Maximising the Value of Farmed Scottish Salmon By-products

Waste or the Future of Scottish Innovation?

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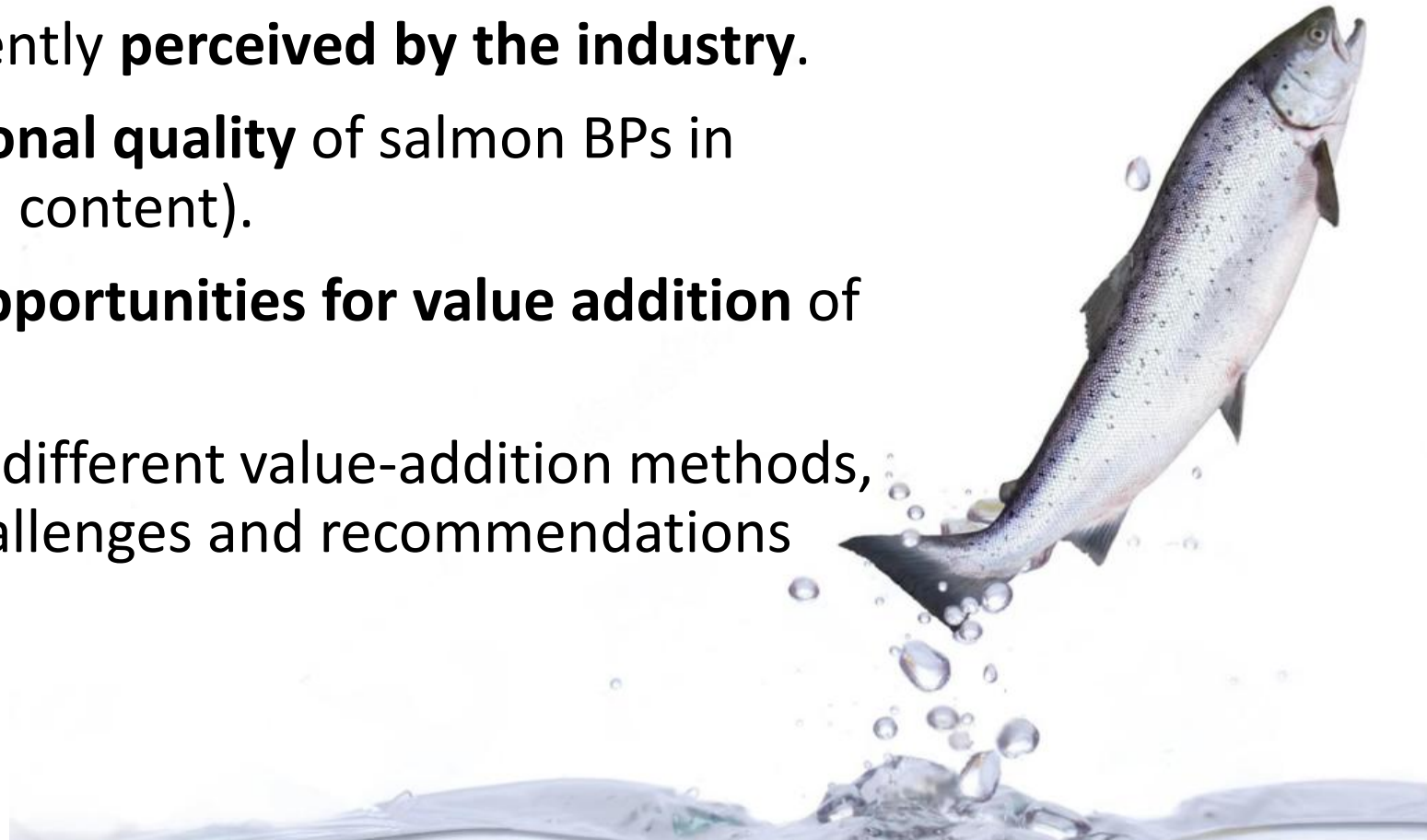
Key Objectives

1. Identify the **current status** of salmon aquaculture by-product (BP) streams in Scotland (type, quantity, use, value).
2. Identify how BPs are currently **perceived by the industry**.
3. Assess the current **nutritional quality** of salmon BPs in Scotland (particularly lipid content).
4. Identify and review **key opportunities for value addition** of salmonid BPs.
5. Examine the **feasibility** of different value-addition methods, identifying limitations, challenges and recommendations for future growth.

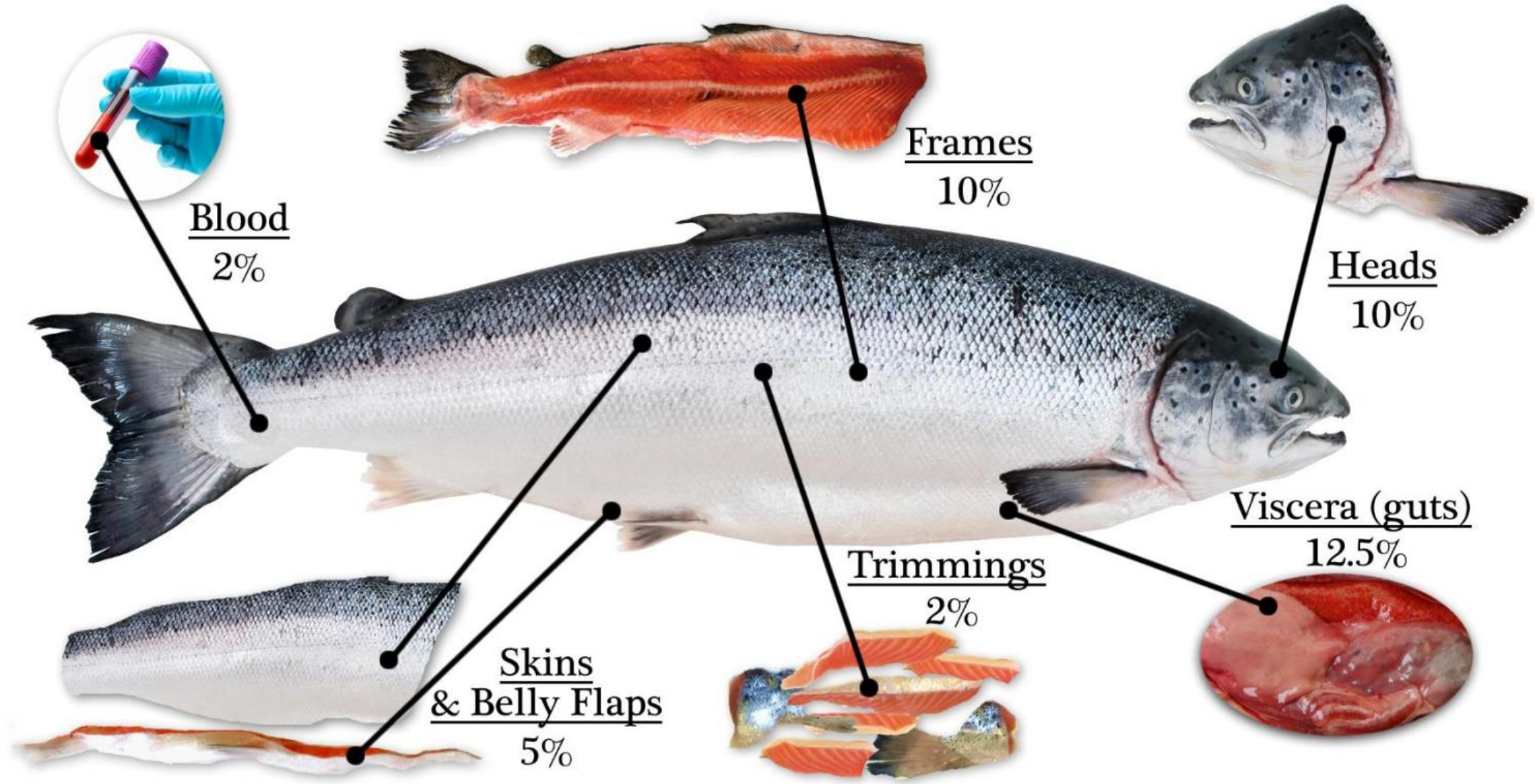


Mixed Method Approach

To achieve key objectives, I gathered both **quantitative** and **qualitative** data, from a broad range of sources.

1. Literature review – Scottish Industry, comparative review with other sectors.
2. Key informant (KI) interviews (with 21 informants).
3. Processor and facility surveys (with 14 processors and 4 facility participants).
4. Industry perception survey – UK Aquaculture Conference (with 74 participants).
5. Nutritional analysis of by-products (Lipid, Fatty Acid, Flesh yield, Protein)
6. Feasibility analysis of various utilisation methods (SWOT).

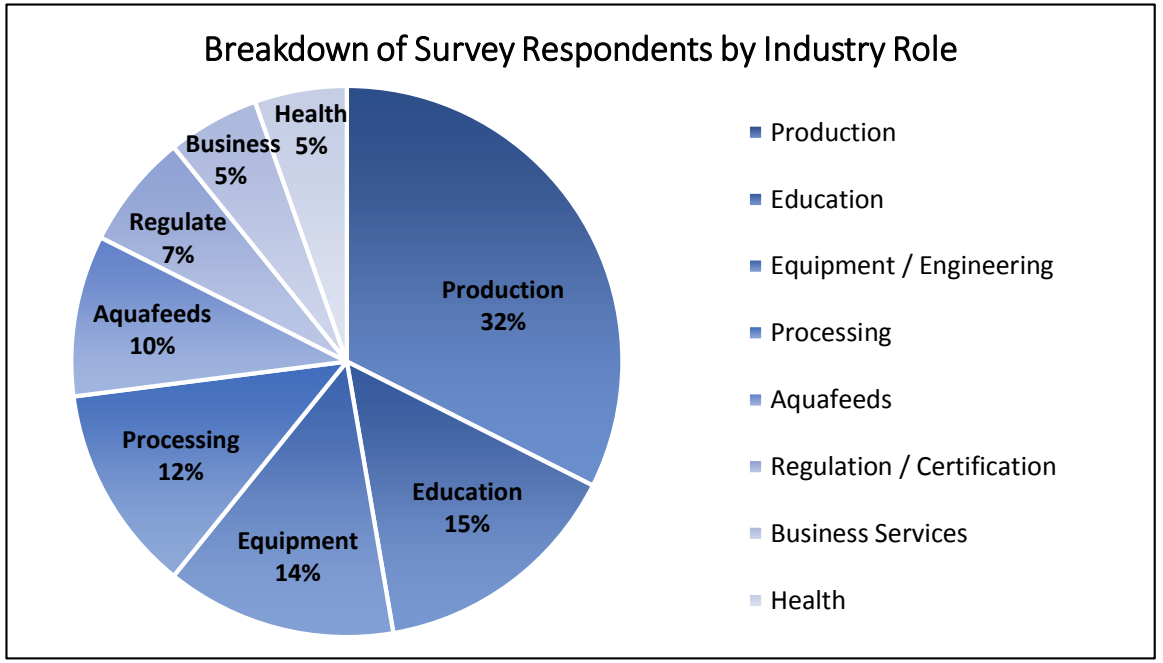
By-product: All the raw material, edible or inedible, left over following the preparation of the main product.



Atlantic Salmon By-product Fractions as a Percentage of the Total Wet Weight. Compiled from: FAO 2014; Rustad 2007; Liaset *et al*. 2003; Sandnes *et al*. 2003

Results: Industry Perception Survey

- Of the 74 survey respondents, 97% considered by-products to be an industry resource.
- 80% of respondents considered by-products as a way of making profits.
- Uncertainty to the actual value of by-products, and how they can be best ustilised.



N = 74

Salmonid By-Product Utilisation:

Globally there are four broad categories of utilisation:

1. **Food and food ingredients for human consumption.**
2. **Ingredients in Animal feed.**
3. **Specialty and niche products.**
4. **Bio-Fuel/fertiliser.**

Food and Food Ingredients

- Products for food service and catering industries.
- Ready made meals.
- Export products – fish heads, belly flaps.

Source: https://www.dairygoodness.ca

Source: http://chopinandmysaucepan.com

Source: http://wantanmien.com

Ingredients in Animal Feed

- Direct to pet food.
- Fish meal and fish oil.
- Hydrolysed protein concentrates.
- Functional amino acids and flavour additives.

Source: http://www.petco.com/

Source: http://saltyco.com/

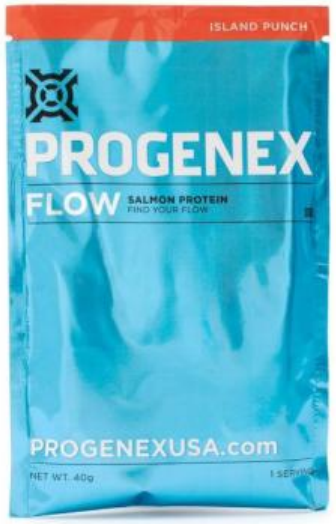
Photo courtesy of Alban Caratis

Specialty and Niche Products.

- Nutraceuticals
- Pharmaceuticals
- Cosmetics
- Various niche products

Source: http://thefishleather.co/

Source: http://organika.com/



Source: https://www.progenexusa.com

Source: http://www.salmonbrightbymuku.com/

Source: http://snack21treats.com/

Bio-Fuel and Fertiliser

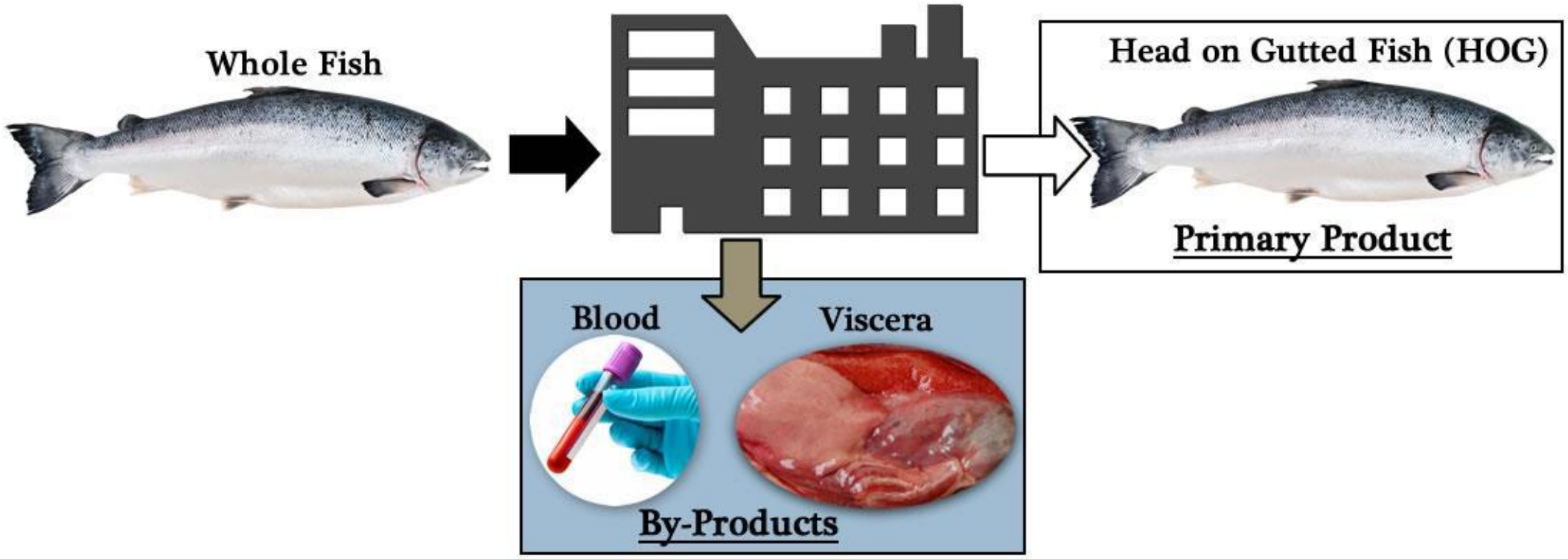
- Anaerobic digestion for bio-fuel production.
- By-products from AD can be used as fertilisers.

Source: http://www.constructionbusiness.ie/

“A responsible and sustainable use of fish resources, whether from capture fisheries or from aquaculture, foresees an efficient utilization of the whole fish including the use of the various by-products generated throughout the processing stage.”

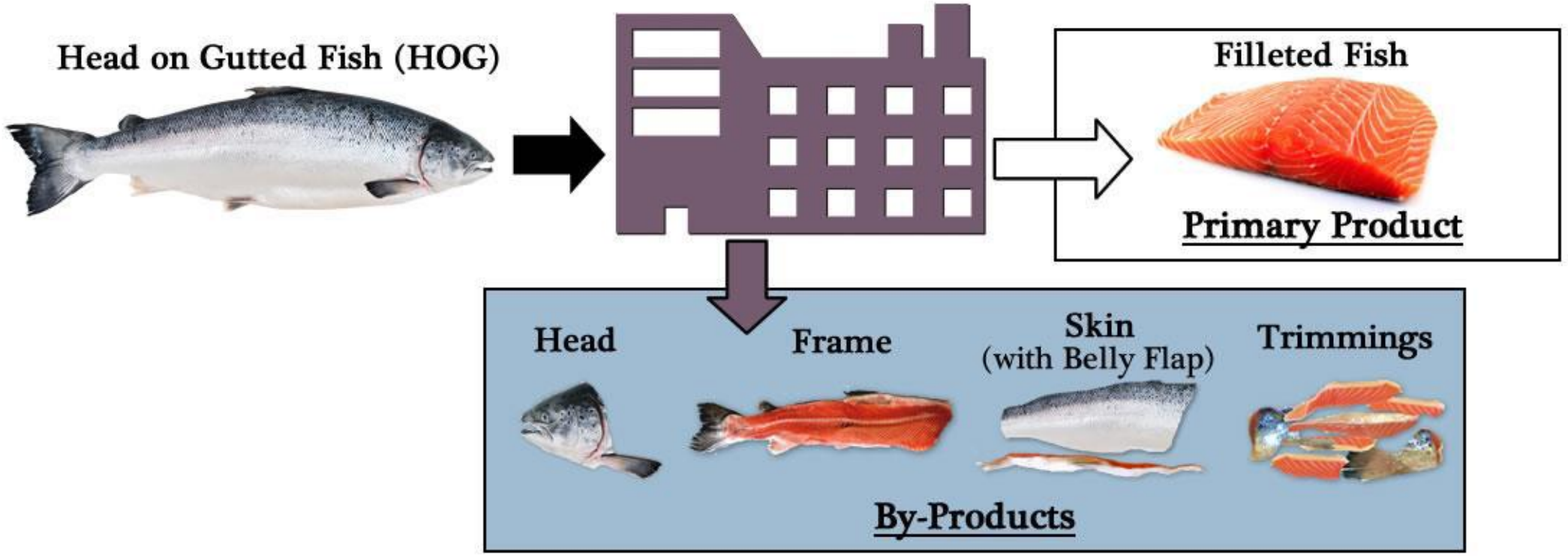
Ramirez, 2007 (FAO)

Primary Processor



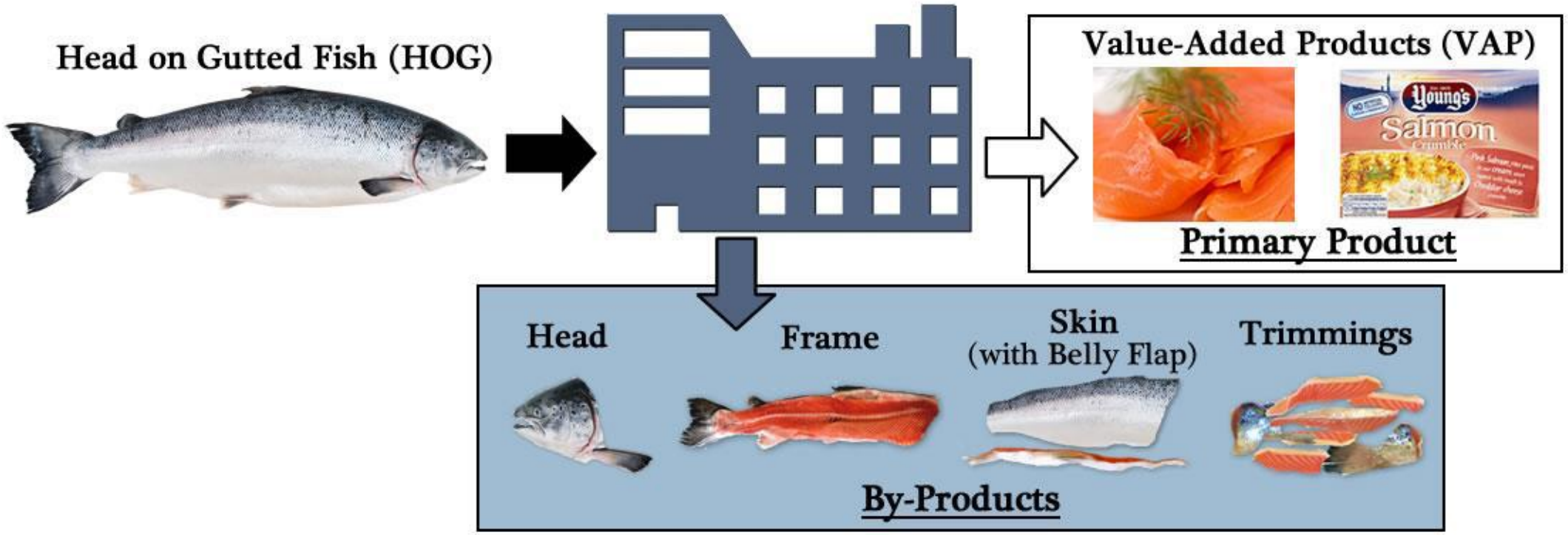
Primary Processor (PP): whole fish are gutted and packaged to produce head-on gutted (HOG) salmon and trout. In Scotland it is very often managed by producers, and generates two types of by-products: viscera (guts) and 'blood water.'

Secondary Processor



Secondary Processor: fillets are produced from HOG or whole fish. It generates: heads, frames, trimmings, belly-flaps, and skins.

Value-Added Product Processor



Value-Added Processor (VAP): creating value-added products and ready-made meals, such as hot or cold smoked products. VAP processing may generate the following by-products: heads, frames, trimmings, belly-flaps, skins, as well as smoked trimmings.

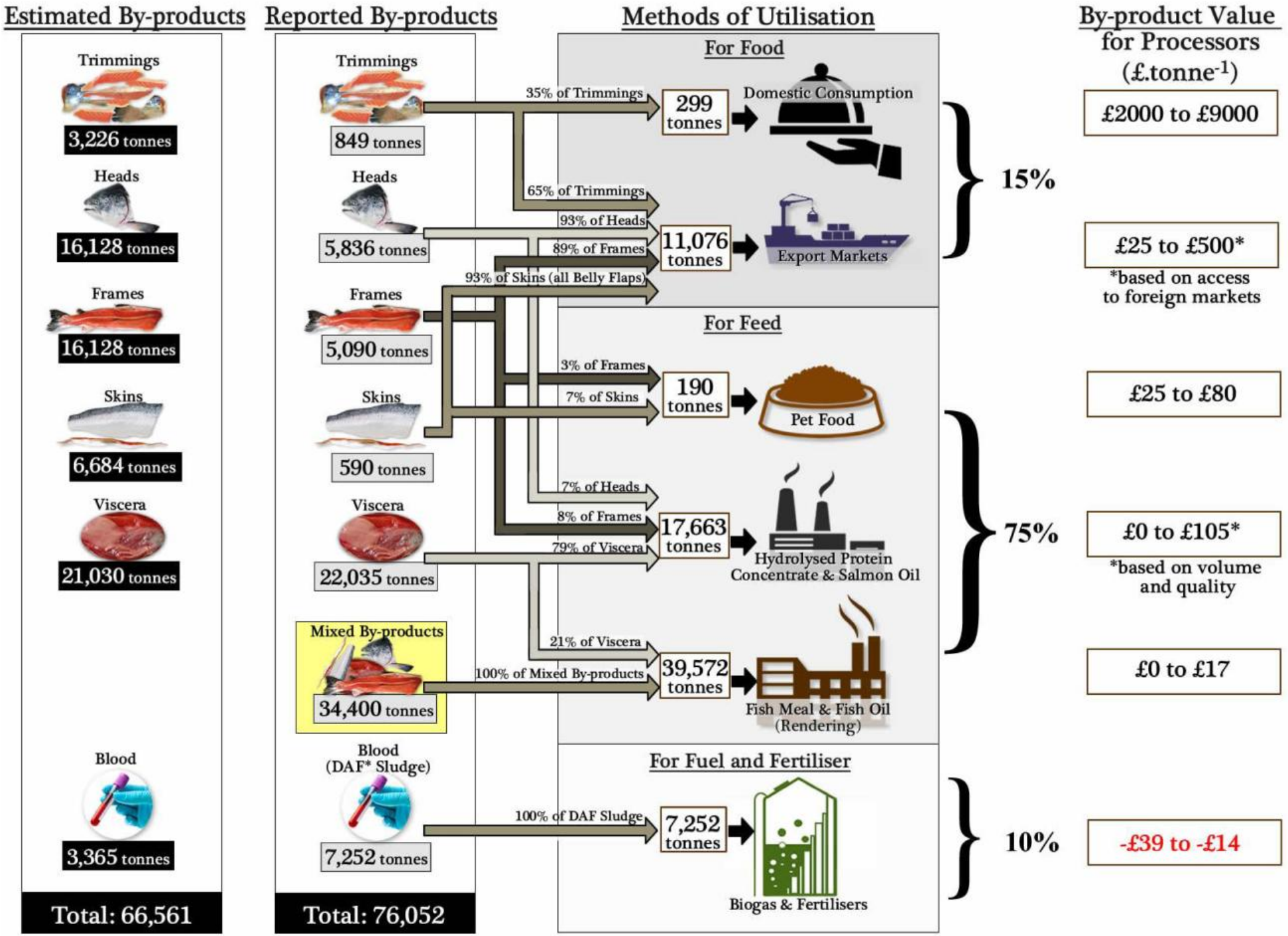
Processing Industry Participants

- The *Primary* and *Mixed Primary* processors who contributed data represent more than 99% (by volume) of the salmon primary processing in Scotland.

- The 5 *Value-Added Product* (*VAP*) and Mixed *VAP* processing company participants maintain contracts with most of the major supermarket chains in the UK.

Results: Scottish Processors 2016

Results: By-product Totals 2015



Results: Nutritional Analysis

- Confirm Scottish salmon BPs contain higher levels of Omega 3 fatty acids than those seen in fillets.
- EPA + DHA levels averaged **1.92 ± .47 g.100g^{-1}**.
- In comparison, Scottish Atlantic salmon fillets provided **1.36** g.100g^{-1} of EPA + DHA (Sprague *et al*. 2016).

	EPA g.100g^{-1}	DHA g.100g^{-1}	**Combined EPA+DHA**
Atlantic Salmon			
Heads	0.86	1.29	**2.15**
Frames	0.56	0.89	**1.45**
Belly Flaps	0.80	1.24	**2.04**
Trimmings	0.67	1.06	**1.73**
Viscera	0.88	1.37	**2.25**

Results: Nutritional Trend

- Processing facility data indicated a decreasing trend in the omega-3s found in salmon viscera; one processor noted a 50% reduction over 12 years.
- This finding is supported by a recent study which identified decreasing EPA+DHA levels (between 2006-2015) due to increasing use of vegetable oils in salmon diets.

SCIENTIFIC REPORTS

Impact of sustainable feeds on omega-3 long-chain fatty acid levels farmed Atlantic salmon, 2006–2015 M. Sprague,[a,1] J.R. Dick,[1] and D.R. Tocher[1]

- The decreasing levels of omega-3s in salmon BPs may impact their potential uses.

Source: http://www.bodybuilding.com/

Key Opportunities from SWOT Analysis

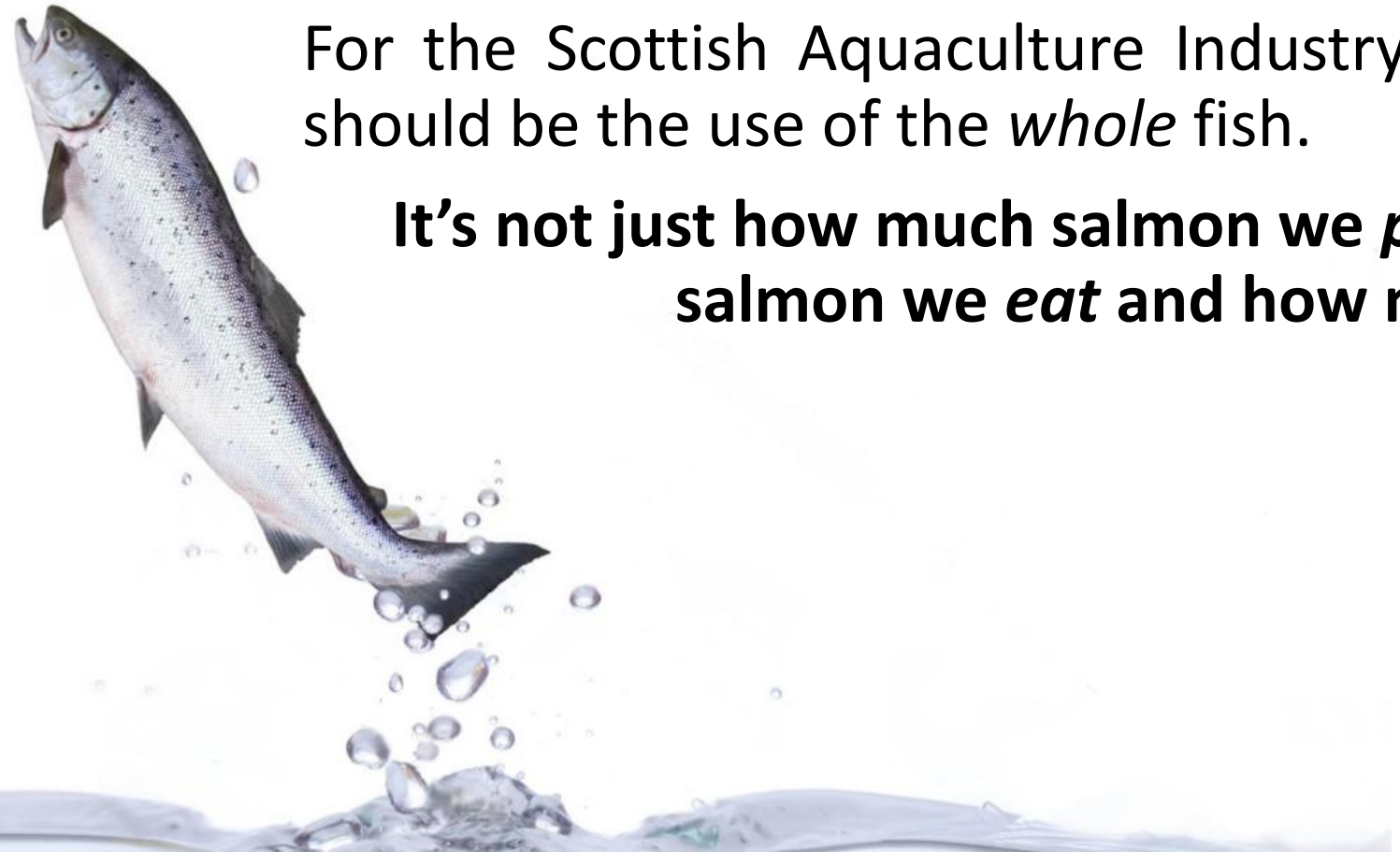
To maximise human consumption and profit:

1. By-products must be managed with the same level of care as the primary product - HACCP
2. Trimmings: keep separate from other fractions; smoke / poach trimmings to increase value.
3. Frames: remove high quality ‘loin’ meat; process frames for mince.
4. Heads: different size categories increase value
5. Skins: belly flaps should be separated.

Key Recommendations

1. **Investment in Value Addition** – with 68,500 tonnes of BPs available (not include blood) and only 11,800 tonnes being used for value addition, lots of raw material for industry development.
2. **Enhanced Transport and Collection Networks** – Currently, processors in remote regions as well as small scale processors have limited options for utilising their BPs.
3. **Collaboration and Knowledge Sharing** - By collaborating with various stakeholders, the best valorisation and transport options can be identified.

Final Thoughts



For the Scottish Aquaculture Industry a sustainable use of resources should be the use of the *whole* fish.

It's not just how much salmon we *produce*, it's how much of the salmon we *eat* and how much we *maximise*.

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IFFO THE MARINE INGREDIENTS ORGANISATION

Thank You

I would like to say thank to my supervisors Dave Little and Richard Newton for their guidance and support.

A big thank you to the **Marine Ingredients Organisation** and **Neil Auchterlonie** for their support and sponsorship.

Thanks to all the staff at the Institute of Aquaculture as well as the many research participants who generously provided their time, technical guidance, and expertise.