THE BC OPPORTUNITY for LAND-BASED AQUACULTURE

KUTERRA

Garry Ullstrom & Gary Robinson  June 1, 2017
GROWING SALMON IN A RAS
MISSION

ASSESS FEASIBILITY

• Technological
• Biological
• Economic
Discharged water
Cleaned. To be used to grow plants.

Oxygen & ozone

Smolts
100 grams

Well water
UV disinfected

Salmon to market

Feed

Solid waste
Turned into fertilizer.

CO₂
May be used to grow plants.

RAS=Recirculating Aquaculture System

Drum filter
ADVANTAGES

- plankton
- super chill
- storms
- low oxygen
- sea lice
- predators
- disease

OPTIMIZED REARING CONDITIONS
DISADVANTAGE

Higher capital cost than ocean net-pens
Mandate
Data and Reporting
TECHNOLOGICAL FEASIBILITY
TECHNOLOGICAL FEASIBILITY
OPERATING PARAMETERS CONFIRMED
BIOLOGICAL FEASIBILITY

Premium quality
BIOLOGICAL FEASIBILITY

• Growth rate
• Salt water
• Temperature
ECONOMIC FEASIBILITY

Premium Wholesale Price vs Kuterra

CAD equivalent, Seattle Market, Source: Urner Barry

Price (CAD/lbs HOG FOB Seattle)

Period


6-8 lb HOG

4-6 lb HOG

Kuterra
## ECONOMIC FEASIBILITY

<table>
<thead>
<tr>
<th>BEST CHOICE</th>
<th>Type</th>
<th>Method</th>
<th>Location</th>
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</thead>
<tbody>
<tr>
<td>Salmon, Atlantic (Farmed Salmon, Sake)</td>
<td>Farmed in Recirculating Aquaculture Systems</td>
<td>Worldwide</td>
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<table>
<thead>
<tr>
<th>GOOD ALTERNATIVE</th>
<th>Type</th>
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<tbody>
<tr>
<td>Salmon, Atlantic Verlasso* (Verlasso *)</td>
<td>Farmed</td>
<td>Chile</td>
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<table>
<thead>
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<th>AVOID</th>
<th>Type</th>
<th>Method</th>
<th>Location</th>
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</thead>
<tbody>
<tr>
<td>Salmon, Atlantic (Farmed Salmon, Sake)</td>
<td>Farmed in Net Pens</td>
<td>Scotland</td>
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<table>
<thead>
<tr>
<th>AVOID</th>
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<tbody>
<tr>
<td>Salmon, Atlantic (Farmed Salmon, Sake)</td>
<td>Farmed in Net Pens</td>
<td>Chile</td>
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<tr>
<th>AVOID</th>
<th>Type</th>
<th>Method</th>
<th>Location</th>
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<tr>
<td>Salmon, Atlantic (Farmed Salmon, Sake)</td>
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<td>British Columbia</td>
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<table>
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<th>AVOID</th>
<th>Type</th>
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<th>Location</th>
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</thead>
<tbody>
<tr>
<td>Salmon, Atlantic (Farmed Salmon, Sake)</td>
<td>Farmed in Net Pens</td>
<td>Norway</td>
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</table>
ECONOMIC FEASIBILITY

POWER

WATER
ECONOMIC FEASIBILITY

Size is critical!
BUSINESS DEVELOPMENT

• Partnership
• Upgrades
• Scale up
Global Trends That Favour Land-Based Salmon Production
Global Trends Favouring Land-Based Salmon Production

1. Rising product demand, limited supply
2. Advancing technology, increasing scale
3. Advancing production knowledge
4. Rising feed costs
5. Rising transport costs
6. Rising environmental compliance costs
1. Rising product demand, limited supply
Trend 1

Growing Seafood Demand

Seafood consumption is growing.

Aquaculture vs capture in global production
1950 - 2024 (FAO-OECD projections)
Rising Consumer Expectations

The increasing appetite for sustainable seafood

The Marine Stewardship Council is the world’s leading certification and ecolabelling program for sustainable seafood. Look for the blue MSC ecolabel when buying wild-caught fish and seafood.

9 in 10 believe ocean sustainability is important

- 65% agreed it’s important for supermarkets to sell sustainably caught fish
- 61% believe restaurants should show sustainable seafood options on their menus
- 60% agreed buying sustainably caught seafood is helping restore fish stocks
- 46% agreed they trust brands using ecolabels more than those that don’t

Sustainability and traceability high on the agenda when making purchasing decisions

- 61% sustainability
- 66% traceability
- 41% of seafood buyers actively look for fish from a sustainable source

46% of those who recognise the MSC ecolabel were more likely to think that the commercial fishing industry is improving its level of sustainability

147% increase in MSC ecolabelled products between 2010 and 2014

Consumer facing retail value of USS4.8bn

9,999 regular seafood buyers were questioned across 25 countries:
Australia, Canada, Denmark, France, Finland, Germany, Japan, the Netherlands, Poland, Singapore, South, Sweden, Switzerland, the United Kingdom and the USA.
Surveys took place between 19 March to 29 July 2014.
Factors people care about in choosing food

- **38%** Chemicals, toxins, pesticides
- **31%** Non-GMO
- **23%** All natural, not artificial
- **18%** Organic
- **15%** Additives, fillers
- **11%** Preservatives

Source: Nutrition Business Journal
Trend 1: Willingness to pay more for seafood that meets expectations

<table>
<thead>
<tr>
<th>Product Description</th>
<th>Rating</th>
<th>Price / lb.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wegmans Fresh Farm-Raised Boneless Atlantic Salmon Fillets - 1 Fillet</td>
<td>3 / 5</td>
<td>$9.99</td>
</tr>
<tr>
<td>Wegmans Food You Feel Good About Fresh Wild Alaska Sockeye Salmon Fillet</td>
<td>5 / 5</td>
<td>$14.99</td>
</tr>
<tr>
<td>Wegmans Food You Feel Good About EU Organic Salmon - 1 Fillet</td>
<td>5 / 5</td>
<td>$16.99</td>
</tr>
</tbody>
</table>

Source: Wegmans.com
2. Advancing technology, increasing scale
Technology advances through

- Innovation
- Optimization
- Standardization
- Scale
Trend 2  RAS Technology Advances

Scale vs CAPEX

- Kuterra (400 mt) $24/kg
- New and proposed facilities (3000-6000 mt) $10-$15/kg

CAPEX ($/kg production)

Production (mt/year)
Key technology drivers

- More RAS for “post-smolt” production
- More RAS for market salmon RAS production
- Incubation centres
- Centres of excellence

Source: Akva Group
Trend 2  RAS Technology Advances

Where we came from
Trend 2

RAS Technology Advances

Today
Trend 2

RAS Technology Advances

Where we are going

© Inter Aqua Advance

Photo: Akva Group
Trend 2  RAS Technology Advances

New directions
Trend 2
3. Advancing production knowledge
Trend 3

Advancing Production Knowledge

O₂  Temp  Hardness  NH₃  CO₂  Light  Density  pH  Speed
4. Rising feed costs
Rising Feed Costs

3000 mt/y RAS model farm

- Production costs
  - FEED: 53%
  - Smolts (hatchery)
  - Water treatments
  - Energy
  - Labour
  - Insurance
  - Maintenance

Trend 4
Rising Feed Costs

Source: OECD - FAO Agricultural Outlook 2014 - 2023
Rising Feed Costs

• RAS salmon farming offers the potential to achieve better feed-to-growth conversions than salmon grown in the ocean.

• Therefore, as feed costs rise, RAS competitiveness improves.... significantly!
5. Rising transport costs
Trend 5

Rising Transport Costs

Sample freight savings from local production (USD)

Sources: Anders Gjendemsjø, Deloitte AS for Akva Group
Marine Harvest Yearbook
6. Rising environmental compliance costs
Trend 6

Rising Environmental Compliance Costs

- Site productivity limits
- Sea lice treatments
- Net-strength limits
- Monitoring and reporting
- Licence and tenure fees

Photo: BC Salmon Farmers Association
Direct Impacts of Trends

- Capital costs are decreasing
- Operating costs are decreasing
- Risks are decreasing
- Sale price premiums are substantial and stable
- Competitiveness compared with open net-pens is increasing.
Results

• RAS salmon production is at the economic tipping point and has the potential for investment grade returns.
• This situation will improve based on the trends discussed.
• The news is already out. Industry expansion has begun.... The “RAS salmon train has left the station”.
### Operating Market-size Salmon RAS Facilities

<table>
<thead>
<tr>
<th></th>
<th>Facility Name</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>KUTERRA (Canada)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Golden Eagle Aqua (Canada)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Superior Fresh (USA)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>CanAqua (Canada)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Sustainable Blue (Canada)</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>BDV (France)</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Langsand Laks Atlantic Sapphire (Denmark)</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Danish Salmon (Denmark)</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Jurassic Salmon (Poland)</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Swiss Alpine (Switzerland)</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Xinjiang Ehe (China)</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Shandong Oriental (China)</td>
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# RAS Market-size Salmon Production Facilities

<table>
<thead>
<tr>
<th>Company</th>
<th>Country</th>
<th>Planned Production</th>
<th>Planning Construction</th>
<th>Operating</th>
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</thead>
<tbody>
<tr>
<td>Atlantic Sapphire-Miami</td>
<td>USA (Flor.)</td>
<td>90,000</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Nekst</td>
<td>Norway</td>
<td>20,000</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Akvafarm Rjukan AS</td>
<td>Norway</td>
<td>10,000</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Whole Oceans/Emergent Holdings</td>
<td>USA (ME)</td>
<td>5,000</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>FishFrom</td>
<td>Scotland</td>
<td>3,600</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Nordic Aquafarms</td>
<td>Norway</td>
<td>2,400</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Atlantic Sapphire-Langsand Laks</td>
<td>Denmark</td>
<td>2,000</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Danish Salmon</td>
<td>Denmark</td>
<td>2,000</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Inland Seas/Dyne Aquaculture</td>
<td>USA (IA)</td>
<td>2,000</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Niri AS</td>
<td>Scotland</td>
<td>2,000</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Atlantic Salmon South Africa</td>
<td>South Africa</td>
<td>1,500</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Jurassic Salmon</td>
<td>Poland</td>
<td>1,000</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Yantai Salmon Farm</td>
<td>China</td>
<td>1,000</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Xinjiang E’ehe Construction and Investment Company</td>
<td>China</td>
<td>1,000</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>SmögenLax Aquaculture AB</td>
<td>Sweden</td>
<td>1,000</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Swiss Alpine</td>
<td>Switzerland</td>
<td>600</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Palom</td>
<td>USA (ME)</td>
<td>600</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Kuterra</td>
<td>Canada (BC)</td>
<td>370</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Sustainable Blue</td>
<td>Canada (NS)</td>
<td>185</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>CanAqua Seafoods</td>
<td>Canada (NS)</td>
<td>100</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>BDV</td>
<td>France</td>
<td>100</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td><strong>Total Production (mt/year)</strong></td>
<td><strong>146,455</strong></td>
<td><strong>135,985</strong></td>
<td><strong>95,000</strong></td>
<td><strong>8,355</strong></td>
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The BC Opportunity

BC has ..... Established facilities & professionals in:

1. Feed production
2. Processing
3. Fish health science & diagnostics
4. Aquaculture support businesses
5. Close proximity to I-5 corridor
6. Low hydro rates
BC's Challenges

1. Uncertainty about getting new discharge licences
2. Barriers to getting new strains of eggs and smolts
3. Unfamiliarity with RAS among BC investors
4. RAS industry is seen as a threat
Council priorities

1. Expand seafood production
2. Promote innovation
3. Reconcile with First Nations
Recommendation #1

Make it a priority to develop a land-based Atlantic salmon farming industry in BC.
Recommendation #2

Improve access to capital by creating an investment tax credit program for land-based RAS Atlantic salmon production facilities that grow fish to market size.
Recommendation #3

Fund an annual BC-based Aquaculture Innovation Workshop for five years in order to:

• foster information exchange
• reduce perceived uncertainties
• increase investor knowledge.
Define in regulation a clear process for securing a discharge licence during the site selection process.
Recommendation #5

Fund a workforce strategy to ensure that there are trained RAS technicians to work in new land-based facilities.
Recommendation #6

Create regulations to permit the importation to BC of high performance Atlantic salmon eggs for use in the land-based industry.
Recommendation #7

Fund RAS research that addresses BC-specific issues.
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