INDOOR SHRIMP FARMING WORKSHOP

OPTIMIZING FEED PROGRAMS FOR PROFITABILITY

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Profits

- Profits are much like breathing. If we don’t breathe, we are dead.
- If we don’t achieve enough profit for the risk we take, we are also dead.
- Profits are a risk premium we need as we commit today’s definite resources to tomorrow’s uncertain return.

“Many receive advice, only the wise profit from it”
Publilius Syrus
The Keys to Success

One of the most fundamental keys to successful, profitable shrimp culture:

Feeds and Feed Management
Feed Drives the System

The fate of feed applied to aquaculture ponds.

- Boyd 2009
Feed Drives the System

The fate of feed applied to aquaculture ponds.
- Boyd 2009

Health Problems
Maximize Nitrogen Assimilation
Precision Feeding

Precision Feeding Concept:

Provide each Animal with:

- the exact quantity of feed that it can consume,
- when the animal is ready to consume it,
- the exact nutrition that the animal requires,
- the correct feed particle sizes and optimum texture,
- In the location where the animal is located

“With the objective to optimize the desired results”
Complete Feed Program

- Formulation
- Manufacturing
- Feeding Methods

Success

- Nutrients
- Feed
- Feeding
Diet Formulation

- Specialized according to system and life stage
- All required nutrients in correct quantities
- Concentrated dense balance of essential nutrients
- Palatable, very digestible
- Void of toxins and anti-nutritionals
- Support health
  - Immune system balance
  - Stress management

↑ Nitrogen conversion efficiency
↓ Growth
↓ Water quality problems
Aquaculture: The nutrient conflict

Limited Aqua nutrient supply from raw materials
- Limited raw materials from marine origin
- High prices for protein and lipid sources
- Variable quality of raw materials

Increased nutrient requirements
- Increasing total aqua production and lower margins
- Genetically improved faster growing strains
- Better farming/Higher yield expectations

Solutions demand a better understanding of nutrient requirements, digestible nutrients in ingredients and nutrient supplementation
New Tools Beyond the Basics

- Better assessment of ingredient digestibility, palatability, nutrient utilization
- Experimental systems for testing species specific requirements and for testing different life stage requirements under varying environmental conditions.
- Improving understanding of new raw material opportunities and limitations.
- Measurement of immunocompetence, gut integrity, and overall health status
Nutritional Immunology - Vpak™

Laboratory WSSV Challenge

- Control
- II
- III
- IV
Feed Physical Characteristics

➢ Particle size and uniformity depend on shrimp size and uniformity
➢ Freshness – check labels for manufacture dates
➢ Packaged to retain quality, shelf life and palatability
➢ Water stability adequate to retain nutrients
➢ Shape and texture as preferred by shrimp
➢ Proper storage
We become what we eat

Strong, Healthy

Sick

Dead
Feed Size
Driving a Ferrari on a Dirt Road

How do we improve feeding as we improve feed technologies
Overfeeding

- Overfeeding is a very common mistake with very serious consequences, including:
  - Increases floc and bacteria populations
  - Increases requirements for probiotics
  - Increases oxygen demand, CO₂ production
  - Increases ammonia and nitrite production
  - Sludge accumulation, toxic hydrogen sulfide
  - AHPNS outbreaks
Feeding is based on Gains and Expected FCR

- A better method of calculating feeding rates:
  1. Develop a typical growth curve for the growing conditions and genetic stock
  2. Calculate the daily weight gain
  3. Multiply the expected gain by the Population Estimate and Expected Feed Conversion Factor (FCR)

\[
\text{Feed Quantity} = \text{Daily Gain} \times \text{Population} \times \text{FCR}
\]
Zeigler Precision Feed Program

- Growth curve based on the system's history and genetics of animals
- The feeding is based on accurate population projections, gains per day, FCR, and temperature
- Includes a mechanism to adjust the feed rate on the basis of average weight samples, population estimates, adjustments to projected growth per day, and temperature.
Managing Feed Costs

- Feed cost per unit gain
  \[ \text{FCR} \times \text{Feed Cost} = \text{FC/UG} \]

- Profit
  Total expenses – Total revenues

- In aquaculture, a close economic relationship exists between cost inputs and output revenues

- Feed plays a critical role in determining, growth potential, water quality, health etc.
Value of Quality Feed

- Larger animals = more value per lb
- Healthier animals = less shrinkage, improved processing efficiency, better meat quality, improved shelf life
- Better water quality = less cost for treatment, probiotics etc., faster growth, lower FCR, higher carrying capacity
- Faster growth = more cycles, less operating cost, lower risk
Closed System Feeding Strategy

- Design feeds and feeding program to efficiently meet shrimp requirements
  - High protein nutrient dense formulations
  - Tight control of feeding rates to meet requirements for growth
  - Supplemental carbon addition as necessary until nitrifying community established
  - Dilution or denitrification to control nitrate buildup
  - Avoid waste nutrient buildup over time, Phosphorus, Minerals etc.
Samocha 2013 - Example

- Standard commercial pond feed (SI-35) vs (HI-35) specially formulated for intensive closed system culture
- Both feeds with 35% protein and 7% fat
- 67 days
- 3x - 40-m³ raceways
- 500/m³
- 2.66 g initial weight
Feeding and Growth

- Rations determined assuming FCR of 1.4, growth of 1.5 g/wk, and mortality of 0.5%/wk,
- Adjusted according to twice a week growth samples

\[ y = 1.1463x + 1.4894 \quad R^2 = 0.9954 \]
\[ y = 1.0621x + 1.3139 \quad R^2 = 0.9917 \]
Performance Results

Performance of shrimp fed HI-35 & SI-35 diets in a high-density 67-d in biofloc dominated system

<table>
<thead>
<tr>
<th></th>
<th>HI-35</th>
<th>SI-35</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final Weight (g)</td>
<td>22.12 ± 11.35a</td>
<td>19.74 ± 8.28b</td>
</tr>
<tr>
<td>Growth (g/wk)</td>
<td>2.03 ± 0.01a</td>
<td>1.76 ± 0.10b</td>
</tr>
<tr>
<td>Total Biomass (kg)</td>
<td>389.8 ± 1.77a</td>
<td>348.5 ± 9.21b</td>
</tr>
<tr>
<td>Yield (kg/m³)</td>
<td>9.74 ± 0.04a</td>
<td>8.71 ± 0.22b</td>
</tr>
<tr>
<td>FCR</td>
<td>1.25 ± 0.01a</td>
<td>1.43 ± 0.04b</td>
</tr>
<tr>
<td>Survival (%)</td>
<td>87.4 ± 0.52a</td>
<td>88.3 ± 4.18a</td>
</tr>
</tbody>
</table>
Water Quality Effects

![Graphs showing TSS, VSS, Turbidity, and Alkalinity over 9 weeks for two different treatments, HI-35 and SI-35.](image-url)
Economic Analysis

- Shrimp sales price: averaged $7.20/kg ($3.27/lb)
- Grow-out feed: Zeigler Brothers
  - Semi-Intensive (SI-35): $0.99/kg = $ 990/MT or $0.452/lb = $ 904/ton
  - Hyper-Intensive (HI-35): $1.75/kg = $1,750/MT or $0.795/lb = $1,590/ton
- Juveniles production cost: $20.00/1,000
- Interest rate for loans: 8%
- Initial Investment $ 991,997
- Greenhouse system with eight 500M³ Raceways
## Enterprise Budgets ($/kg)

<table>
<thead>
<tr>
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<th>HI-35</th>
<th>SI-35</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Sales per year</td>
<td>$1,542,816</td>
<td>$1,379,664</td>
</tr>
<tr>
<td>Gross Receipts</td>
<td>$7.20</td>
<td>$7.20</td>
</tr>
<tr>
<td>Variable Costs</td>
<td>$4.06</td>
<td>$4.54</td>
</tr>
<tr>
<td>Income Above Variable Cost</td>
<td>$3.14</td>
<td>$2.66</td>
</tr>
<tr>
<td>Fixed Cost</td>
<td>$0.47</td>
<td>$0.53</td>
</tr>
<tr>
<td>Total of All Specified Expenses</td>
<td>$4.53</td>
<td>$5.07</td>
</tr>
<tr>
<td>Net Returns Above All Costs</td>
<td>$2.67</td>
<td>$2.13</td>
</tr>
<tr>
<td>Payback period, years</td>
<td>$1.4</td>
<td>$1.9</td>
</tr>
<tr>
<td>Net present value ($ mil.)</td>
<td>$2.9</td>
<td>$2.0</td>
</tr>
<tr>
<td>Internal Rate of Return (%)</td>
<td>$66.6</td>
<td>$50.1</td>
</tr>
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Invest in feed quality

- Cost of high quality feeds are quickly justified by small increases in crop growth and survivability

Effect of 20% change in variable costs
10 year Net Present Value

- Growout survival: 97%
- Shrimp price: 89%
- Stocking density: 57%
- Growth rate: 45%
- Feed: 22%
- Nursery survival: 10%
- PL cost: 9%

Hanson et al. 2007
Shrimp production efficiencies

- Feeding early stages properly is crucial to overall crop success
- Maintain high performance standards developing and applying the correct metrics against global standards
- Feed drives the system apply precision feeding
- Do not compromise performance to cut cost, feed is an investment in overall profitability
"The ability to learn faster than your competition may be the only sustainable competitive advantage."