Strategies to Improve Economic Efficiency of the Dairy

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This site is designed to support dairy farming decision-making focusing on model-based scientific research. The ultimate goal is to provide user-friendly computerized decision support tools to help dairy farmers improve their economic performance along with environmental stewardship.

University of Wisconsin
University of Wisconsin - Madison
UW - Cooperative Extension
UW - Dairy Science
Dairy Cattle Reproduction
Dairy Cattle Nutrition
Milk Quality
UW Dairy Nutrient
Understanding Dairy Markets
UW Center for Dairy Profitability

Latest Projects
Improving Dairy Farm Sustainability
Genomic Selection and Herd Management
Dairy Reproduction Decision Support Tools
Strategies of Pasture Supplementation
Improving Dairy Cow Fertility

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Helpful Link
Repro Money Program

Victor E. Cabrera, Ph.D.
Tools

A collection of the state-of-the-art and scientific-based dairy farm management decision support tools that are user-friendly, interactive, robust, visually attractive, and self-contained. These tools count with associated documentation and video demonstrations. Technical support on their application is also available upon request.

Feeding
- FeedVal 2012
- Grouping Strategies for Feeding Lactating Dairy Cattle
- Optigen® Evaluator
- Income Over Feed Supplement Cost
- Dairy Extension Feed Cost Evaluator
- Corn Feeding Strategies
- Income Over Feed Cost
- Dairy Ration Feed Additive Break-Even Analysis

Heifers
- Heifer Pregnancy Rate
- Cost-Benefit of Accelerated Liquid Feeding Program for Dairy Calves
- Economic Value of Sexed Semen Programs for Dairy Heifers
- Heifer Replacement
- Heifer Break-Even

Reproduction
- The Economic Value of a Dairy Cow
- Economic Value of Sexed Semen Programs for Dairy Heifers
- Exploring Timing of Pregnancy Impact on Income Over Feed Cost
- Dairy Reproductive Economic Analysis
- Heifer Pregnancy Rate
- Retention Pay-Off (RPO) Calculator

Production
- Milk Curve Fitter
- Decision Support System Program for Dairy Production and Expansion
- Economic Analysis of Switching from 2X to 3X Milking
- Lactation Benchmark Curves for Wisconsin
- Economic Evaluation of using rBST
- Altfafa Yield Predictor: Using a Computer Application to Predict Irrigated Alfalfa Yield

Replacement
- The Economic Value of a Dairy Cow
- Value of a Springer
- Heifer Replacement
- Heifer Break-Even
- Herd Structure Simulation
- Retention Pay-Off (RPO) Calculator

Health
- Economic Evaluation of ChoIPEARL

Financial
- LGM-Dairy Analyzer
- Working Capital Decision Support System
- The Wisconsin Dairy Farm Ratio Benchmarking Tool
- Decision Support System Program for Dairy Production and Expansion
- Least Cost Optimizer
- LGM-Dairy Premium Sensitivity
- Return to Labor
- Estimate Your Mailbox Price
- LGM Dairy Feed Equivalent Calculator
- Net Guarantee Income Over Feed Cost for LGM-Dairy

Price Risk
- LGM-Dairy Premium Sensitivity
- Least Cost Optimizer
- LGM Premium
- LGM Dairy Feed Equivalent Calculator
- Milk Component Price Analysis

Environment
- Dairy Nutrient Manager
- Grazing-N: Application that Balances Nitrogen in Grazing Systems
- Seasonal Prediction of Manure Excretion
- Dynamic Dairy Farm Model

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Considering nutritional grouping

Take home messages

Opportunity to improve economic efficiency
Considering additional nutritional groups

Diets closer to requirements
Saves feed costs and increases income over feed costs

Improved profitability
IOFC gains far exceed additional expenses or losses

Additional benefits
- ↓ environmental concerns
- ↑ health conditions
Feeding all lactating cows equally
A larger number of cows are overfed

Same ration (TMR) to all cows (groups)
All lactating cows receive same nutrient density diet

Preferred “high” rations
Low producing animals receive more nutrients than required

One diet for all
Would never optimize production and efficiency

VandeHaar, 2011
Improve feed efficiency
+ feeding groups

Improved nutrient use efficiency
Diet closer to cow requirements

Less nutrient excretion
Decreased environmental concerns

Less overfed animals
Decreased over conditioned cows

Lower feeding costs
Higher milk income over feed cost

Wang et al., 2000
Why farmers do not group more?
Trying to find most important constraints

2-page mailed survey

Constraints to feeding more ration groups

1. Milk drops when cows are moved
2. Desire to keep management simple
3. Conflicts with grouping for reproduction
4. Farm facilities do not allow it
5. Not enough labor or personnel to handle it

Results (responses)

- 196 WI farms
- 211 MI farms

Contreras-Govea et al., 2015 (accepted)
A simulation study...
Strategies for grouping cows
Depend on farm and herd characteristics

Individual cow nutrient requirements
• Energy
• Protein (RUP, RDP, MP)

Number of lactating cows on the herd
States

Farm characteristics
Capacity to handle lactating feeding groups

Adapted from McGilliard et al., 1983; St-Pierre and Thraen, 1999
Milk (and components)
Cow-specific lactation curves

Milk based on
• Herd ME305
• Cow PPA or ME305
• Stochasticity

Components
• Herd
• Stochasticity

Base function
• Woods
• Adjusted Woods

De Vries, 2001
Initial individual cow BW

Cow-specific BW

1. Available from farm records, or
2. Stochastic distribution

Daily BW and BCS change according to:
- Lactation
- DIM
- Stochasticity

<table>
<thead>
<tr>
<th>Days after calving</th>
<th>Body weight, kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>565</td>
</tr>
<tr>
<td>200</td>
<td>565</td>
</tr>
<tr>
<td>400</td>
<td>565</td>
</tr>
<tr>
<td>600</td>
<td>565</td>
</tr>
<tr>
<td>800</td>
<td>565</td>
</tr>
</tbody>
</table>

Lactation $> 1$ (mean=600 kg)
Mean=600 kg
Criteria for nutritional grouping

Several criteria exist

**Days after calving (DIM)**
Based on stage of lactation

**Fat (protein) corrected milk**
Based on level of production measured as $F(P)CM$

**Dairy merit**
Function of both $F(P)CM$ and BW

**Cluster**
Seems to be MOST efficient criterion

McGilliard et al., 1983
St-Pierre and Thraen, 1999
Nutritional grouping
Two main types of groups

Obligated groups
- Fresh (< 22 DIM)
- Dry (~> 220 DCC)
- Daily assigned

Optional groups
- Actual additional groups
- Daily assigned
- Monthly re-grouped
Cow and herd simulation
Monte Carlo approach

Next event scheduling
• Pregnancy
• Abortion
• Dry-off
• Parturition
• Involuntary culling
• Death

Immediate replacement
• After a cow leaves the herd

Two-step
• 1. Binary outcome of event:
  • Happens or not
  • E.g., uniform distribution

• 2. DIM of the occurrence
  • When it happens
  • E.g., Weibull distribution

Replicates
• 1,000 replicates for each cow within specific herd
### Cow simulation

Follows actual COW card

<table>
<thead>
<tr>
<th>Variable</th>
<th>Unit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cow ID</td>
<td>#</td>
<td>Cow identification</td>
</tr>
<tr>
<td>Parity</td>
<td>#</td>
<td>Lactation</td>
</tr>
<tr>
<td>DIM</td>
<td>d</td>
<td>Days in milk, days after calving</td>
</tr>
<tr>
<td>DCC</td>
<td>d</td>
<td>Days in pregnancy (DIP)</td>
</tr>
<tr>
<td>Fat</td>
<td>%</td>
<td>Fat component on milk</td>
</tr>
<tr>
<td>Protein</td>
<td>%</td>
<td>Protein component on milk (%)</td>
</tr>
<tr>
<td>PPA*</td>
<td>%</td>
<td>Predicted producing ability</td>
</tr>
<tr>
<td>ME 305*</td>
<td>kg/305 d</td>
<td>Mature equivalent milk production</td>
</tr>
<tr>
<td>BW</td>
<td>kg</td>
<td>Live body weight</td>
</tr>
</tbody>
</table>

*Either PPA or ME305 used to assess cow’s milk class. PPA preferred if available
### Studied herds

All data collected at the **cow-level**

<table>
<thead>
<tr>
<th>Herd (size)</th>
<th>570</th>
<th>787</th>
<th>727</th>
<th>331</th>
<th>1460</th>
</tr>
</thead>
<tbody>
<tr>
<td>Herd ME 305, kg</td>
<td>16,140</td>
<td>12,884</td>
<td>13,897</td>
<td>13,348</td>
<td>14,188</td>
</tr>
<tr>
<td>1st lactation, %</td>
<td>43</td>
<td>39</td>
<td>39</td>
<td>38</td>
<td>45</td>
</tr>
<tr>
<td>Average DIM</td>
<td>187</td>
<td>178</td>
<td>201</td>
<td>208</td>
<td>189</td>
</tr>
<tr>
<td>21-d PR, %</td>
<td>18</td>
<td>19</td>
<td>19</td>
<td>17</td>
<td>18</td>
</tr>
<tr>
<td>Culling risk, %</td>
<td>32</td>
<td>37</td>
<td>36</td>
<td>35</td>
<td>40</td>
</tr>
<tr>
<td>Abortion, %</td>
<td>7</td>
<td>11</td>
<td>11</td>
<td>16</td>
<td>7</td>
</tr>
<tr>
<td>BW available</td>
<td>✗</td>
<td>✗</td>
<td>✓</td>
<td>✓</td>
<td>✗</td>
</tr>
</tbody>
</table>
...And we are finding
Herd 331, nutritional diets

Crude protein, % DM

1 group

2 groups

3 groups

Months after starting simulation
Herd 787, nutritional diets

Energy in diet (Mcal/kg DM)

Months after starting simulation

1 Group
5 Groups
Cow 6338(727) = 78% milk, 1 yr

3rd Lactation

Milk

DMI

-$23$ milk, -$200$ feed, +$177$ IOFC

Group-pen availability

1 Group

State of cow

-846 Mcal

-137 kg CP
Cow10020(727) = 92% milk, 1 yr

1st Lactation

Milk

BW

DMI

-$18\text{ milk}$, $-\$43\text{ feed}$, $+\$25\text{ IOFC}$

Diet or DMI (kg/dl)

Milk or DMI (kg/dl)

Days in milk

Diet energy (Mcal/kg DM)

-165 Mcal

Body weight (kg)

Diet crude protein (% DM)

-32 kg CP

Days in milk
Cow 928(727) = 109% milk, 1 yr

-27 milk, -9 feed, -18 IOFC

Possible grouping milk depression

-30.3 Mcal

-16.6 kg CP
Cow 6320 (727) = 100% milk
Economic efficiency

Income over feed cost ($/cow per yr)

Nutritional groups

1. $2,375
2. $2,425
3. $2,475
4. $2,525
5. $2,575

Nutritional groups:
- 331
- 570
- 727
- 787
- 1460

Economic efficiency:
- +$19
- +$20
- +$45
- +$47
- +$55
- +$57
- +$61
- +$63
- +$66
- +$70
- +$73
Energy efficiency

Mcal milk/Mcal consumed (%) vs Nutritional groups

- +0.38%
- +0.58%
- +0.69%
- +0.75%
- +0.73%
- +0.63%
- +0.93%
- +1.02%
- +0.96%
Nitrogen efficiency

![Graph showing nitrogen efficiency across different nutritional groups.]

- **Milk N produced/Feed N consumed (%)**
- **Nutritional groups**: 1 to 6
- **Nitrogen efficiency values**:
  - Nutritional group 1: +0.25%
  - Nutritional group 2: +0.41%
  - Nutritional group 3: +0.61%
  - Nutritional group 4: +0.75%
  - Nutritional group 5: +0.71%
  - Nutritional group 6: +0.93%

Legend:
- 331
- 570
- 727
- 787
- 1460
Impact of milk depression

Nutritional groups

Herd 787

- Milk depression
- No milk depression

Income over feed cost ($/cow per yr, bars)

Milk N produced/Feed N consumed (%) (lines)

$2,620
$2,600
$2,580
$2,560
$2,540
$2,520

25.50%
25.70%
25.90%
26.10%
26.30%
26.50%
26.70%

-0.05%
-0.06%
-0.07%
-0.10%
-0.13%

-$16
-$19
-$21
-$23

9.1 kg
Decision support tool...

http://DairyMGT.info
A simplified online tool
Herd-specific assessments (DairyMGT.info)
Additional costs and benefits
Impacts grouping feeding strategies

Management cost
• Additional labor
• Extra management

Avoid costs
• Additives and supplements savings

Milk depression
• Cow social interactions
Grouping Strategies

Farm/herd possibilities and decision-making

Current Groups

- How many does?
- How many can?

Current diet

- Group sizes

Added Cost & Benefits

Current diet

- Group sizes

Added Cost & Benefits

NO

YES
### Grouping Illustration

#### Economic impact of nutritional grouping

<table>
<thead>
<tr>
<th>Current Situation</th>
<th>Possible Situation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lactating Cows</td>
<td>Groups</td>
</tr>
<tr>
<td>470</td>
<td>3</td>
</tr>
<tr>
<td>Current Groups</td>
<td>Group Sizes</td>
</tr>
<tr>
<td>None</td>
<td>100, 100, 270</td>
</tr>
<tr>
<td>NEL Mcal/lb</td>
<td>Milk loss</td>
</tr>
<tr>
<td>0.80</td>
<td>2.27 kg/d x 4 d</td>
</tr>
<tr>
<td>CP, %</td>
<td>Added Costs</td>
</tr>
<tr>
<td>17</td>
<td>$1,000/month</td>
</tr>
<tr>
<td></td>
<td>Saved costs</td>
</tr>
<tr>
<td></td>
<td>None</td>
</tr>
</tbody>
</table>
### Decision Support System Illustration

#### Cluster grouping criteria

<table>
<thead>
<tr>
<th>Group</th>
<th>Cows</th>
<th>NEL</th>
<th>CP</th>
<th>IOFC</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>470</td>
<td>0.80</td>
<td>17.00</td>
<td>6.9</td>
</tr>
</tbody>
</table>

Current Situation:

<table>
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<td>470</td>
<td>0.80</td>
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<td>6.9</td>
</tr>
</tbody>
</table>

Possible Situation:

<table>
<thead>
<tr>
<th>Group</th>
<th>Cows</th>
<th>NEL</th>
<th>CP</th>
<th>IOFC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100</td>
<td>0.62</td>
<td>13.07</td>
<td>4.7</td>
</tr>
<tr>
<td>2</td>
<td>100</td>
<td>0.65</td>
<td>14.18</td>
<td>7.2</td>
</tr>
<tr>
<td>3</td>
<td>270</td>
<td>0.71</td>
<td>16.05</td>
<td>9.3</td>
</tr>
<tr>
<td>All</td>
<td>470</td>
<td>0.68</td>
<td>15.02</td>
<td>7.9</td>
</tr>
</tbody>
</table>

Annual value of grouping:

- $1,336
- $1,189

**Total:** $135,000/herd
Wisconsin herds analysis
Analysis from dairy farm records
30 Wisconsin dairy farms

No grouping vs. 3 groups
• Same size groups

Grouping criterion
• Cluster

Same prices for all
• $0.35/kg milk
• $0.315/kg CP
• $0.1174/Mcal NEI

Projected body weight
• 500 kg primiparous
• 600 kg multiparous
Analysis from dairy farm records
30 Wisconsin dairy farms

<table>
<thead>
<tr>
<th>Lactating cows (n=30)</th>
<th>No grouping</th>
<th>3 Groups</th>
<th>Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>&lt;200</td>
<td>697</td>
<td>1,059</td>
</tr>
<tr>
<td>Mean</td>
<td>788</td>
<td>2,311</td>
<td>2,707</td>
</tr>
<tr>
<td>Maximum</td>
<td>&gt;1,000</td>
<td>2,967</td>
<td>3,285</td>
</tr>
</tbody>
</table>

Increase of IOFC ($/cow per year)
- Between 7 and 52%
- Mean = $396
- Range = $161 to $580
Acknowledgements

This project is supported by Agriculture and Food Research Initiative Competitive Grant No. 2011-68004-30340 from the USDA National Institute of Food and Agriculture
Thanks