Arctic char fish farming in Iceland*

Is it a success?

IIFET – 2016
Aquaculture1: New markets & new species

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* Work on this paper was funded by from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 635188.
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  – Brief history of farmed Arctic char in Iceland
  – World production of Arctic char
  – Markets for Arctic char
  – Arctic char industry in Iceland today
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  – Comparison to other Salmonids industries
  – Economics
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  – Conclusion
Arctic char farming in Iceland

• Farming of Arctic char since the year 1910.
• Production of Arctic char on an industrial scale did not emerge on a significant scale until 1987.
• At first production was not profitable.
• The Icelandic government initiated an Arctic char genetic improvement program in 1992.
  – The main goal of the program has been to develop strains with an increased growth rate and delayed sexual maturation.
• Production doubled within five years from when the program was implemented.
• By 1997, Iceland accounted for more than half of the world production of Arctic char, a market share that has remained pretty stable ever since.
Arctic char world production

Volume has been increasing annually, on average, since 1987 by.

<table>
<thead>
<tr>
<th></th>
<th>World: 15.6%</th>
<th>Iceland: 19%</th>
</tr>
</thead>
</table>

Value has been increasing annually, on average, since 1987 by.

<table>
<thead>
<tr>
<th></th>
<th>World: 14.6%</th>
<th>Iceland: 18.5%</th>
</tr>
</thead>
</table>

Reference: FAO statistics and the Worldbank.
Markets for Arctic char

Arctic char exports by products
(Volume)

<table>
<thead>
<tr>
<th>Year</th>
<th>Frozen whole and fillets</th>
<th>Smoked</th>
<th>Fresh fillets</th>
<th>Whole fresh</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>2008</td>
<td>600</td>
<td>400</td>
<td>600</td>
<td>600</td>
</tr>
<tr>
<td>2009</td>
<td>700</td>
<td>300</td>
<td>700</td>
<td>700</td>
</tr>
<tr>
<td>2010</td>
<td>800</td>
<td>200</td>
<td>800</td>
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<tr>
<td>2011</td>
<td>900</td>
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<tr>
<td>2012</td>
<td>1000</td>
<td>200</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td>2013</td>
<td>1100</td>
<td>300</td>
<td>1100</td>
<td>1100</td>
</tr>
<tr>
<td>2014</td>
<td>1200</td>
<td>400</td>
<td>1200</td>
<td>1200</td>
</tr>
</tbody>
</table>

Reference: Statistics Iceland and the Central Bank of Iceland
Markets for Arctic char

Arctic char value chain in 2014

Domestic production 3.411 t. – 8 $/kg

Processing industry 2.729 t. (gutted Arctic char)

Exports 2.606 t. 8,9 $/kg

- Frozen 426 t. – 10,2 $/kg
  - Germany: 123 t.
  - Sweden: 72 t.
  - Other countries: 285 t.
  - Retail price NA

- Smoked 272 kg – 29 $/kg
  - Switzerland: 152 kg
  - Netherlands: 50 kg
  - Other countries: 70 kg
  - Retail price NA

- Fresh fillets 616 t. – 12,1 $/kg
  - USA: 250 t.
  - Germany: 156 t.
  - Other countries: 220 t.
  - Retail price ca. 44 $/kg (23.06.2016)

- Fresh whole 1.563 t. – 7,2 $/kg
  - USA: 609 t.
  - UK: 594 t.
  - Other countries: 360 t.
  - Retail price ca. 34-44 $/kg (23.06.2016)

Imports 9,6 t. – 6,9 $/kg

Domestic consumption 123 t.

Reference: Statistics Iceland and the Central Bank of Iceland
Arctic char farming in Iceland today

• Two companies are in business of producing fertilized eggs.
• Today, over 90% of the domestic Arctic char production in Iceland is conducted by five farms: Holalax, Fiskeldid Haukamyri, Rifos, Nattura Fiskirækt and Islandsbleikja.
  – Four of them operate land-based grow-out technology.
  – One conducts the grow-out in water cages.
• Most of the farms use natural spring water for rearing Arctic char.
• However, one of the producers is located near the coast in a geothermal area.
  – The water is pumped from drill holes located within the farm area.
  – This water is a mix of natural spring water and ocean water.
The Icelandic Arctic char producers

Descriptive statistics for the observed data.

<table>
<thead>
<tr>
<th></th>
<th>Quantity (metric tonnes)</th>
<th>Total production cost (million USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of observations</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Mean</td>
<td>681,9</td>
<td>4,1</td>
</tr>
<tr>
<td>Median</td>
<td>208,9</td>
<td>1,3</td>
</tr>
<tr>
<td>Maximum</td>
<td>2275</td>
<td>13,3</td>
</tr>
<tr>
<td>Minimum</td>
<td>82</td>
<td>0,58</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>838,2</td>
<td>4,9</td>
</tr>
<tr>
<td>Skewness</td>
<td>1,08</td>
<td>1,01</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>2,3</td>
<td>2,08</td>
</tr>
</tbody>
</table>

- Examination of the data suggested that the costs could be adequately explained by the following cost function form.
  \[ C(q(i), i) = \alpha_0(i) + \alpha_1(i) \cdot q(i)^{\alpha_2(i)}, i = 1,\ldots 4 \]
- The method of non-linear least squares was used to estimate the coefficients of the four cost functions.
The Icelandic Arctic char producers

**Average cost**

- **Íslandsbleikja**
- **Haukamýri**
- **Rifós**
- **Hólalax**

**Marginal cost**

- **Íslandsbleikja**
- **Haukamýri**
- **Rifós**
- **Hólalax**

**Reference:** Directorate of Internal Revenue, Central Bank of Iceland and authors own calculations
How does the Icelandic Arctic char industry compare to other Salmonids industries?

<table>
<thead>
<tr>
<th>Real production cost by category in USD per tonne (cost shares in parentheses)</th>
<th>Icelandic Arctic char industry*</th>
<th>Norwegian Salmonids industry</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average (2009-2014)</strong></td>
<td><strong>Average (2009-2014)</strong></td>
<td></td>
</tr>
<tr>
<td>Feed cost</td>
<td>2.133 (35,0%)</td>
<td>1.879 (48,0%)</td>
</tr>
<tr>
<td>Wages</td>
<td>1.175 (19,3%)</td>
<td>279 (7,1%)</td>
</tr>
<tr>
<td>Other production costs</td>
<td>2.237 (36,7%)</td>
<td>1.497 (38,2%)</td>
</tr>
<tr>
<td>Capital costs**</td>
<td>556 (9,1%)</td>
<td>263 (6,7%)</td>
</tr>
<tr>
<td>Total</td>
<td>6.102</td>
<td>3.917</td>
</tr>
<tr>
<td>Production (tonnes)</td>
<td>2.462</td>
<td>1.121.468</td>
</tr>
</tbody>
</table>

*Approximately 85% of the Arctic char industry is represented in these numbers

** Maintenance is not included in capital costs

Reference: Directorate of Internal Revenue, Central Bank of Iceland, Norwegian Directorate of Fisheries and authors own calculations
Average cost of production

USD per metric tonnes

- Icelandic Arctic char industry
- Norwegian Salmonids industry

Reference: Directorate of Internal Revenue, Central Bank of Iceland, Norwegian Directorate of Fisheries and authors own calculations
Success?

- Change of main indicators since 2009:
  - Production increasing annually by 6%.**
  - Value added increasing annually by 1,8%.
  - Profits declining annually by 5%.
  - Net profits declining annually by 14%.**
  - Real wages per employee increasing annually by 2%.
  - EBITDA ratio declining annually by 6,6%.**
  - Return of capital declining annually by 24%.**

- For comparison, in the Norwegian Salmonids industry:
  - Production increasing annually by 7%, value added by 12,5% and profits by 13,5%.**
  - EBITDA ratio declining annually by 1,2% and return of capital by 0,3%.

Reference: Directorate of Internal Revenue, Central Bank of Iceland, Norwegian Directorate of Fisheries and authors own calculations
*Approximately 85% of the Arctic char industry is represented in these numbers
**Statistically significant
Conclusion

• Production has increased. More on average than other Salmonids species.
• However, profitability measures indicate that the Arctic char industry is becoming worse off.
  – Most likely explained by a less favorable exchange rate.
• Also, the industry finds that regulations and administration are badly implemented, which is effecting them negatively for further growth.
• However, the large increase in Arctic char production is a strong indicator that the industry has, overall, been profitable.
Thank you for your attention

Acknowledgement

Work on this paper was funded by from the *European Union’s Horizon 2020 research and innovation programme*. Grant agreement No 635188