Grouping Strategies for Feeding Lactating Dairy Cattle

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What seems to be the problem?
Dairy farmers might be over-feeding lactating cows

Same ration in a group
No feeding groups or only a few groups

Preferred “higher” rations
Low producing animals receive more nutrients than required
What could be a possible solution?
Consider additional feeding groups for lactating cows

Improved nutrient use efficiency
Diet closer to cow requirements

Less overfed animals
Decreased overweighted cows

Less nutrient excretion
Decreased environmental concerns

Lower feeding costs
Higher milk income over feed cost
Why dairy farmers do not group more?
There could be a myriad of reasons!

Farm facilities or equipment limitations
Physical constraints

Not enough labor or personnel
Labor constraints

Other reasons
Trying to find them

Not enough expertise or knowledge available
Management constraints
Strategies for grouping lactating cows
Depend on farm and herd characteristics

Individual cow nutrient requirements
- Energy
- Protein

Number of lactating cows on the herd

Farm characteristics
Capacity to handle lactating feeding groups

Adapted from McGilliard et al., 1983; St-Pierre and Thraen, 1999
Cow nutrient requirement

Energy

Total net energy ($\text{NE}_{\text{total}}$)
Energy required for maintenance + energy required for milk production

\[ \text{NE}_{\text{total}} \ (\text{Mcal}) = \text{NE}_{\text{maintenance}} + \text{NE}_{\text{milk}} \]

\[ \text{NE}_{\text{maintenance}} \]
Function of animal body weight

\[ \text{NE}_{\text{maintenance}} = 0.079 \times BW^{0.75} \]

\[ \text{NE}_{\text{milk}} \]
Function of milk and fat production

\[ \text{NE}_{\text{milk}} = \text{Milk} \times (0.36 + 0.0969 \times \text{Fat\%}) \]

NRC, 2001
Cow nutrient requirement

Protein

Total crude protein \((CP_{total})\)
Protein required for maintenance + protein required for milk production

\[
CP_{total} (g) = CP_{maintenance} + CP_{milk}
\]

**\(CP_{maintenance}\)**
Function of animal body weight

\[
CP_{maintenance} = 104.78 + 0.73 \times BW - 0.00015432 \times BW^2
\]

**\(CP_{milk}\)**
Function of milk and fat production

\[
CP_{milk} = Milk \times (4586 + 1036 \times Fat\%)
\]

McGilliard et al., 1983
Cow nutrient requirement

Total dry matter intake (DMI)
Function of DIM, BW, and 4% fat corrected milk (4% FCM)

\[
DMI \text{ (kg)} = (0.372 \times 4\% \text{ FCM} + 0.0968 \times BW^{0.75}) \times (1 - e^{(-0.192 \times ((\text{DIM}/7) + 3.67)})
\]

4% FCM = 0.4 x Milk + 15 x (Fat%/100) x Milk

NRC, 2001
**Cow body weight**

Measurements are not always available

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**Estimation based on**
- Lactation
- DIM
- Cohorts’ average BW

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Korver et al., 1985 function fitted to NRC, 2001
Nutrient requirement for a group of cows
Energy and protein

Lead factor
Multiplicative factor to adjust nutrient requirements of a group

\[ \text{NE}_{\text{group}} \ (\text{Mcal}) = 83^{rd} \text{ Percentile} (\text{NE}_{\text{group\_cows}}) \]

\[ \text{CP}_{\text{group}} \ (%) = 83^{rd} \text{ Percentile} (\text{CP}_{\text{group\_cows}}) \]

Stallings and McGilliard, 1984
Number of groups for lactating cows
Optimal maximum number of feeding groups

Farm characteristics
• Facilities
• Equipment
• Management
• Labor

Previous findings
• Published reports
• Empirical analyses

Number of groups
• 1, 2, 3, or 4 groups

McGilliard et al., 1983; St-Pierre and Thraen, 1999
Criteria for grouping
Several criteria exist

Days after calving (DIM)
Based on stage of lactation

Fat corrected milk
Based on level of production measured as FCM

Dairy merit
Function of both FCM and BW

Cluster
Function of NE and CP. Seems to be most efficient criterion.

McGilliard et al., 1983; St-Pierre and Thraen, 1999
Calculate the value of NE and CP
Determine diets’ cost

Value of NE and CP could be deducted
Using referee feeds

Value of NE and CP could be available on a farm
Based on farm experience

Price NE and CP
Nutrient values NE ($/Mcal) and CP ($/kg)

\[
\text{Corn \%CP + Corn Mcal NE} = \$/kg \text{ Corn Price}
\]

\[
\text{SBM \%CP + SBM Mcal NE} = \$/kg \text{ SBM Price}
\]
Optimize cows belonging to a feeding group
Maximize the income over feed cost

Non-linear optimization
• Iterative process
• Search for global maxima IOFC

\[
\text{Max(IOFC)} = \text{SUM(IOFC}_{\text{group}})
\]

\[
\text{IOFC}_{\text{group}} = \text{Milk Value - Feed Cost}
\]

\[
\text{Milk Value} = \text{SUM (Milk}_{\text{cow}}) x \text{Milk Price}
\]

\[
\text{Feed Cost} = \text{SUM (DM}_{\text{cow}}) x 83\% \text{ CP x CP price}
+ \text{SUM (DM}_{\text{cow}}) x 83\% \text{ NEI x NEI price}
\]
Additional costs and benefits

Impacts grouping feeding strategies

Management cost
- Additional labor
- Extra management

Milk depression
- Cow social interactions
- Diet changes

Avoid costs
- Additives savings
Overall net return
Bottom line grouping strategies

Net return
+ Max (IOFC)
- Extra management
- Milk depression
+ Savings
Decision support system
Perform your own calculations

Group feeding strategies are farm specific
Every farm is different

Herd demographics change dynamically
Re-grouping is permanent

Market conditions change permanently
Might impact decisions

User-friendly application
Easy to use, still robust
Grouping strategies
For feeding lactating dairy cattle
Feeding grouping strategies

Where to find it

DairyMGT.info

Tools
Grouping strategies

Farm possibilities

Currently grouping?

- How many groups farm can do?
  - How many groups farm does?

  - Currently grouping?
    - no
    - yes
      - How many groups farm can do?
        - How many groups farm can do?
          - Current diet formulation
            - Size of possible groups
              - Additional costs and benefits
          - Additional costs and benefits
          - Current diet formulation
            - Size of possible groups
Decision support system illustration
Economic impact of grouping

<table>
<thead>
<tr>
<th>Current situation</th>
<th>Possible situation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lactating cows</td>
<td>470</td>
</tr>
<tr>
<td>Number groups</td>
<td>None</td>
</tr>
<tr>
<td>NE, Mcal/lb</td>
<td>0.80</td>
</tr>
<tr>
<td>CP, %</td>
<td>17%</td>
</tr>
<tr>
<td>Number groups</td>
<td>3</td>
</tr>
<tr>
<td>Group sizes</td>
<td>100, 100, 270</td>
</tr>
<tr>
<td>Added cost, $</td>
<td>$1,000/month</td>
</tr>
<tr>
<td>Milk loss</td>
<td>5 lb/cow</td>
</tr>
<tr>
<td>Milk loss time</td>
<td>4 days</td>
</tr>
<tr>
<td>Saved cost, $</td>
<td>$0</td>
</tr>
</tbody>
</table>
## Decision support system illustration

### Cluster grouping criteria

<table>
<thead>
<tr>
<th>Possible situation</th>
<th>Cow numbers</th>
<th>NE, Mcal/lb</th>
<th>CP, %</th>
<th>IOFC, $/cow/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>270</td>
<td>0.71</td>
<td>16.05</td>
<td>9.3</td>
</tr>
<tr>
<td>Group 2</td>
<td>100</td>
<td>0.65</td>
<td>14.18</td>
<td>7.2</td>
</tr>
<tr>
<td>Group 3</td>
<td>100</td>
<td>0.62</td>
<td>13.07</td>
<td>4.7</td>
</tr>
</tbody>
</table>

Herd net return, $/herd per year (x1,000): 1,189, 1,336, 1,100, 1,175, 1,250, 1,325, 1,400

No grouping

3 clusters
Analysis from dairy farm records

30 Wisconsin dairy farms

No grouping vs. 3 groups
• Same size groups

Same prices for all
• $15.89/cwt milk
• $0.14337/lb CP
• $0.1174/Mcal NEI

Projected body weight
• 1,100 lb primiparous
• 1,300 lb multiparous

Cluster grouping
• 83rd percentile CP and NEI
Analysis from dairy farm records
30 Wisconsin dairy farms

<table>
<thead>
<tr>
<th></th>
<th>Number of lactating cows (n=30)</th>
<th>Income over Feed Cost (no grouping)</th>
<th>Income over Feed Cost (3 groups)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>$/cow per year</td>
<td>$/cow per year</td>
</tr>
<tr>
<td>Mean</td>
<td>788</td>
<td>$2,311</td>
<td>$2,707</td>
</tr>
<tr>
<td>Minimum</td>
<td>&lt; 200</td>
<td>$697</td>
<td>$1,059</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

After reasonable extra costs
- Still increased net margin of between 5 and 47%
Analysis with dairy farmers input
2 dairy farms

Farm 1
• Current: 3 groups using DIM
• Proposed: 4 cluster groups

Additional net return:
• $106/cow per year

Farm 2
• Current: 4 groups using lactation and breeding
• Proposed: 4 additional groups

Additional net return:
• Not determined yet: additional analysis required
• Preliminary data show potential
Acknowledgement

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Thanks