The Manitoba – Canadian Model Aqua-Farm Initiative

Interprovincial Partnership for Sustainable Freshwater Aquaculture Development

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Aquaculture Innovation Workshop
September 26-27, 2011
Campbell River, BC
Rationale

- Considerable capacity to expand freshwater aquaculture through traditional agriculture
- “Farmers” need comprehensive information
  - production technologies and practices
  - costs and benefits
  - training & skills development

Objective:

To be successful, the farmer needs more than just technology
Model Farm Planning Workshop

Scope of the Model Farm

- To optimize productivity, economic prosperity and environmental sustainability

- Species
  - Salmonids (rainbow trout)

- Product
  - Food fish / stocking / baitfish

- Scale
  - Minimal commercial size (100-200 tonnes)
  - >98% recirculation

- Industry-driven
  - Promote industry expansion
Model Farm Layout

- Simple, efficient design to fit in a barn
- 130 tonnes / year
- New water ~227 Lpm
- Total Flow ~20,500 Lpm
- ~200'L x 34’W x 5½’D

- Vol Total = 982 m³
- Vol Rearing = 716 m³
- Recirc’n = 33% vol/d or 98.9% Q
- Density Max = 69 kg/m³
- Ration Max = 431 kg/d
Production Strategy

- Year-round production
  - 30,000 20g fry every 3 months
  - 12 months to ~1200g @ ~10°C
  - Harvest ~10,800 kg per month
MB-CMAF Construction
First Stocking (Nov 2010)
First fish stocked in November 2010
- 40,000 @ 20 grams
- 40,000 @ 5 grams
# Preliminary Performance Data

<table>
<thead>
<tr>
<th>Date</th>
<th>Avg Wt / Fish (g)</th>
<th>FCR</th>
<th>TGC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LR-01-10</td>
<td>LR-02-10</td>
<td>LR-01-10</td>
</tr>
<tr>
<td>13-Nov-10</td>
<td>20</td>
<td>4</td>
<td>na</td>
</tr>
<tr>
<td>3-Dec-10</td>
<td>28</td>
<td>6</td>
<td>0.80</td>
</tr>
<tr>
<td>22-Dec-10</td>
<td>45</td>
<td>8</td>
<td>0.70</td>
</tr>
<tr>
<td>21-Jan-11</td>
<td>79</td>
<td>16</td>
<td>0.90</td>
</tr>
<tr>
<td>22-Feb-11</td>
<td>140</td>
<td>30</td>
<td>0.82</td>
</tr>
<tr>
<td>21-Mar-11</td>
<td>194</td>
<td>44</td>
<td>0.96</td>
</tr>
<tr>
<td>18-Apr-11</td>
<td>253</td>
<td>78</td>
<td>1.08</td>
</tr>
<tr>
<td>24-May-11</td>
<td>388</td>
<td>147</td>
<td>1.02</td>
</tr>
<tr>
<td>25-Jul-11</td>
<td>594</td>
<td>247</td>
<td>2.37</td>
</tr>
<tr>
<td><strong>Cumulative</strong></td>
<td><strong>1.20</strong></td>
<td><strong>0.96</strong></td>
<td><strong>2.02</strong></td>
</tr>
</tbody>
</table>

Average Temp = 11.3°C  
Range = 8-16°C
## Water Quality

### Primary Well
- **Hardness**: 471
- **pH**: 8.1
- **Alkalinity**: 431
- **Chloride**: 6.4

### Parameter

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Tank Inlet</th>
<th>Tank Outlet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alkalinity</td>
<td>336</td>
<td>314</td>
</tr>
<tr>
<td>TSS</td>
<td>2.3</td>
<td>2.8</td>
</tr>
<tr>
<td>TKN</td>
<td>2.8</td>
<td>3.1</td>
</tr>
<tr>
<td>TAN</td>
<td>0.17</td>
<td>0.52</td>
</tr>
<tr>
<td>NO2-N</td>
<td>0.13</td>
<td>0.16</td>
</tr>
<tr>
<td>NO3</td>
<td>36.6</td>
<td>37.1</td>
</tr>
<tr>
<td>TP</td>
<td>0.66</td>
<td>0.71</td>
</tr>
<tr>
<td>BOD</td>
<td>4.3</td>
<td>7.3</td>
</tr>
<tr>
<td>Chloride</td>
<td>10.1</td>
<td>10.4</td>
</tr>
</tbody>
</table>
Financial Metrics

❖ Capital

■ Capital Cost = $ 761,000
  • Does not include barn, well, manure lagoon (sunk costs)
  • $5.85 per kg production capacity

■ Working Capital ~$250,000
  • Feed, Fingerlings, Utilities, Supplies, etc.

❖ Electrical

■ Circulating Pumps, Biofilter Blowers, CO2 Pumps, Well Pumps, O2 & O3 Generator and Compressor → 72 hp (54 Kwhr)

■ 3.6 Kw / tonne production capacity
## Cost of Goods Sold

<table>
<thead>
<tr>
<th>Harvest (kg)</th>
<th>130,800</th>
<th>$/kg</th>
<th>% Sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL REVENUES</td>
<td>$519,048</td>
<td>$3.97</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

### Cost of Production

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
<th>$/kg</th>
<th>% Sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opening Inventory</td>
<td>$111,299</td>
<td>$0.85</td>
<td></td>
</tr>
<tr>
<td>Feed</td>
<td>$219,125</td>
<td>$1.68</td>
<td>42.2%</td>
</tr>
<tr>
<td>Fingerlings</td>
<td>$44,437</td>
<td>$0.34</td>
<td>8.6%</td>
</tr>
<tr>
<td>Electricity</td>
<td>$50,224</td>
<td>$0.38</td>
<td>9.7%</td>
</tr>
<tr>
<td>Heating</td>
<td>$9,653</td>
<td>$0.07</td>
<td>1.9%</td>
</tr>
<tr>
<td>Labour</td>
<td>$31,200</td>
<td>$0.24</td>
<td>6.0%</td>
</tr>
<tr>
<td>Maintenance &amp; Repairs</td>
<td>$9,259</td>
<td>$0.07</td>
<td>1.8%</td>
</tr>
<tr>
<td>Supplies</td>
<td>$23,148</td>
<td>$0.18</td>
<td>4.5%</td>
</tr>
<tr>
<td>Stock Insurance</td>
<td>$5,793</td>
<td>$0.04</td>
<td>1.1%</td>
</tr>
</tbody>
</table>

| TOTAL COST OF PRODUCTION      | $504,139 | $3.85 |         |

### Closing Inventory

| Closing Inventory            | $111,295 | $0.85 |         |

### Cost of Sales

| Cost of Sales                | $392,844 | $3.00 | 75.7%   |

### Gross Margin

| Gross Margin                 | $126,204 | $0.96 | 24.3%   |
## Indirect Costs

<table>
<thead>
<tr>
<th>Indirect Costs</th>
<th>Amount</th>
<th>Percentage</th>
<th>Percentage of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depreciation</td>
<td>$43,042</td>
<td>$0.33</td>
<td>8.3%</td>
</tr>
<tr>
<td>Professional Services</td>
<td>$9,000</td>
<td>$0.07</td>
<td>1.7%</td>
</tr>
<tr>
<td>Insurance</td>
<td>$2,400</td>
<td>$0.02</td>
<td>0.5%</td>
</tr>
<tr>
<td>Interest</td>
<td>$21,041</td>
<td>$0.16</td>
<td>4.1%</td>
</tr>
<tr>
<td>Telecommunications</td>
<td>$2,400</td>
<td>$0.02</td>
<td>0.5%</td>
</tr>
<tr>
<td>Management</td>
<td>$0</td>
<td>$0.00</td>
<td>0.0%</td>
</tr>
<tr>
<td>Office Expense</td>
<td>$1,200</td>
<td>$0.01</td>
<td>0.2%</td>
</tr>
<tr>
<td>Lease</td>
<td>$0</td>
<td>$0.00</td>
<td>0.0%</td>
</tr>
<tr>
<td>Vehicle Expenses</td>
<td>$6,000</td>
<td>$0.05</td>
<td>1.2%</td>
</tr>
<tr>
<td><strong>Total Indirect</strong></td>
<td><strong>$85,083</strong></td>
<td><strong>$0.65</strong></td>
<td><strong>16.4%</strong></td>
</tr>
<tr>
<td>Profit/(Loss) before taxes</td>
<td>$41,120</td>
<td>$0.31</td>
<td>7.9%</td>
</tr>
</tbody>
</table>

EBIT = 12.0%
## Ratio Analysis

### Liquidity
- **Current Ratio (times)**
  - Year 1: 5.7
  - Year 2: 6.2
  - Year 3: 7.5
  - Year 4: 8.7
  - Year 5: 10.1
  - 5-Year Avg: 10.1
- **Quick Ratio (times)**
  - Year 1: 1.5
  - Year 2: 2.7
  - Year 3: 4.0
  - Year 4: 5.2
  - Year 5: 6.5
  - 5-Year Avg: 6.5

### Assets Management
- **Inventory Turnover (days)**
  - Year 1: 394
  - Year 2: 98
  - Year 3: 103
  - Year 4: 103
  - Year 5: 103
  - 5-Year Avg: 103

### Debt Management
- **Debt Ratio**
  - Year 1: 60%
  - Year 2: 64%
  - Year 3: 62%
  - Year 4: 56%
  - Year 5: 49%
  - 5-Year Avg: 49%
- **Times Interest Earned**
  - Year 1: -5.67
  - Year 2: -1.12
  - Year 3: 0.89
  - Year 4: 1.95
  - Year 5: 2.95
  - 5-Year Avg: 2.95

### Profitability
- **Gross Margin**
  - Year 1: -0.1%
  - Year 2: 19.0%
  - Year 3: 24.0%
  - Year 4: 24.3%
  - Year 5: 24.3%
  - 5-Year Avg: 18.3%
- **Return on Sales**
  - Year 1: -20.9%
  - Year 2: 14.9%
  - Year 3: 20.0%
  - Year 4: 20.3%
  - Year 5: 20.3%
  - 5-Year Avg: 10.9%
- **Cash Earnings on Sales**
  - Year 1: 4.5%
  - Year 2: 7.4%
  - Year 3: 7.6%
  - Year 4: 7.6%
  - Year 5: 7.6%
  - 5-Year Avg: 6.9%
- **ROI (Cash in - Cash out)**
  - Year 1: 7.9%
  - Year 2: 14.7%
  - Year 3: 15.0%
  - Year 4: 15.0%
  - Year 5: 15.0%
  - 5-Year Avg: 13.5%

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**Total CF = Labour + Net Cash Flow**

\[ \text{Total CF} = \$31,200 + 39,300 \]

\[ = \$70,500 \]
Lessons Learned

Disease & Mortality

- Biosecurity cannot be under-estimated
- Aeromonas
- Ichthyobodo (Costia)
- Flavobacter
- Vibrio
- Pasturella
- Parasite-S

To be successful, the farmer needs more than just technology
Lessons Learned

- Calcium phosphate precipitate in system
  - Sources: concrete and hard water
- Changed buoyancy of biofilter media
  - Affected hydraulics in biofilter
- Gill Lesions
Demonstration & Validation

Intensive operational monitoring program
- 3-year performance monitoring and management program established
- Farm Manager hired to oversee fish culture operations and compile performance management data and information
Performance Management

Canadian Model Aqua-Farm

**OPERATIONAL SUSTAINABILITY**

**Production**
- Fingerlings
  - Number
  - Size
  - Timing
- Feed / Diet
  - Formulation
  - Ration
- Inventory
  - Number per Lot
  - Avg fish size
  - Total biomass
  - Harvest
- Temperature
  - System
- Energy
  - Electricity
  - Diesel

**Productivity**
- Growth Rate
  - SGR
  - TGC
- Mortality
  - Number
  - Size
- Fish Health
  - Diagnoses
  - Treatments
- Feed Conversion
  - Biological
  - Economic
- Carrying Capacity
  - Water
  - Energy
  - Volume
- Water Use
  - Total Flow
  - Exchange

**Economics**
- Fingerlings
- Feed
- Labour
- Supplies & Repairs
- Power
- Skills Training
- Indirect Costs
- Capital
- Supplies & Repairs

**Environment**
- Metabolic Wastes
  - Solids
  - Phosphorus
  - Nitrogen
  - BOD
  - Carbon Dioxide
- Other Factors
  - Dissolved Oxygen
  - pH
  - Temperature
- Chemicals
  - Therapeutics
- Waste Managm't
  - Solids
  - Mortalities
Thank you

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- **Fisheries & Oceans Canada**
  - **AMD – Aquaculture Innovation & Market Access Program**
  - **Science – Aquaculture Cooperative R&D Program**

- **Manitoba Agriculture, Food & Rural Initiatives**

- **Interprovincial Partnership for Sustainable Freshwater Aquaculture Development**
  - **Veridis Aquatic Technologies Inc.**

- **Riddell’s Roasters (Rudy & Leslie Reimer)**