Increasing Aquaculture Productivity: Shrimp

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Robins McIntosh has been involved in shrimp aquaculture for 30 years. In 1996, he helped establish Belize Aquaculture, the first zero-water-exchange commercial farm in Belize. In 2002, McIntosh joined Charoen Pokphand Foods to assist in the restructuring of shrimp culture in Thailand and Southeast Asia. He continues his work in increasing the efficiency of both white and black tiger shrimp culture.
What Led To The Explosion In Shrimp Production?

In the Beginning....

Thailand Shrimp Productions
Pre- 1990

Healthy Shrimp- Most of the Time
Gambler Mentality

“High Market Prices” Lead To Shrimp Fever
Then Stagnation!
1994-2002

Thailand Shrimp Productions
1992-2002

Deteriorating shrimp stocks made farming less predictable, and often unprofitable.
Followed By The Explosion In Shrimp Production!
2002-Current

Thailand Shrimp Productions

+100%
Domesticate, Healthy

Post 2002
Transition to “Industrial Mentality”

- Domestication, Genetic Selection.
- Modernization of Hatcheries.
- Installation of “Controlled Pond” Systems.
- Systemization of Farm Management.
## Technology Has Been Key To Increasing Sustainable Production

<table>
<thead>
<tr>
<th>Species</th>
<th>2002 Monodon</th>
<th>2009 Vannamei</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cycles/yr</td>
<td>1.8</td>
<td>2.95</td>
</tr>
<tr>
<td>Stock Density /m²</td>
<td>65</td>
<td>116</td>
</tr>
<tr>
<td>Harvest Size (g)</td>
<td>16.5</td>
<td>14.2</td>
</tr>
<tr>
<td><strong>Yield (kg/ha/yr)</strong></td>
<td><strong>11,952</strong></td>
<td><strong>44,651</strong></td>
</tr>
<tr>
<td>Survival (%)</td>
<td>62</td>
<td>91</td>
</tr>
<tr>
<td>Growth Rate (g/wk)</td>
<td>0.95</td>
<td>1.16</td>
</tr>
<tr>
<td>FCR</td>
<td>1.73</td>
<td>1.34</td>
</tr>
</tbody>
</table>
Sustainable Increased Efficiencies Have Resulted In Lower Production Costs

<table>
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<tr>
<th>Species</th>
<th>2002 Monodon</th>
<th>2009 Vannamei</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harvest pcs/kg</td>
<td>60</td>
<td>71</td>
</tr>
<tr>
<td>Farm Gate Value (USD/kg)</td>
<td>5.70</td>
<td>3.40</td>
</tr>
<tr>
<td><strong>Cost of Production/kg (USD)</strong></td>
<td>5.27</td>
<td>2.71</td>
</tr>
<tr>
<td>Profit/kg (USD)</td>
<td>0.43</td>
<td>0.69</td>
</tr>
<tr>
<td>% Profit</td>
<td>7.8</td>
<td>25.4</td>
</tr>
</tbody>
</table>
Domestication, Selective Breeding

“SPF” Shrimp
Sustainable Production Has Been: Increasing Survivorship, Reduced Pond Failures

(> 6,000 harvests/yr)
Growth Rate Improvement

Key to cost reduction:
FCR, Time to Harvest, Survival

Days of Culture

Growth Rate Improvement
Key to cost reduction:
FCR, Time to Harvest, Survival
Genetic Gains Have Contributed To Annual Gains In Pond Efficiency

(Growth (ADG))

2006 2007 2008 2009 2010

1.6 1.5 1.3

FCR

 (> 6,000 harvests/yr)
Genetics Is The Driver For More Efficient Production

Pond Energy Cost

Fish In: Fish Out
Modernization of Hatcheries

Pre-2002

- Low Survivals
- Carriers of Disease
- Poor Performance Consistency
Sanitary
High Survival
Healthy PLs
Consistent Operations
Healthy Shrimp
Do Not Require Antibiotics

• Pre-Domestication

• Post-Domestication
Realization of Genetic Improvement Requires Control Of The Pond Environment
Open Systems Move To Closed, Controlled Systems

- Risk Reduction
Controlling the Pond Environment
Key To Realizing Genetic Improvements

• Biosecurity.
• Oxygen.
• Predator and Competitor Exclusion.
• Pond Bottoms.
Control Means Reduced Risk

- Uncontrolled
- Controlled
Development Of Technologies That Result In Healthier Environments

Microbes that create a healthier pond environment
Consistent Farm Management: Follow the Yellow Brick Road to Success

Pond Prep → Problems → Failure → Oxygen → Sediments → Feeding
Implementation Of New Sustainable Technologies Requires Education and Investment

- Vietnam
- China
The Future: Sustainably More From Less

<table>
<thead>
<tr>
<th></th>
<th>Production (tons)</th>
<th>Pond Area (Ha)</th>
<th>Yield/Ha/Yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>308,000</td>
<td>85,000</td>
<td>3,625</td>
</tr>
<tr>
<td>2009</td>
<td>560,000</td>
<td>55,000</td>
<td>10,200</td>
</tr>
<tr>
<td>2010 Lamae Farm</td>
<td>900</td>
<td>18</td>
<td>50,000</td>
</tr>
</tbody>
</table>
From The Producers: Can The Established Markets Be Increased?