Economic Value of a New Technology: Integrated Multi-Trophic Aquaculture (IMTA) in BC

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What is the value of a new technology?

- To economists, it has three components:
  1. Increased benefits to consumers from consuming the products
  2. Private financial benefits for producers
  3. Benefits (or decreased costs) accruing to society at large (e.g. environmental)

- We have been examining all three components for Integrated Multi-Trophic Aquaculture (IMTA) in BC and on the East Coast (N.B.)

- A key feature of the research is comparisons with economic aspects of Closed Containment Aquaculture (CCA)

- Our research is funded by a $5 million, 5 year NSERC Strategic Network Grant (CIMTAN)

- Network involves 26 scientists at 8 universities plus government and private partners (http://www.cimtan.ca/)
What is IMTA?
Integrated Multi-Trophic Aquaculture (IMTA)

1. **Fed Salmon Aquaculture**
   Consumes the food & organic waste from the salmon cages

2. **Shellfish Aquaculture** (e.g. oysters, mussels)
   Consumes the food & organic waste from the salmon cages

3. **Seaweed Aquaculture** (e.g. kelp)
   Consumes wastes from the shellfish and crustaceans

4. **Crustacean Aquaculture** (e.g. lobsters)
   Consumes the food & organic waste from the salmon cages

*Chopin et al., 2010*
versus: Closed Containment Aquaculture (CCA)

DFO, 2010

Living Oceans Society, 2011
Some Examples of Alternative Systems of Salmon Aquaculture in British Columbia

- Closed-Containment Aquaculture
  - Namgis Project (pilot re-circulating aquaculture system)
  - Agrimarine (flow-through floating system)
  - Swift Aquaculture (pilot scale land-based system)
  - Marine Harvest Canada pilot project (on hiatus)

- Integrated Multi-Trophic Aquaculture
  - Kyuquot Seafoods (farming sablefish at Kyuquot Sound)
  - Cooke Aquaculture actively experimenting on East Coast
What benefits for consumers?
Preferences for IMTA vs CCA Salmon on the West Coast of the USA (from our market surveys in three “consuming” markets)
Understanding Consumer Heterogeneity using a Discrete Choice Experiment (DCE)

Which of these options will you choose, if any? [please select one]

- **King Salmon**
  - Farm-Raised (Closed Containment)
  - Fresh
  - Product of Canada
  - Unit Price: $16.99/lb

- **Atlantic Salmon**
  - Farm-Raised (Conventional)
  - Fresh
  - Product of Chile
  - Unit Price: $10.99/lb

- **Sockeye Salmon**
  - Wild
  - Previously Frozen
  - Product of USA
  - Unit Price: $14.99/lb

- **None**
  - I’m not going to purchase any because none of these options appeal to me.
Characteristics of Farmed Salmon Market Segments based on Survey Responses

**Species**

- **Atlantic Salmon**
- **Sockeye Salmon**
- **King Salmon**

**Production Atlantic**

- **Conventional**
- **IMTA**
- **CC**

Legend:
- Wild Salmon Lovers
- Price-Sensitive Consumers
- Sustainably Farmed Salmon Supporters
Mean Willingness-to-pay (WTP) for Atlantic Salmon from IMTA and CCA vs. Conventional Salmon Farming, by Market Segment

<table>
<thead>
<tr>
<th></th>
<th>All Segments</th>
<th>Wild salmon lovers</th>
<th>Price-sensitive consumers</th>
<th>Sustainably farmed salmon supporters</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IMTA vs. Conventional</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IMTA</td>
<td>-</td>
<td>-$4.48</td>
<td>$0.96</td>
<td>$2.00</td>
</tr>
<tr>
<td>Conventional farming</td>
<td>-</td>
<td>-$9.05</td>
<td>$0.46</td>
<td>$1.62</td>
</tr>
<tr>
<td>Difference (Marginal WTP)</td>
<td>$1.07</td>
<td>$4.58</td>
<td>$0.50</td>
<td>$0.38</td>
</tr>
<tr>
<td><strong>CCA vs. Conventional</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CCA</td>
<td>-</td>
<td>-$8.90</td>
<td>$0.69</td>
<td>$1.50</td>
</tr>
<tr>
<td>Conventional farming</td>
<td>-</td>
<td>-$9.05</td>
<td>$0.46</td>
<td>$1.62</td>
</tr>
<tr>
<td>Difference (Marginal WTP)</td>
<td>$0.43</td>
<td>$0.15</td>
<td>$0.23</td>
<td>-$0.11 *</td>
</tr>
</tbody>
</table>

**Note:** All prices expressed in USD dollar per lb of salmon; (*) Confidence interval is -0.68 to 0.46
Is IMTA attractive to producers?
Potential producer benefits have not been studied yet in BC

- However, there is a much-cited article by Ridler et al. (2007) that presents some results for New Brunswick

  **Results**: Over 10 years with 5% discount rate, NPV for IMTA system (US $3.3 million) was 24% higher than NPV of a comparable monoculture operation (US $2.7 million)

- In contrast, several studies examining the potential profitability of CCA in BC have shown mixed results so the jury is still out..

  **Results**: DFO (2010) found that conventional net pens generated an IRR of 40.6%v versus 3.4% for a recirculating aquaculture system (RAS); Wright & Arianpoo (2010) estimated an annual gross margin for CCA of $5 million (44%) for a 1000 MT operation and somewhat higher assuming a 25% price premium

- Some concerns that Ridler’s IMTA study may be optimistic and exclude some elements of cost, e.g. management costs, processing costs, production risk

- We are updating the Ridler model (Mark Carras) … but salmon aquaculture is carried out differently in BC so modifications are needed
How would an IMTA farm be configured in BC (vs. NB)?

Conventional Salmon Farm

Salmon Farm Retrofitted with IMTA

(DFO, 2010)
How are the environmental benefits of IMTA vs. CCA valued?
Preliminary findings on attitudes in BC towards IMTA vs. CCA from survey results
If either IMTA or CCA was to be adopted for salmon farming, how strong is your preference for one method over the other?

Responses from surveys in “Consuming” Region (West Coast, USA)

Responses from survey in “Producing” Region (West Coast, USA)
Barriers to implementation of IMTA (and CCA) Systems

- Untested on a commercial scale in British Columbia (uncertainty)
- Increased management complexity, high switchover costs, production risk; suitable for smaller, niche market producers only ??
- No private financial incentive for producers to adopt these technologies since biomitigation is not “rewarded”
- Feasibility studies address profitability only (not incentives) and seem to ignore some financial considerations
- New regulatory regime hinders adoption: Federal government responsible for non-plant but Province for plant organisms
Thank you
Valuing the environmental benefits of IMTA or CCA in BC using a Discrete Choice Experiment is ongoing ...

Choose Your Preferred Scenario for B.C’s Coast (1 of 6)

<table>
<thead>
<tr>
<th>Program Outcomes</th>
<th>Program 1</th>
<th>Program 2</th>
<th>No Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employment in Salmon Farming</td>
<td>1000</td>
<td>500</td>
<td>1500</td>
</tr>
<tr>
<td>Risk of Disease and Parasite Transfer</td>
<td>Moderate Risk</td>
<td>Low Risk</td>
<td>Moderate Risk</td>
</tr>
<tr>
<td>Marine Habitat Quality</td>
<td>Good Quality</td>
<td>Very Good Quality</td>
<td>Fair Quality</td>
</tr>
<tr>
<td>Coastal Aesthetic Quality</td>
<td>Good Quality</td>
<td>Fair Quality</td>
<td>Fair Quality</td>
</tr>
<tr>
<td>Additional ANNUAL Taxes per Household for the Next Ten Years</td>
<td>$20</td>
<td>$5</td>
<td>$0</td>
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