universities with major producers.

Importantly, BBSRC mandates industry co-investment and knowledge exchange in all major grants, ensuring that funded salmon aquaculture research delivers both scientific excellence and tangible economic and social impact.

### 2.10.2 Funding to date

Since 2018, BBSRC has funded a range of salmon related aquaculture initiatives across the UK. However, establishing an exact total funding value is challenging, as many projects are delivered in collaboration with multiple partners, making individual BBSRC contributions difficult to isolate. Based on our compiled project database (see Section 3 for further detail), BBSRC has been involved in 61 salmon related innovation projects in Scotland since 2018. Some example projects are provided below:

Title	Partners	Project value	Focus
Prosperity Partnership: Chronic Disease Resilience in Farmed Salmon	Roslin Institute Mowi BBSRC	£8.5m	Chronic disease resilience in farmed salmon

<sup>15</sup><https://www.ukri.org/what-we-do/supporting-collaboration/supporting-collaboration-bbsrc/collaborative-programmes/uk-aquaculture-initiative/>

<sup>16</sup><https://www.ukri.org/what-we-do/supporting-collaboration/supporting-collaboration-bbsrc/collaborative-programmes/uk-aquaculture-initiative/>

<sup>17</sup> <https://www.exeter.ac.uk/research/saf/projects/arch/>

<sup>18</sup> <https://mowi.com/uk/blog/2025/02/03/much-improved-fish-health-and-biology-for-mowi-scotland-in-2024/>

<sup>19</sup> <https://www.exeter.ac.uk/research/saf/projects/arch/>

<sup>20</sup> <https://www.abdn.ac.uk/news/11101/>

Title	Partners	Project value	Focus
AquaLeap: Genetics and Breeding Innovation	Roslin Institute University of Exeter University of Stirling Hendrix Genetics Xelect SAIC	£1.5m	Genetic improvement of Atlantic salmon and other aquaculture species
ROBUST SMOLT	University of Stirling Roslin Institute University of Exeter University of Aberdeen Mowi Scotland Cooke Aquaculture BioMar PHARMAQ Salmon Scotland	£1m	Influence of freshwater rearing conditions on salmon robustness at sea
Risk Factors for Escalating Saprolegniosis Outbreaks in Salmon Farms (RIFE-SOS)	University of Aberdeen STIM SCOTLAND Scottish Sea Farms Pulcea Mowi Scotland Landcatch Natural Selection Grieg Seafood Hjaltdland Cooke Aquaculture SAIC BBSRC	£1.1m	Determining risk factors and conditions for outbreaks of saprolegniosis
Genolice Edinburgh University	University of Edinburgh SAIC Benchmark PLC BBSRC	£1.1m	Functional genetics and genome editing to enhance disease resistance to sea lice in farmed salmon

## 2.11 Aquaculture Research Collaborative Hub UK (ARCH-UK)

### 2.11.1 Description/role

ARCH-UK was established to strengthen the UK's capacity for sustainable aquaculture through high quality, interdisciplinary research and strategic collaboration. Jointly led by BBSRC and NERC, the initiative was launched in response to declining research council investment and growing sectoral demand for innovation<sup>21</sup>. It was a partnership between four universities; the University of Stirling (Lead Research Organisation), Swansea University, the University of Aberdeen and the University of Exeter.<sup>22</sup>

### 2.11.2 Funding to date

ARCH-UK was established in 2017, ending in 2022, with a £650,000 research grant from BBSRC and NERC to build a national aquaculture research network<sup>23</sup>. While it does not issue grants itself, instead, it serves as a strategic coordination platform by:

- coordinating joint initiatives with BBSRC, NERC and SAIC
- supporting large-scale projects like AquaLeap, ROBUST SMOLT and Environment Offshore, all of which involve Scottish institutions and salmon producers

<sup>21</sup><https://www.ukri.org/what-we-do/browse-our-areas-of-investment-and-support/aquaculture-research-collaborative-hub-uk-arch-uk/>

<sup>22</sup><https://www.exeter.ac.uk/research/saf/projects/arch/>

<sup>23</sup><https://www.ukri.org/what-we-do/browse-our-areas-of-investment-and-support/aquaculture-research-collaborative-hub-uk-arch-uk/>

## 2.12 Innovate UK (IUK)

### 2.12.1 Description/role

Innovate UK (IUK) supports technology driven innovation, automation, and sustainability solutions that can be scaled across the UK aquaculture sector. Its aquaculture portfolio includes multiple salmon focused projects, particularly in:

- automation and AI-driven feeding systems
- environmental monitoring and modelling
- disease prevention and welfare technologies

### 2.12.2 Funding to date

Similar to BBSRC, establishing an exact total funding value is challenging, as many projects are delivered in collaboration with multiple partners. As well as delivering KTPs and funding via the Transforming Food Production initiative (no longer in existence), Innovate UK also funds networks to improve regulation in emerging sectors through its Regulatory Science and Innovation Networks (RS&IN) as part of a £4.7m initiative<sup>24</sup>. Additionally, it funds aquaculture projects through its business-led innovation programmes.

Examples of projects funded to date are shown in the table below:

Project	Project value	Innovate UK contribution	Partners	Focus
Regulatory Science and Innovation Networks	Unknown	£471,000 (RS&IN)	Esox Biologics Bakkafrost Scotland Scottish Sea Farms University of Glasgow Aquatic Vets Ltd	Whole-genome metagenomics to detect all microorganisms in salmon samples, improving disease prevention and ecological monitoring
Improving Medicinal Treatment Outcomes in Atlantic Salmon Farming	Unknown	£189,878 (KTP)	Pulcea University of Stirling	To increase the efficacy of existing medicinal treatments used to control sea lice in salmon aquaculture by integrating acoustic technologies with traditional chemical bath treatments
Pulcea – Acoustic Sea Lice Treatment		£198,573 (via Marine Fund Scotland with Innovate UK collaboration)		Non-invasive treatment for salmon with gill disease using sound waves

IUK's salmon related funding complements broader UK Research and Innovation (UKRI) efforts, including BBSRC's Sustainable Aquaculture Partnerships.

<sup>24</sup> <https://www.ukri.org/news/eleven-regulatory-science-and-innovation-networks-announced/>

## 2.13 Seafood Innovation Fund (SIF)

### 2.13.1 Description/role

The Seafood Innovation Fund (SIF), administered by Cefas (Centre for Environment, Fisheries and Aquaculture Science), was a UK Government-backed research and development programme that launched in July 2019 and ran until March 2025. It formed part of the UK Seafood Fund under the Science and Innovation pillar, with a total budget of £10m<sup>25</sup>. It closed for open calls for applications in late 2024.

Several SIF funded projects have direct relevance to Scottish salmon aquaculture, which span feasibility studies and full R&D grants, with individual awards ranging from £50,000 to £250,000<sup>26</sup>. Many salmon related innovations focus on feed sustainability, parasite control and environmental remediation.

### 2.13.2 Funding to date

A breakdown of selected salmon focused projects from the Seafood Innovation Fund project archive is highlighted below<sup>27</sup>:

Project	SIF funding	Focus
Lipophagy in Atlantic Salmon	£199,985	Investigating lipid metabolism for healthier salmon diets
Continuous Flow Acoustic Sea-Lice Treatment (CFAST)	£250,000 (est.)	Non-invasive lice treatment using sound waves
Hemp By-Products in Salmon Feed	£54,000 (feasibility) £332,525 (follow-on)	Exploring UK-sourced hemp protein as a sustainable feed alternative
Wellfish	£101,749 (feasibility) £448,428 (follow-on)	Study using biomarkers for fish health and diagnostic screening purposes
VSI Pen stage testing	£777,500	Test of VSI (voluntary swim in) at a pen stage on big fish and operational considerations
Micro Jellyfish	£60,230 (feasibility) £510,903 (follow-on)	Using lab reared jelly fish to assess the damage they cause to fish gills
Tritonia	£167,020 (feasibility with SAIC) £502,129 (follow-on)	Develop and validate reliable, cost-effective techniques to improve underwater navigational accuracy and enable the semi-autonomous operation of ROVs to produce 3D models of seabed
Offshore Salmon	£431,608	Inflatable marine products for aquaculture containment technology

<sup>25</sup> <https://www.cefas.co.uk/impact/programmes/seafood-innovation-fund/>

<sup>26</sup> <https://www.fishfarmingexpert.com/aquaculture-saic-seafood-innovation-fund/aquaculture-innovators-offered-thousands/1154640#:~:text=Aquaculture%20projects%20that%20have%20already,caases%20has%20received%20%C2%A3250%2C000.>

<sup>27</sup> <https://www.seafoodinnovation.fund/projects/>

## 2.14 Horizon Europe

### 2.14.1 Description/role

Horizon Europe funds Scottish aquaculture projects through several specific funding streams within the Horizon Europe programme. These funds are not Scotland specific, Scottish organisations access them by applying as part of an EU-wide consortia.

### 2.14.2 Funding to date

Horizon Europe is built around three interconnected pillars that together support the full pathway from scientific discovery to market ready innovation:

- Pillar I – Excellent Science, which strengthens Europe's research base through frontier research, researcher mobility, and world-class research infrastructures
- Pillar II – Global Challenges and European Industrial Competitiveness, which funds large collaborative projects addressing society's biggest challenges, such as climate change, food systems, biodiversity, health, and digital technology through six thematic clusters and the EU Missions
- Pillar III – Innovative Europe, which accelerates breakthrough innovation and scale-ups via the European Innovation Council, European Innovation Ecosystems, and the European Institute of Innovation and Technology (EIT) (described in more detail in section 2.15)

## 2.15 European Institute of Innovation and Technology – Food (EIT Food)

### 2.15.1 Description/role

The European Institute of Innovation and Technology Food (EIT Food) sustainable aquaculture competition was launched in December 2020 to strengthen the innovation portfolio of its 2021-2023 Business Plan and to expand its partner community, in what is the fastest growing form of food production. The fund aims to:

- accelerate technological and sustainable solutions in aquaculture
- promote circular systems across the supply chain
- support commercialisation of innovations that improve seafood safety, quality and sustainability

### 2.15.2 Funding to date

EIT Food offers two main funding streams<sup>28</sup>:

- collaborative missions – up to €1m per project per year
- single projects – commercial projects: up to €1m, with 70% cost reimbursement; non-commercial projects: up to €100,000 for 18 months

An example includes:

Project	Project value	Partners	Focus
BREEZE	£1.2m	Aqua Pharma Group has formed a consortium with Pulcea Ltd, Norwegian University of Science and Technology, and University of Stirling	A revolutionary and environmentally friendly concept for fish health management, under development in response to the needs of salmon farming for new approaches and effective methods to improve the management of sea lice

<sup>28</sup> <https://transition-pathways.europa.eu/agri-food/programmes/all-eit-food-projects>

## 2.16 European Institute of Innovation and Technology – Digital (EIT Digital)

### 2.16.1 Description/role

While most aquaculture related activity in the EIT ecosystem comes from EIT Food, EIT Digital has supported digital aquaculture solutions such as data platforms, AI, and IoT for salmon farms.

### 2.16.2 Funding to date

EIT Digital does provide funding, but not through a single, standalone grant scheme. Instead, it allocates financial support through targeted calls and programmes designed to back start-ups, scale-ups, and innovation consortia. Through its Open Innovation Factory, EIT Digital specifically supports the development and scaling of breakthrough digital technologies by offering financial co-investment to help bring these innovations to market<sup>29</sup>.

One example of aquaculture funded projects includes:

Project	Funding	Partners	Focus
Aquaculture Insights	£987,981	Uhuru Corporation Softbank Signify SAIC Aqua Pharma Ace Aquatec	Creation of a digital, open, single point of access data platform for the sector

## 2.17 FHF Norway (the Norwegian Seafood Research Fund)

### 2.17.1 Description/role

FHF is Norway's industry funded R&D body for seafood, financed through a 0.3% levy on Norwegian seafood exports and owned by Norway's Ministry of Trade, Industry and Fisheries. Its mission is to fund R&D that benefits the whole seafood sector, including aquaculture. While primarily aimed at supporting innovation/application in Norway, the learning is being translated back to Scotland.

### 2.17.2 Funding to date

FHF funds major R&D projects in Norway on:

- fish health
- environmental documentation
- cleaner fish
- welfare and disease control

These topics closely match Scottish aquaculture challenges, meaning Scottish research bodies and companies often mirror, adopt, or collaborate on FHF funded innovations, even when funding is not directly transferred to Scotland. This is indirect influence through knowledge sharing.

<sup>29</sup> <https://www.frontiersin.org/journals/aquaculture/articles/10.3389/faqc.2023.1239402/full>

## 2.18 Summary

Overall, Scotland's aquaculture innovation landscape is supported by a broad and diverse mix of funders, each contributing to different parts of the research and commercialisation pipeline. Since 2018, major public bodies including BBSRC, NERC, SAIC, MFS, IUK, UKRI and SIF have invested significantly in improving fish health, environmental sustainability, genetics, welfare and technological innovation. Many funding streams now require strong industry-academic collaboration, ensuring research delivers practical impact for the sector. While this investment has driven substantial progress, the landscape remains fragmented, with short-term funding cycles and gaps in large-scale trial infrastructure. Strengthening coordination, ensuring longer-term support, and improving the transition from early stage research to commercial deployment will be essential to maximise future innovation and maintain Scotland's global leadership in sustainable aquaculture.

### 3 Project Baseline Overview

The information in this section brings together project data sourced from SAIC, supported by desk-based research and interviews with industry, academic, and funding stakeholders. It covers salmon related innovation and R&D with a public funding component dating back to 2018. Projects funded directly by companies have been excluded due to commercial sensitivity.

Up until the end of 2025, there have been **286 projects totalling £183,698,756, with 156 academic partners, 47 funders and 158 industry partners**. Top academic partners include the University of Stirling, Aberdeen, Edinburgh and the Highlands and Islands as well as the Scottish Association for Marine Science.

Top funders include:

- SAIC
- BBSRC
- Marine Fund Scotland
- Seafood Innovation Fund
- NERC
- Innovate UK

Top industry partners include:

- Mowi Scotland (producer)
- Scottish Sea Farms (producer)
- Bakkafrost Scotland (producer)
- BioMar (supply chain)
- Cooke Aquaculture (producer)

Research focus broken down by theme and funding (projects can cross multiple themes):

Project Focus	Number	Project value <sup>30</sup>
Infrastructure	35	£52,051,110
Fish health/welfare – practices/vaccine development	86	£51,765,253
Sea lice management inc. cleaner fish	42	£35,986,210
Fish feed alternatives	14	£17,739,998
Genetics/genome editing/RNA sequencing	26	£17,680,844
Environmental monitoring – fresh water and marine	45	£17,292,573
Energy	8	£17,019,244
Circular economy	11	£15,392,584
Gill health monitoring/management	29	£11,954,453
Digital data	18	£5,675,581
Benthic monitoring/impact	14	£4,684,504
Nutrition	7	£4,450,768

Project outcomes aligned to funding included:

Potential/actual outcomes	Number	Project value
Fish health/welfare	123	£83,851,960
Environmental/sustainability	67	£51,791,326
New/improved products/processes/services	49	£43,095,449
Productivity/efficiencies/cost savings etc.	49	£38,316,264
New/improved infrastructure/equipment	31	£36,864,952
New/expanded markets	8	£14,604,752
Knowledge/skills development	31	£9,347,277
Developed AI/digital solution(s)	19	£7,167,839
Regulatory compliance/policy	14	£7,079,307
Health and safety	3	£2,304,218
Human nutrition	6	£2,103,889

<sup>30</sup> Includes a range of funding sources

## 4 Researcher Findings

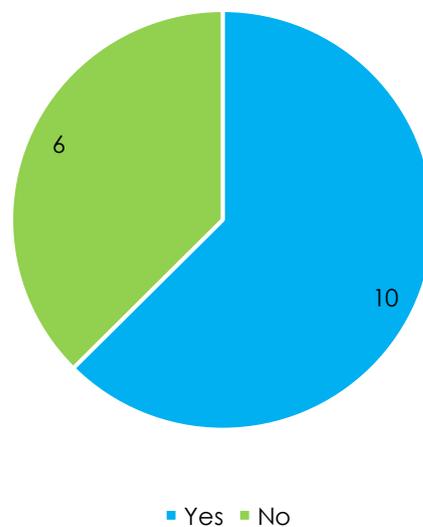
We interviewed 19 academic researchers from 11 academic institutions; a breakdown is provided in Appendix 2. The 'n=' states how many researchers responded to a particular question.

Nearly half (8) of those who responded (19) said the 'majority' of their research involves industry partners. The remaining responses indicated that all of their research does (6) or only some of it does (5). When asked about changes since 2018, 12 provided a response, six indicated that industry involvement in their research had increased, while another six reported that it had remained the same.

### 4.1 Project delivery

Among those with industry partners, the majority (10) indicated that their industrial partners have commercialised research outputs from aquaculture innovation projects. Just over one third (6) said outputs have not been commercialised.

**Figure 4.1: Industrial partners commercialising research outputs**

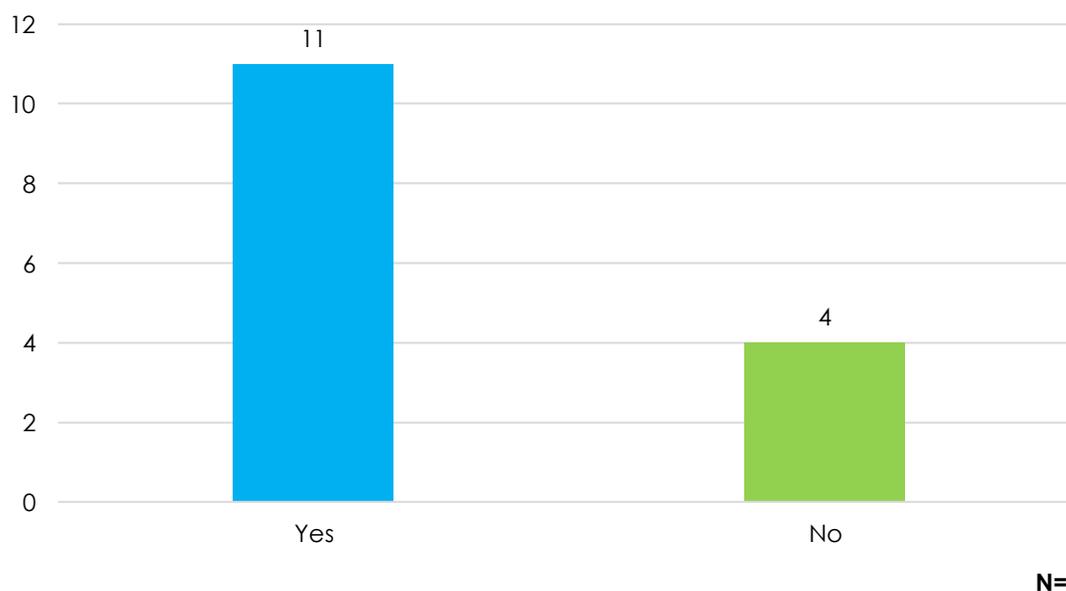


**N=16**

Further detail on commercialisation by researchers included descriptions of a range of commercialisation readiness outputs together with other benefits for Scotland, such as the transferable application of technology developed across the wider sector.

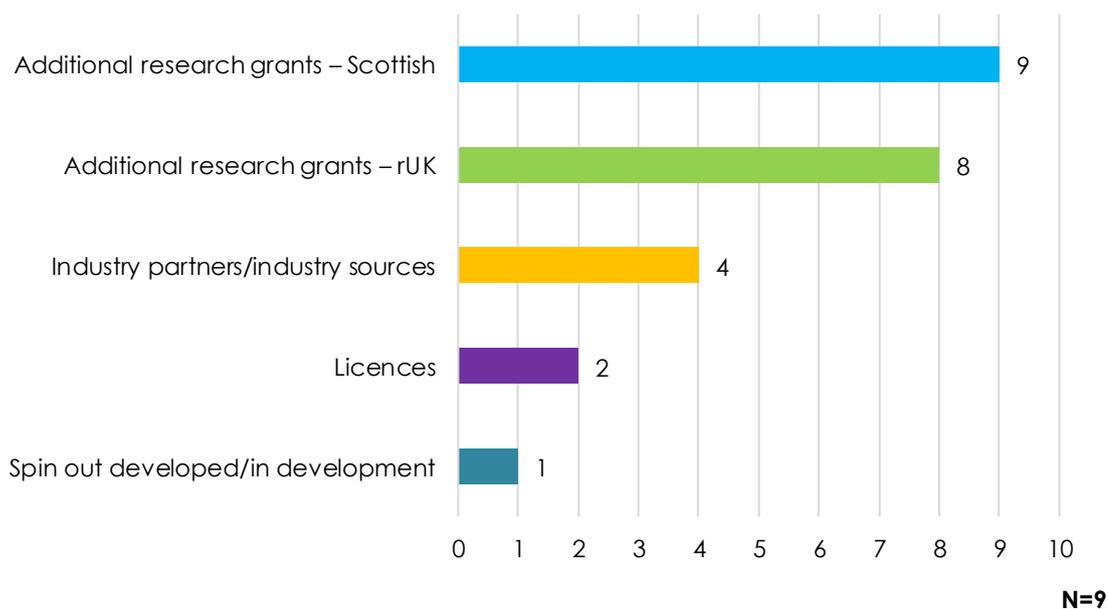
Almost three quarters (11) of researchers reported that their institution or research partners had received monetary gains from the commercialisation of aquaculture innovation projects. A smaller proportion (4) indicated they were not aware of any such financial benefits.

**Figure 4.2: Awareness of monetary gains for institution or research partners**



Monetary gains identified were most commonly in the form of additional research grants from Scotland (9) and the rest of the UK (8). Figure 4.3 presents the full findings.

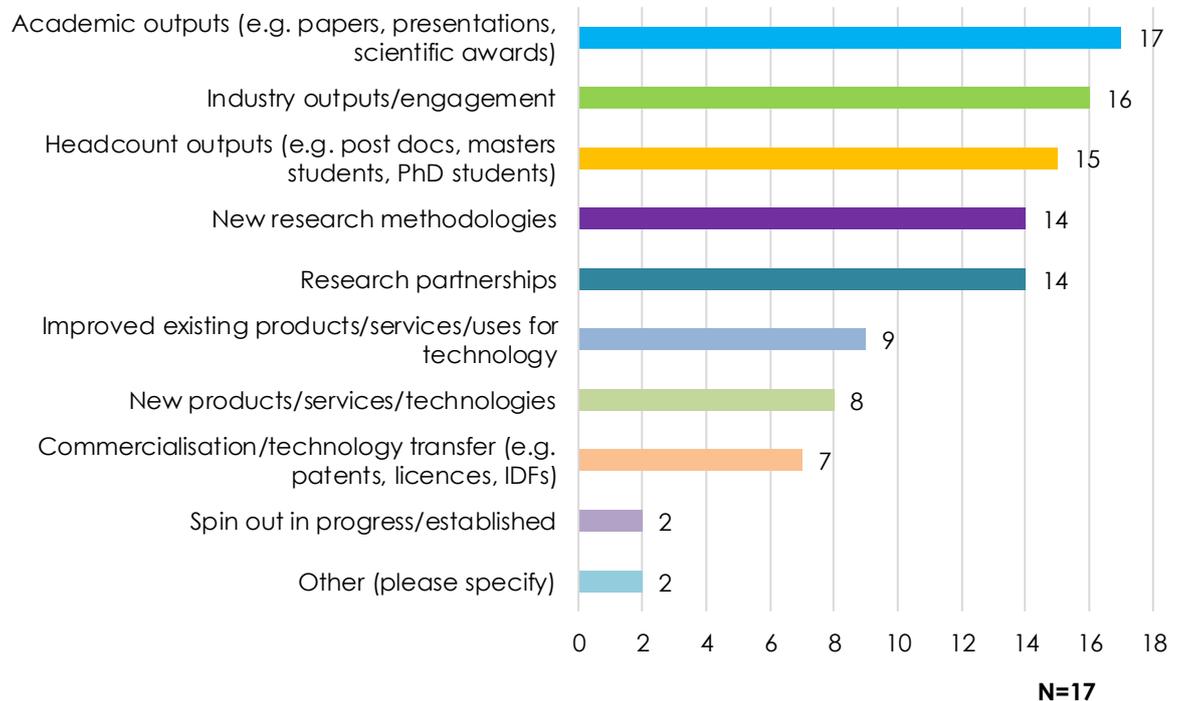
**Figure 4.3: Additional income**



## 4.2 Benefits and outcomes for researchers

Interest and involvement in applied research have resulted in a range of outputs. The most frequently reported were academic outputs (17), followed closely by industry outputs and engagement (16). Headcount related outcomes, such as new positions or roles, were noted by 15 researchers. Additionally, 14 researchers highlighted the development of new research methodologies and the formation of research partnerships. Figure 4.4 presents the full findings.

**Figure 4.4: Research benefits**

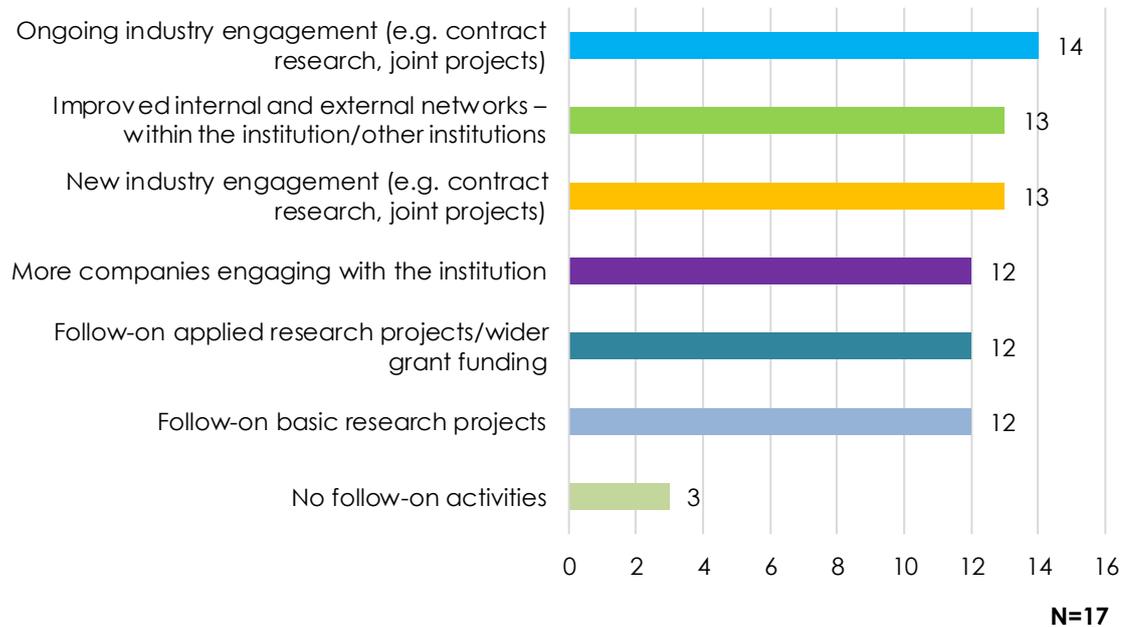


Further detail on benefits achieved was provided by 10 researchers with benefits focusing on environmental, operational and commercial domains. Key achievements included the development of innovative products such as ExPAND 1 and 2, which aim to reduce waste in fish farms and improve ocean health, alongside projects like MeioMetBar and BactMetBar that streamline sample processing and reduce resource demands. These advances, coupled with pending regulatory approvals, promise substantial cost savings for aquaculture operations.

Additionally, researchers describe how involvement in the research projects has strengthened regulatory knowledge, enhanced collaboration, and expanded research capacity through PhD training and tools like Salmon Sim, which have proven valuable for workforce development. Further, initiatives such as the PKD Network have fostered international collaboration to improve disease management, understand climate related risks, and advance vaccine development. Collectively, these outcomes demonstrate a strong alignment between environmental stewardship, commercial viability and knowledge transfer, reinforcing the sector's resilience and sustainability.

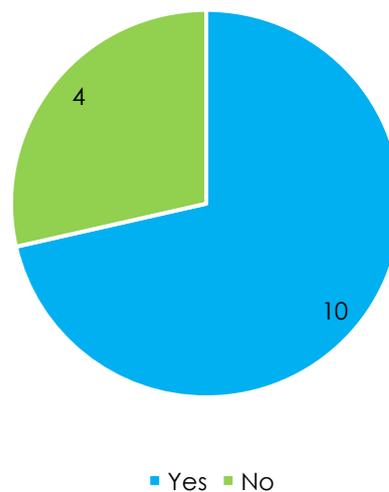
Researchers noted a range of follow-on activities resulting from the funded research projects. The most common were ongoing industry engagement (14), followed by improved internal and external networks – within the institution/other institutions (13), and new industry engagement (13). Only three researchers noted no follow-on activity.

**Figure 4.5: Follow-on activities**



Out of 14 researchers, **almost three quarters (10) stated that member(s) of their research team have moved on to work in industry in Scotland.**

**Figure 4.6: Members of research team(s) moved on to work in industry in Scotland**

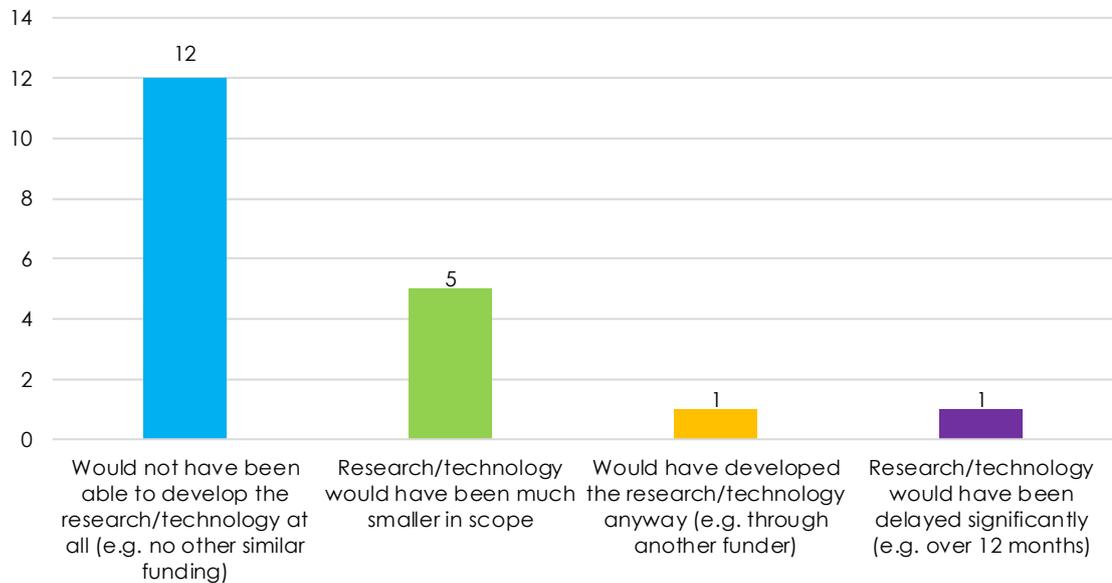


**N=14**

### 4.3 Funding additionality

**Additionality of the funding is very high**, with the majority of researchers stating they would not have been able to develop the research/technology at all if it was not for the funding. Only one researcher commented they would have developed it anyway. Figure 4.7 represents the findings.

**Figure 4.7: Additionality of funding<sup>31</sup>**



**N=13**

<sup>31</sup> More than one option could be selected

## 5 Company Findings

### 5.1 Background

We interviewed 29 companies operating within the Scottish salmon aquaculture ecosystem of which 25 were undertaking some form of innovation activity in Scotland. A full breakdown is provided in Appendix 2. The 'n=' states how many companies responded to a particular question.

These companies span key sectors such as aquaculture production, health and diagnostics, technology and equipment, feed and nutrition, processing and distribution, and genetics and breeding services. They have an average operating history of around 20 years, with some established as recently as two years ago and others trading for over 60 years.

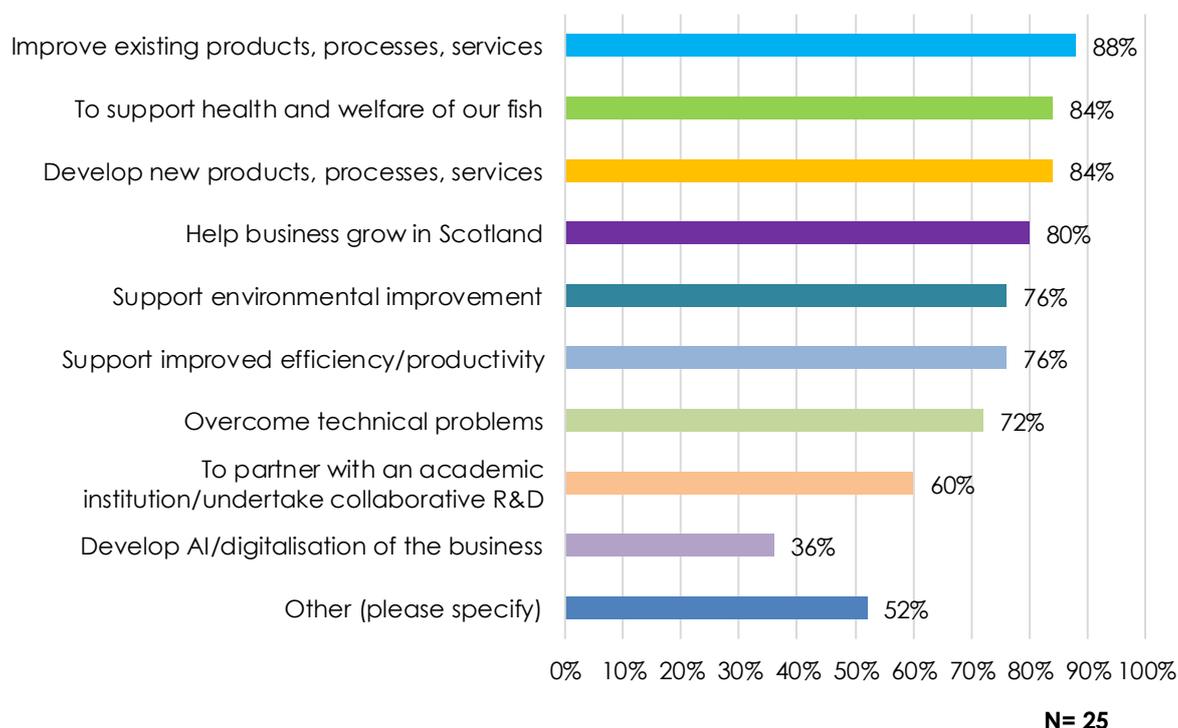
### 5.2 Company research, development and innovation activity

Reasons for companies undertaking research and innovation activities in Scotland included:

- to improve existing products, processes and services (88%, 22)
- to support health and welfare of our fish (84%, 21)
- to develop new products, processes, services (84%, 21)
- to help the business grow in Scotland (80%, 20)

A full breakdown is provided in Figure 5.1.

**Figure 5.1: Main objectives in undertaking research/innovation activities in Scotland**



Other objectives included:

- adapting products and solutions for the Scottish market
- to support the wider supply chain
- to solve Scottish industry problems

Sources of finance used to support research and innovation activities included:

- company linked finance – e.g. Scottish or overseas (85%, 22)
- public sector finance – e.g. grant support (Scottish, rUK, outside rUK) (81%, 21)
- in-kind contribution – staff time, equipment, materials (50%, 13)
- private sector finance (27%, 7)

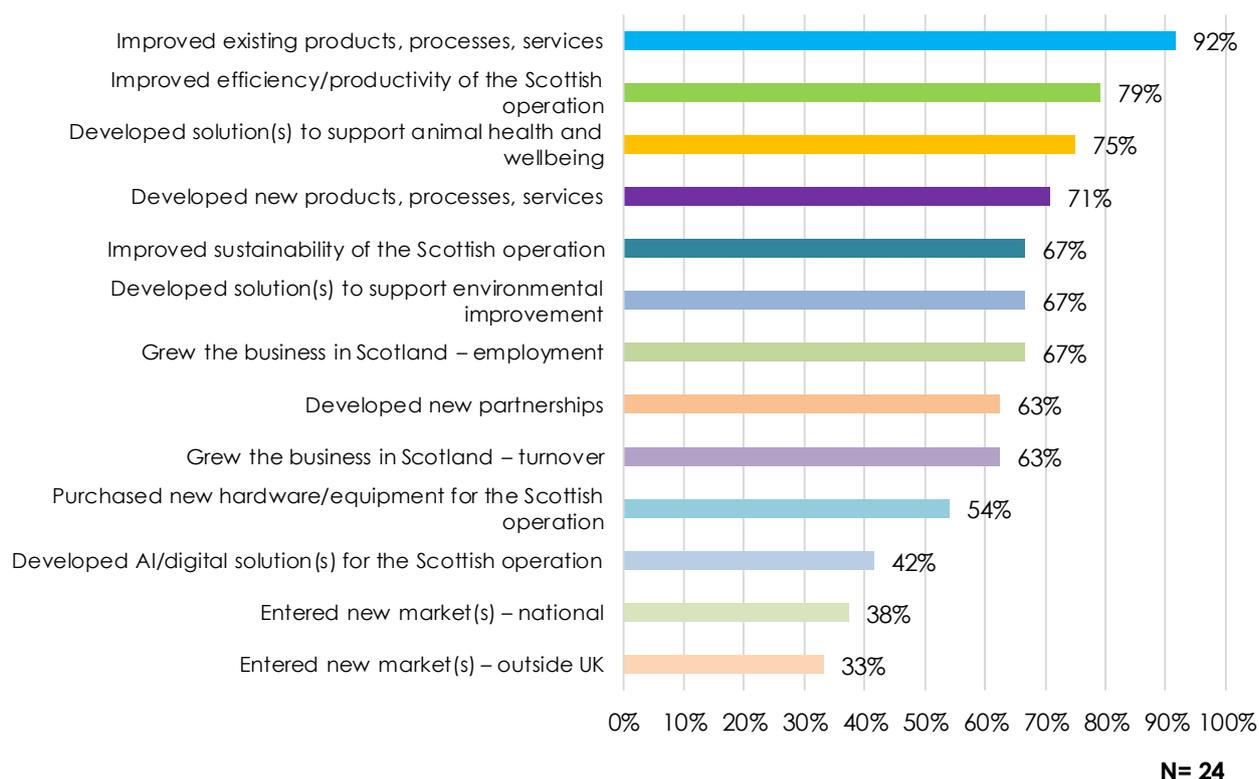
### 5.3 Company benefits from research, development and innovation activity

Companies reported a variety of benefits from research and innovation activities undertaken, with the most common being:

- improved existing products, processes, services (92%, 22)
- improved efficiency/productivity of the Scottish operation (79%, 19)
- developed solution(s) to support animal health and wellbeing (75%, 18)
- developed new products, processes, services (71%, 17)

Other common gains included environmental improvement (67%), as well as improved sustainability (67%). Growth in Scottish operations was evident through increased employment (67%) and turnover (63%), alongside new partnerships (63%) and investments in hardware (54%). Digital and AI solutions were developed by 42% of businesses, while market expansion occurred nationally (38%) and internationally (33%).

**Figure 5.2: Outputs/outcomes of the research/innovation activities**



Direct examples from the companies include:

**New/improved products, services, and processes:**

- **genetic disease resistance** – development of Cardiomyopathy Syndrome (CMS) resistance genetic markers initially worked on in Norway, aiming to integrate into UK products for improved disease resistance
- **robust smolt testing** – introduced a test to determine fish readiness for seawater transfer, providing insights into fish health, immunology, and optimal vaccination timing
- **sustainable mortality management** – developed more efficient and sustainable methods for removing dead fish, with potential for creating new products

#### Efficiency/productivity improvements:

- **farmer-focused enhancements**
  - better fish health insights allow farmers to make informed decisions on when to transfer fish to sea, improving outcomes
  - faster testing methods that provide more comprehensive information compared to single-pathogen tests
  - reduced time for processes, improved worming of larvae, positively impacting production
- **automation and technology** – implemented fish retrieval automation, hydrolicer improvements, optical weighing systems, remote feeding, and optical wound analysis for better operational efficiency
- **fish performance** – achieved better Specific Growth Rate (SGR) and Feed Conversion Ratio (FCR), leading to improved overall fish performance

#### Animal health/wellbeing:

- **feeding optimisation** – pellet detection and software improvements have enhanced feeding practices, leading to better growth and healthier fish
- **disease resistance** – development of an immersion challenge model and identification of genetic markers enable selective breeding for fish with higher resistance to *Flavobacterium psychrophilum*, reducing antibiotic use and improving overall health and welfare
- **welfare improvement** – initiatives designed to enhance the wellbeing of farmed salmon through improved husbandry practices and welfare-focused standards, including research using lab reared jellyfish to assess the damage they cause to fish gills
- **early detection** – through real time modelling, monitoring and prediction models such as HAB Alerts for Scottish Finfish Aquaculture

#### Sustainability improvements:

- **energy and water efficiency** – adoption of electricity-based systems and reduced water usage to lower environmental impact
- **carbon reduction** – conversion of boiler systems to heat pumps and replacement of kerosene with sustainable alternatives
- **feed sustainability** – next generation proteins and trimmings projects aimed at reducing the environmental footprint of feed raw materials

#### Medicinal treatments:

- **biological lice control** – using cleaner fish to remove lice reducing chemical treatments and lowering environmental impact
- **environmental modelling** – projects like NamaQui, EXPAND, and NewDEPOMOD enhancing understanding and management of environmental impacts
- **better feeding practices** – optimised feeding to reduce waste and improve sustainability

#### Environmental improvements:

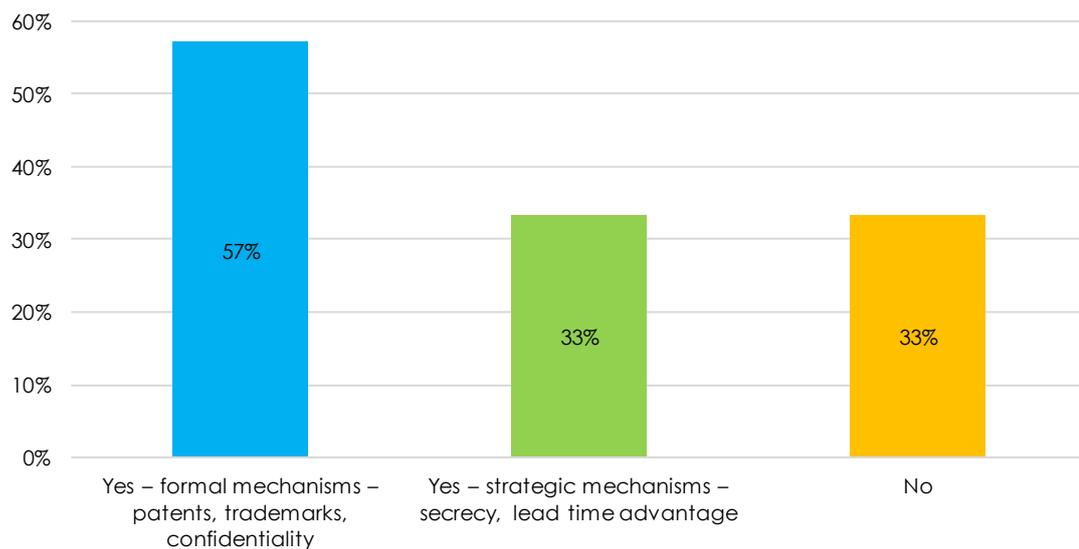
- **biological lice control** – using cleaner fish to remove lice reducing chemical treatments and lowering environmental impact
- **environmental modelling** – projects like NamaQui, ExPAND, NewDEPOMOD, BactMetBar, eDNA, and freshwater production modelling are enhancing understanding and management of environmental impacts
- **better feeding practices** – optimised feeding to reduce waste and improve sustainability
- **environmental monitoring** – through Tritonia photometry to measure how environmental conditions (light levels, water quality, stimuli) affect fish behaviour and physiology

#### Hardware/equipment:

- **energy efficient infrastructure** – new building with heat pumps and upgraded equipment to reduce energy use
- **production enhancements** – installation of a gantry crane and updated software systems for improved data storage and workflow

Two thirds (67%, 14) of companies responding had protected intellectual property associated with the outputs of research/innovation activity with 57% (12) through formal mechanisms and 33% (7) through strategic mechanisms.

**Figure 5.3: Protected intellectual property associated with the outputs of research/innovation activity**

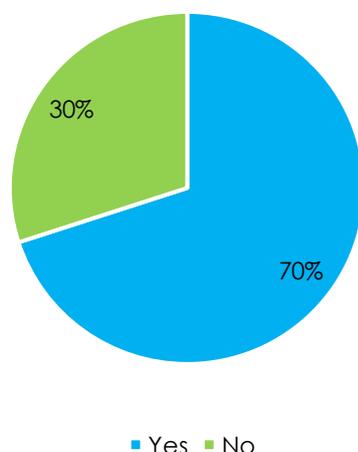


**N=21**

## 5.4 Impacts from research, development and innovation including grant funding

Over two thirds (70%, 14) of companies claimed R&D tax relief in the UK, while 30% (6) did not. The majority claim every year or most years while some only claim when eligible or have stopped claiming due to low spend or administrative burden.

**Figure 5.4: Claiming R&D tax relief**



**N=20**

Twelve companies provided us with their current R&D spend; this ranged from £30,000 – £18,200,000 with the average annual being £2,613,923.

The majority (69%, 11) reported an increase in R&D spend since 2018, three said it remained the same, two indicated a decrease.

When looking to the future, 13 companies provided us with R&D spend estimates showing growth over the next five years reaching an average annual spend of **£4,236,154** by 2030. Table 5.1 summarises the findings.

**Table 5.1: Current and future annual R&D spend**

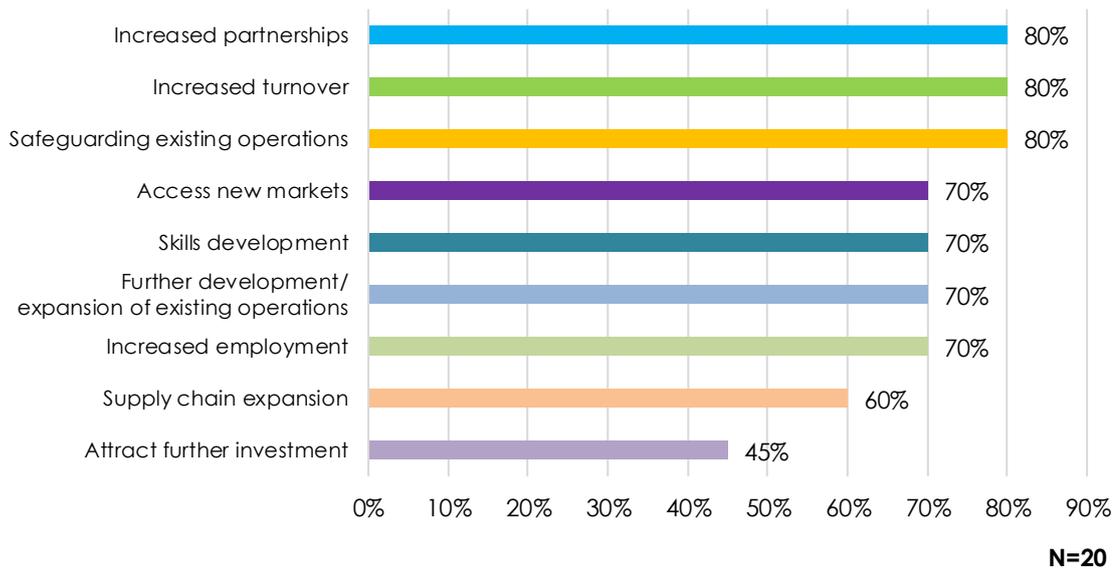
	Current (2025)	Next year (2026)	3 years from now (2028)	5 years from now (2030)
No. of companies	12	12	13	13
Lowest R&D spend	£30,000	£30,000	£30,000	£30,000
Highest R&D spend	£18,200,000	£18,000,000	£20,000,000	£22,000,000
<b>Average</b>	<b>£2,613,923</b>	<b>£3,456,667</b>	<b>£3,658,077</b>	<b>£4,236,154</b>

As a result of this future R&D spend, companies anticipated a range of impacts on their Scottish operations, with the most common being:

- increased partnerships (80%, 16)
- increased turnover (80%, 16)
- safeguarding existing operations (80%, 16)

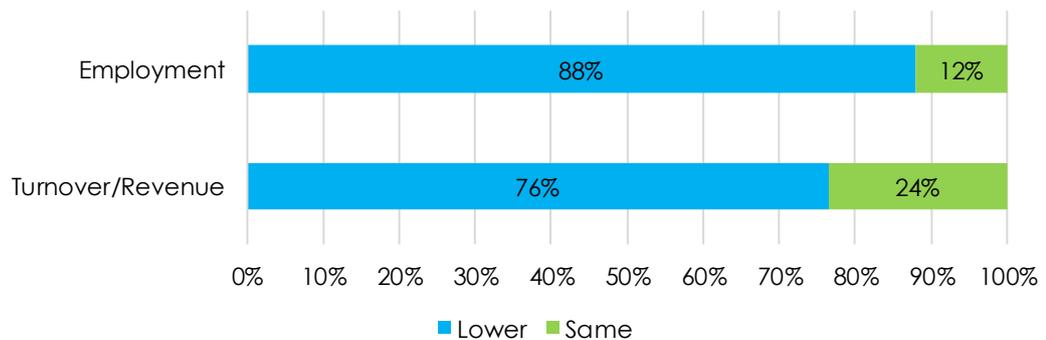
A further 70% (14) indicated priorities such as expanding operations, accessing new markets, developing skills, and increasing employment, while 60% (12) focused on supply chain expansion and 45% (9) on attracting further investment.

**Figure 5.5: Impact of future R&D spend**



Over half (58%, 17), of companies provided employment and/or turnover information to demonstrate the impact of undertaking aquaculture research/innovation activity in Scotland. 88% (14) indicated that their employment levels would have been lower without undertaking research and innovation, and 76% (13) said their turnover would have been lower. Figure 5.6 summarises the findings.

**Figure 5.6: Impact on employment and turnover**



**N=16-17**

Comments included:

*“Business has grown and we have taken on more people. Looking to open a subsidiary lab in Scotland in the future.”*

*“The company wouldn't be in existence without the innovation to the machinery.”*

*“Some of the value chain initiatives that were started a long time ago will have value now. Staff members hired.”*

*“We have seen business growth and turnover increases since 2018 which have been made possible by all the incremental improvements in fish performance, survival, treatment, and expansion of farming into new exposed locations.”*

## 6 Qualitative Feedback on the Aquaculture Innovation and Research Landscape in Scotland

### 6.1 Strengths of the aquaculture research landscape in Scotland

Public innovators (academics and funders) and companies were asked what works well across the aquaculture research landscape in Scotland. Public innovators focused on strengths relating to impactful research outputs e.g. vaccine development and AI detection systems as well as opportunities for gaining broader scientific collaboration. Companies focused on the practical benefits of collaboration, with value also placed on the sharing of best practice, opportunities for networking and the support provided for newer businesses.

Common strengths identified across both public innovators and company groups were:

- **strong networking and collaboration** – with SAIC seen as a central hub for connecting industry and academia, fostering open communication and cross-sector collaboration. It was acknowledged the small size of the Scottish sector makes it easier to build relationships and share knowledge
- **industry-academic partnerships** – in particular multi-partner projects and consortia are praised for addressing non-competitive challenges like fish health, husbandry, and recirculating aquaculture systems (RAS). There was a strong sense that universities and research groups contribute expertise and maintain strong ties with industry
- **shared vision for sustainability** – both public funders and companies emphasise high standards for fish health and welfare and a collective goal to make aquaculture sustainable. There is also a sense of pride in the Scottish salmon sector and commitment to producing healthy protein sources
- **funding mechanisms** – SAIC's funding calls and ability to leverage UK-wide resources are valued by both groups. Funding was generally seen as accessible with companies appreciating funding support as practical and outcome oriented

*"The collaborative nature works well, how companies, academia and SAIC can work together with strong voice including Salmon Scotland. It's beginning to put Scotland on the map as a serious producer of fish."*

*"Helps bring the right people together, we are quite closely linked, quite a small market place, feels more like a family in Scotland. We are competitors on a day-to-day basis, but we come together to try and solve industry problems – the gill health project is a true example of this."*

*"Open communication, collaboration across sectors – with regulators, producers etc. SAIC have been instrumental at being the heart of that network, act as a neutral focal point."*

*"Funding mechanisms which explicitly link R&D institutions with Scottish aquaculture related firms with the intended outcome to resolve challenges specific to Scottish production. Such programmes have the greatest beneficial impact on the Scottish aquaculture sector."*

## 6.2 Challenges and areas for improvement for the aquaculture research landscape in Scotland

When public innovators and industry representatives were consulted, several recurring themes emerged regarding the challenges facing the research landscape. These were:

- **funding constraints and fragmentation** – both groups identified insufficient and fragmented funding streams as challenging together with the lack of continuity and difficulty accessing large-scale, strategic funding. Companies felt there were gaps in funding for scaling innovations beyond pilot phases and lack of capital expenditure support for R&D infrastructure
- **regulatory barriers** – slow regulatory processes were seen to hinder innovation and trials. Both public funder and companies report challenges in obtaining licenses and permissions, which delays projects and increases costs
- **infrastructure limitations** – including a lack of trial facilities and pilot scale R&D infrastructure in Scotland were seen to force reliance on overseas facilities (e.g. Norway), creating bottlenecks and slowing progress
- **collaboration and alignment issues** – while collaboration was also seen as a strength, there are tensions around priorities particularly about which TRL levels to pursue. Both public innovators and companies felt SAIC has provided a coordinating role in bridging such tensions; concerns were raised if this role might be lost with SAIC's future uncertain
- **skills and workforce shortage** – there was some shared concern about a lack of researchers and skilled workers in areas like data science, engineering and fish health

*"Main barriers are lack of funding or where the academic sector is competing over small pots of money, so it is difficult to make major headway in developing applied solutions."*

*"To undertake a trial is super expensive and it can be challenging to get support to do so, we have to go elsewhere."*

*"Research licensing can be a problem as we must go through NatureScot as some of the marine life is EU protected. They are more conservative than Marine Scotland who license things like wind farms. For one project we couldn't get licenses in the area we needed to do the research so the data was not as good as it could have been."*

*"If you want to do anything the regulation hoops are very tough/high – the regulators say no which hampers progress and lets other countries lead the way."*

Suggestions for **improvements** to the aquaculture innovation and research landscape in Scotland included:

- developing a strategic, long-term and joined up funding model with tiered support for early stage and applied research
- ensuring coordination mechanisms to align priorities and maintain trust between academia and industry
- simplification of regulatory processes to enable timely trials and innovation adoption
- investment in R&D infrastructure to reduce reliance on overseas facilities
- promoting skills development programmes and academic-industry exchange opportunities
- improving the way scientific evidence is communicated to the public and local communities together with recognition of the wider environmental impacts of aquaculture and how to improve social licence

### 6.3 The need for continued support and funding for collaborative R&D

There is strong agreement that continued support and funding for collaborative research in Scottish aquaculture is essential for sustainability, innovation and competitiveness. Both public innovators and companies advocate for strategic, long-term funding models, stronger collaboration and cross-sector engagement. There is an apparent need for support at basic science levels through to applied research.

*"It's crucial and we need more support and research and more funding for both basic and applied research."*

*"Funding is very stop start – the follow-on projects that have higher TRL focus – stop the 'fall off the cliff' approach."*

*"It is essential for the challenges. We desperately need this as industry challenges are coming thick and fast."*

*"We haven't had the resources to figure out what funding could be available to us. Just now it's too costly for us to do in Scotland on our own."*

Both public innovators and companies describe Scotland's future funding landscape as tight, uncertain and increasingly competitive across public and private funding support avenues. It was suggested that the Norwegian FHF model (levy-based funding for R&D) could be an approach Scotland could take, as well as a research farm concept where licenses are provided for commercial R&D activity. Both suggestions are aimed at making the future research landscape easier to navigate and access.

## 7 Conclusions

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Since 2018, Scotland's salmon aquaculture sector has undergone a significant period of innovation, characterised by high levels of investment, deep collaboration between industry and academia, and a rapidly diversifying research and development landscape. The evidence presented throughout this report indicates a sector that is dynamic, ambitious, and which considers itself to be globally significant, delivering advances that improve sustainability, fish health, productivity, and environmental performance at increasing scale. Notable features of the aquaculture innovation landscape in Scotland since 2018 include:

- **an expanding and diversifying innovation ecosystem** – with 286 publicly supported R&D and innovation projects delivered representing more than £184m in investment and involving 156 academic partners, 158 industry partners and 47 funding bodies
- **ambitious science and technology advancements** – innovation has flourished across every major challenge area for salmon aquaculture. Significant volumes of research funding have been leveraged to support:
  - fish health and welfare – the most heavily invested area, with 86 projects worth over £51m
  - sea lice management – 42 projects (£36m) spanning biological control, novel treatments, acoustic systems, and AI-enabled detection
  - genetics and breeding – including major investments such as the £8.5m Mowi–Roslin Prosperity Partnership and the multi-partner AquaLeap programme, strengthening Scotland's leadership in genomic innovation
  - environmental monitoring and modelling – including the NewDEPOMOD regulatory modelling programme and cutting-edge eDNA approaches to seabed health assessment
  - sustainability – including renewable energy, digitalisation, circular economy solutions, alternate fish meal ingredients and infrastructure modernisation demonstrating the sector's multidimensional innovation capability
- **strong and productive industry** – industry-academic collaboration which has increased over time. Outputs have included commercialisation of research, new products, services and intellectual property. A range of benefits have also been realised including new methodologies, partnerships, spin outs and workforce development. The R&D activity has strengthened Scotland's research capacity and future talent and project pipeline
- **measurable industry impact** – innovation activity has delivered clear economic and operational benefits for Scottish aquaculture including:
  - efficiency and productivity improvements – reported by nearly 80% of companies supported by advances in feeding systems, diagnostics and automation
  - sustainability gains – reported by two thirds of companies which included reduced environmental impact, enhanced waste management, lower carbon use and cleaner fish solutions
  - growth outcomes – including increased employment and turnover attributed to innovation projects
- **a shared vision for the future** – both industry and public innovators express strong agreement that continued investment in collaborative innovation is essential to meet fast evolving challenges, particularly around climate resilience, regulation, and sustainability. There is appetite for more strategic, coordinated, long-term funding, improved regulatory pathways, and increased infrastructure and skills development to support the next phase of growth. This will ensure innovation is not a peripheral activity but remains central to the sector's competitiveness, resilience and economic contribution

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## Appendix 1 – Case Studies



### Case Study: WellFish Diagnostics – Revolutionising Salmon Health Monitoring

Born out of research at the University of the West of Scotland, WellFish Diagnostics (now known as WellFish Tech) exemplifies how academic expertise can deliver real world impact. The company was a spin out to address a critical challenge in the Scottish salmon industry: traditional health diagnostics relied on lethal sampling, limiting proactive management and compromising fish welfare.

Leveraging cutting-edge science and a range of funding avenues (SAIC, Scottish Enterprise, Seafood Innovation Fund, Marine Fund), WellFish developed a non-lethal, blood-based fish health assessment platform powered by AI analytics. This innovation enables rapid, accurate health assessments, transforming how salmon health is monitored. The spin out journey began with grant funding including a study funded by the UK Seafood Innovation Fund and supported by SAIC, alongside partners including Bakkafrost Scotland, Vertebrate Antibodies, and the University of Aberdeen. Support from Scottish Enterprise and subsequent Knowledge Transfer Partnerships accelerated AI capabilities, paving the way for commercialisation.

With £1.2m in seed funding, WellFish established a state-of-the-art laboratory in Paisley and launched routine blood sampling for salmon farmers. The impact is improved welfare, operational efficiency, and data driven decision making. Now undertaking global expansion having expanded into Norway and Canada, and embracing predictive analytics, WellFish demonstrates how academic spin outs can lead the way in sustainable aquaculture innovation.



### Case Study: Transforming Aquaculture Regulation through NewDEPOMOD

Over an eight-year period, the NewDEPOMOD technology (developed in close collaboration with SEPA, Salmon Scotland and various salmon farming companies) transformed Scotland's aquaculture regulatory framework by delivering a scientifically robust model for predicting seabed impacts from fish farms. Its primary goal was to provide regulators with an accurate, transparent, and open-source tool to underpin licensing decisions and environmental compliance.

The work attracted significant investment, between 2017 and 2020, NewDEPOMOD secured £2.7m in research and commercial income. Its final phase, the ExPAND project (completed in 2024), was worth £394,557, funded jointly by SAIC (40%), industry (30%), and academia (30%). This investment enabled advanced development, large-scale validation, and regulator training and led to ExPAND 2 (£622,449).

Today, NewDEPOMOD is integrated into Scotland's regulatory processes, enabling evidence-based environmental impact assessments and adaptive management strategies. This case exemplifies how sustained collaboration between research institutions, regulators, and industry, backed by public and private funding, can deliver tools that strengthen governance and promote sustainable aquaculture.

*"Development of NewDEPOMOD has established a strong and collaborative network across all sectors involved in salmon aquaculture, which enables communication and working together to ensure sustainability and science-basis in salmon farming and regulation".*

**Helena Reinardy, Senior Lecturer and Teaching Fellow, SAMS**

## TINY FISH Case Study: Tiny Fish – Small Project, Big Impact

In Scottish salmon hatcheries, the smallest juvenile fish, often culled during grading, traditionally end up out with the animal food chain being utilised as AD feed stock, limiting their use for human consumption. This practice raised sustainability concerns and represented a lost economic opportunity.

The Tiny Fish initiative, developed in partnership with all the Scottish salmon producers and supported by Ace Aquatec, introduced an electrical stunning method that humanely harvests small salmon without chemical residues. This breakthrough makes these fish safe for human consumption and suitable for value-added products.

Tiny Fish received Marine Fund Scotland support, covering half of its £237,000 equipment costs (approx. £118,500) for primary processing. A Scottish Government grant later funded additional processing equipment for product diversification.

The project converts small fish into premium food, pet treats and feedstock, creates new income streams for hatcheries and processors, supports Scotland's circular economy goals, and has gained global recognition as a finalist in the Responsible Aquaculture Innovation Awards.

This small, funded project demonstrates how targeted innovation can deliver major sustainability and economic benefits in aquaculture.

*"It is amazing to see how the Scottish salmon industry with companies like Mowi, Scottish Sea Farms and Landcatch have teamed up with the rest of the supply chain to make Tiny Fish a reality. We now routinely collect, harvest, process, pack and distribute tiny salmon. I hope that other production countries such as Norway and Chile could follow our lead because this is a great initiative for animal welfare and zero waste. In our world, every fish counts".*

**Jarl van den Berg, Co-Founder**



## Case Study: eDNA Laboratory for SEPA Compliance in Scottish Aquaculture

Scottish aquaculture is under increasing regulatory pressure to ensure environmental sustainability, with SEPA requiring strict seabed health monitoring around finfish farms. Traditional methods such as benthic sampling and IQI analysis, while effective, are slow and costly. To address this, Ocean Ecology established Scotland's first commercial marine eDNA laboratory in 2023 at the European Marine Science Park near Oban, introducing a modern, data driven approach to compliance monitoring.

The initiative focuses on using eDNA metabarcoding to assess seabed health, meeting SEPA standards while reducing turnaround times and costs. The facility combines advanced eDNA extraction and purification systems, metabarcoding protocols for species identification, and rapid data pipelines for reporting. Supported by funding from Highlands and Islands Enterprise and partnerships with Tritonia Scientific, the project delivers faster, more accurate biodiversity assessments, reduces reliance on traditional sampling, and enhances early detection of ecosystem stressors. This innovation sets a new benchmark for sustainable aquaculture compliance and is paving the way for future applications in offshore renewables and marine biodiversity projects.



### Case Study: Multi Partner – RIFE-SOS project

This was a landmark initiative aimed at tackling *Saprolegnia*, a water oomycetes responsible for major losses of salmon eggs and juveniles. With a £1.1m budget, the project brought together a large and diverse group of partners from across the aquaculture sector. Over its 36-month duration, the consortium united eight leading salmon farming companies; Benchmark, Grieg, Mowi, Scottish Sea Farms, Landcatch, Cooke Aquaculture, Europharma, and Pulcea, and has continued with a RIFE2 project driving forward key findings from the original project into practical solutions on farm. With academic expertise from the University of Aberdeen (lead) and the University of Glasgow, this collaboration was further strengthened by funding and oversight from SAIC and BBSRC LINK, alongside stakeholder support from RSPCA and SSPO.

The scale of the partnership enabled the development of a comprehensive big data resource combining fish, pathogen, and environmental variables. Together, the team identified key risk factors for disease susceptibility and created predictive models and best practice guidance to prevent outbreaks. By pooling resources and expertise across industry, academia, and NGOs, RIFE-SOS set new standards for collaborative disease management in salmon farming, reducing environmental and economic losses and serving as a model for global aquaculture health innovation.



### Case Study: Genomic Disease Resistance in Atlantic Salmon

The **Genomic Disease Resistance Project**, an £8.5m collaboration between **Mowi Scotland** and the **Roslin Institute**, is one of Scotland's most significant aquaculture genetics initiatives. Funded primarily by **BBSRC (UKRI)** with industry contributions, this five-year programme aims to improve the health and resilience of farmed Atlantic salmon through advanced genomic technologies.

The project focuses on identifying genetic markers linked to disease resistance, particularly for conditions affecting gill and heart health. By integrating large-scale genomic sequencing with phenotypic data, researchers are developing predictive breeding strategies that enable Mowi to select salmon strains with enhanced robustness. This approach reduces reliance on antibiotics and medicinal treatments, supporting Scotland's sustainability and regulatory goals.

The impact is substantial: the project strengthens compliance with health standards, minimises losses from disease outbreaks, and positions Scotland as a global leader in precision aquaculture breeding. Ultimately, it demonstrates how science-industry partnerships can drive innovation to meet environmental and regulatory challenges while improving production efficiency.



## Case Study: Hemp by-products as a protein source for Scottish salmon

Scotland's salmon sector is reducing its dependence on imported soy and fishmeal by exploring UK-grown hempseed by-products as a sustainable, lower carbon and nutrient rich alternative for aquafeed. The project brings together Rare Earth Global as lead producer, the University of Stirling's Institute of Aquaculture for scientific assessment, SAIC for co-funding support, SalmoSim for digestibility testing, and later Mowi alongside farming partners in Angus and Aberdeenshire to conduct commercial scale feed development. An initial £54,035 feasibility phase showed that hemp offers high digestibility, favourable nutritional quality and protein levels of up to 50%, along with environmental benefits such as fast growth, low water requirements and strong CO<sub>2</sub> sequestration.

A further £332,525 funded an 18-month R&D phase evaluating long-term performance, welfare, gut health and feed efficiency at scale, confirming hemp as a commercially viable alternative protein ingredient. Salmon fed hemp-based diets demonstrated superior feed conversion ratios to soy protein concentrate while maintaining comparable growth, digestibility, welfare and fillet quality. The research also validated hemp's suitability for shrimp and supported the development of a UK supply chain for hemp protein concentrate, using a zero-waste model that utilises seeds for feed and stalks for construction and bioproducts. Together, the findings show strong potential for hemp to become a sustainable, lower carbon, domestically grown replacement for imported soy in aquafeeds.

*"This circular economy focused project represents the first step in determining the suitability of UK-produced hemp seed by-product as a protein source for the Scottish Atlantic salmon sector".*

**Sarah Riddle, Director of Innovation & Engagement, SAIC**

## Appendix 2 – Consultation List

### Public innovators (25)

1. University of Stirling (4)
2. Scottish Association for Marine Science (3)
3. University of Aberdeen (3)
4. University of Strathclyde (2)
5. Moredun Research Institute (1)
6. Scotland's Rural College (1)
7. University of Dundee (1)
8. University of Edinburgh (1)
9. University of Glasgow (1)
10. University of St Andrews (1)
11. University of the West of Scotland (1)
12. Highlands and Islands Enterprise (1)
13. Defence and Security Accelerator (1)
14. Biotechnology and Biological Sciences Research Council (1)
15. KTP Centres – North of Scotland, West of Scotland, East of Scotland (3)

### Company

- |                                |                   |
|--------------------------------|-------------------|
| 1. Ace Aquatec                 | Supply Chain      |
| 2. AKVA                        | Supply Chain      |
| 3. Aqua Pharma                 | Supply Chain      |
| 4. AquaByte                    | Supply Chain      |
| 5. AquaGen                     | Supply Chain      |
| 6. Aquascot                    | Supply Chain      |
| 7. Bakkafrost Scotland         | Producer          |
| 8. BioMar                      | Supply Chain/Feed |
| 9. Cooke Aquaculture           | Producer/ Feed    |
| 10. DFDS*                      | Supply Chain      |
| 11. Esox Biologics             | Supply Chain      |
| 12. Gael Force                 | Supply Chain      |
| 13. Garware Fibres*            | Supply Chain      |
| 14. Hendrix Genetics           | Producer          |
| 15. Inverlussa                 | Supply Chain      |
| 16. Loch Duart                 | Producer          |
| 17. Loch Long Salmon *         | Producer          |
| 18. Mowi                       | Producer/Feed     |
| 19. Otter Ferry Seafish        | Supply Chain      |
| 20. Patogen                    | Supply Chain      |
| 21. PHARMAQ                    | Supply Chain      |
| 22. Salar Pursuits Ltd         | Supply Chain      |
| 23. ScaleAQ*                   | Supply Chain      |
| 24. Scottish Sea Farms         | Producer          |
| 25. Underwater Contracting Ltd | Supply Chain      |
| 26. VESO                       | Supply Chain      |
| 27. Vonin                      | Supply Chain      |
| 28. WellFish Tech              | Supply Chain      |
| 29. Whiteshore Cockles         | Supply Chain      |
- (\*those not actively involved in innovation activity in Scotland)