

# Move, Keep or Cull Her: Tools for Grouping & Culling Decisions



## **Part 2: 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



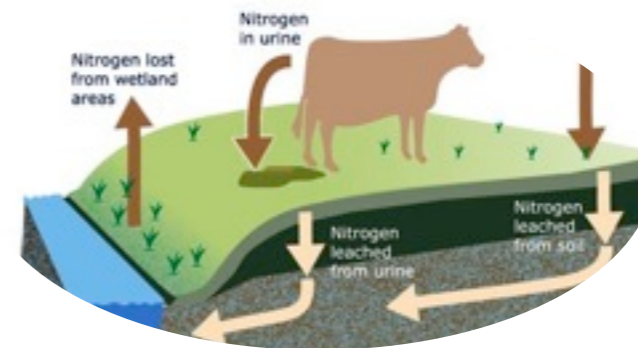
**Improved nutrient use efficiency**

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





# 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 ( $NE_{total}$ )

Energy required for  
maintenance + energy  
required for milk  
production

$$NE_{total} \text{ (Mcal)} = NE_{maintenance} + NE_{milk}$$

### $NE_{maintenance}$

Function of animal body  
weight

$$NE_{maintenance} = 0.079 \times BW^{0.75}$$

### $NE_{milk}$

Function of milk and fat  
production

$$NE_{milk} = \text{Milk} \times (0.36 + 0.0969 \times \text{Fat}\%)$$



# Cow nutrient requirement

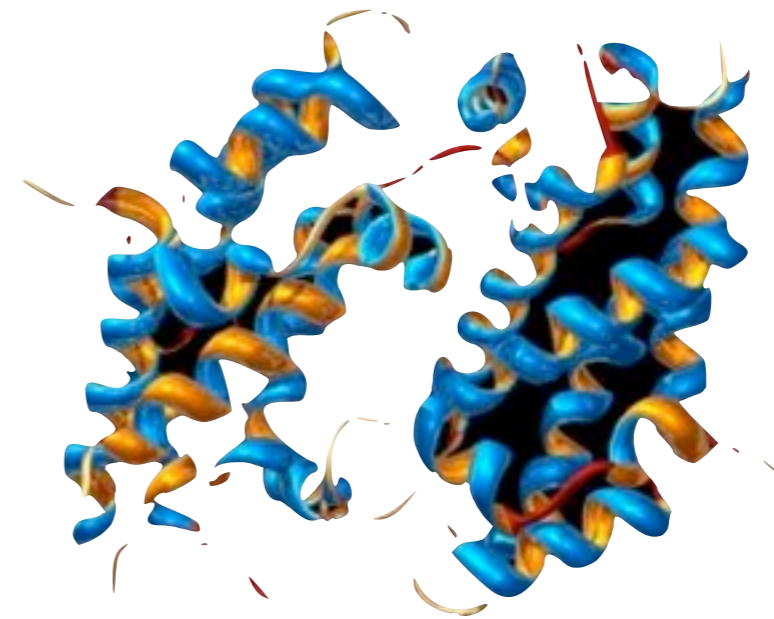
## Protein

**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

## Dry matter intake

### Total dry matter intake (DMI)

Function of DIM, BW, and  
4% fat corrected milk (4%  
FCM)



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

$$4\% \text{ FCM} = 0.4 \times \text{Milk} + 15 \times (\text{Fat\%/100}) \times \text{Milk}$$



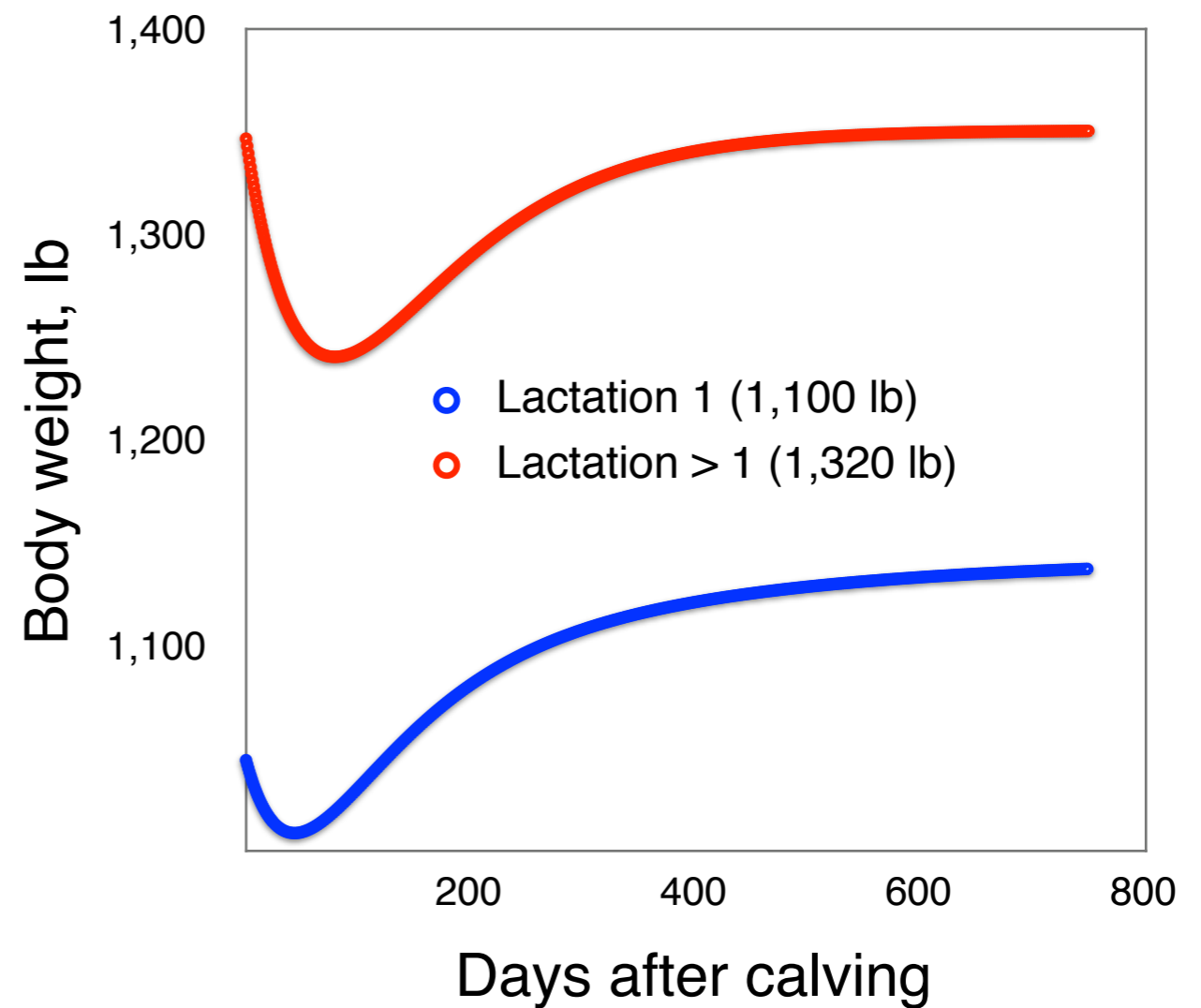
# Cow body weight

Measurements are not always available



## Estimation based on

- Lactation
- DIM
- Cohorts' average BW



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

$$NE_{group} (Mcal) = 83^{rd} \text{ Percentile } (NE_{group\_cows})$$

$$CP_{group} (\%) = 83^{rd} \text{ Percentile } (CP_{group\_cows})$$



# 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

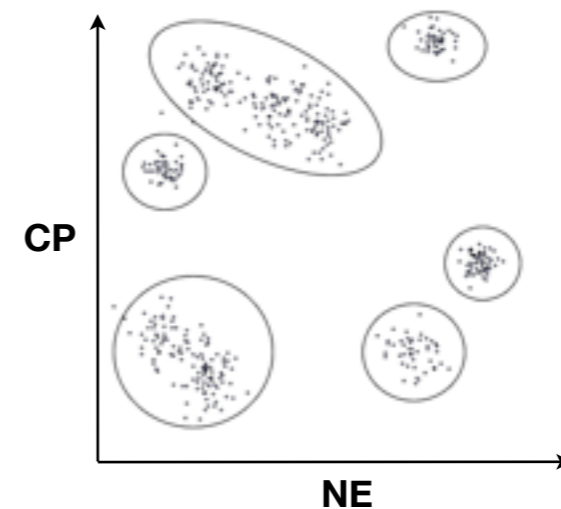
Based on level of production measured as FCM

## 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

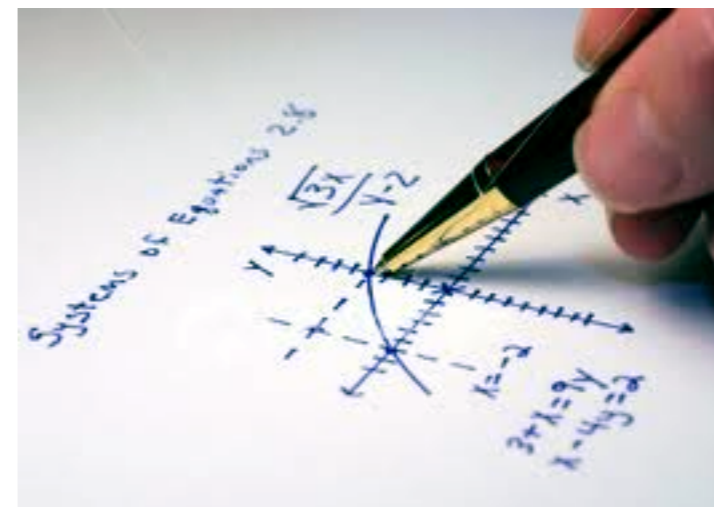
Value of NE and CP could  
be deducted  
Using referee feeds

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

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

$$\text{SBM \%CP} + \text{SBM Mcal NE} = \$/\text{kg SBM Price}$$

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

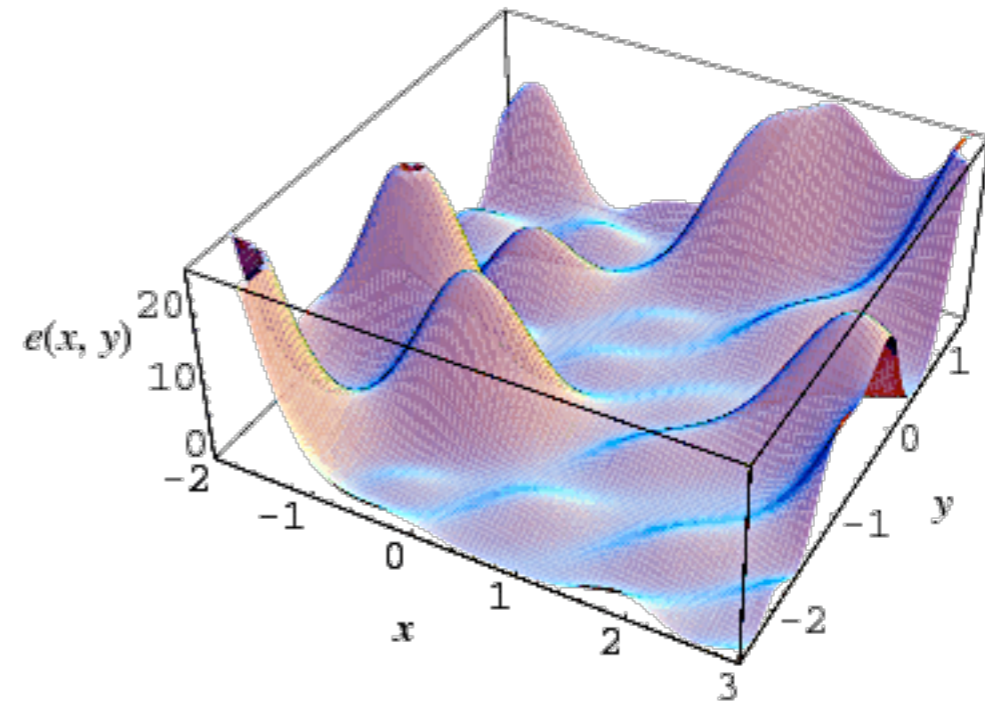


# Optimize cows belonging to a feeding group

Maximize the income over feed cost

## Non-linear optimization

- Iterative process
- Search for global maxima IOFC



$$\mathbf{Max(IOFC) = SUM(IOFC_{group})}$$

$$\mathbf{IOFC_{group} = Milk Value - Feed Cost}$$

$$\mathbf{Milk Value = SUM (Milk_{cow}) \times Milk Price}$$

$$\mathbf{Feed Cost = SUM (DM_{cow}) \times 83\% CP \times CP price} \\ \mathbf{+ SUM (DM_{cow}) \times 83\% NEI \times NEI price}$$

# 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

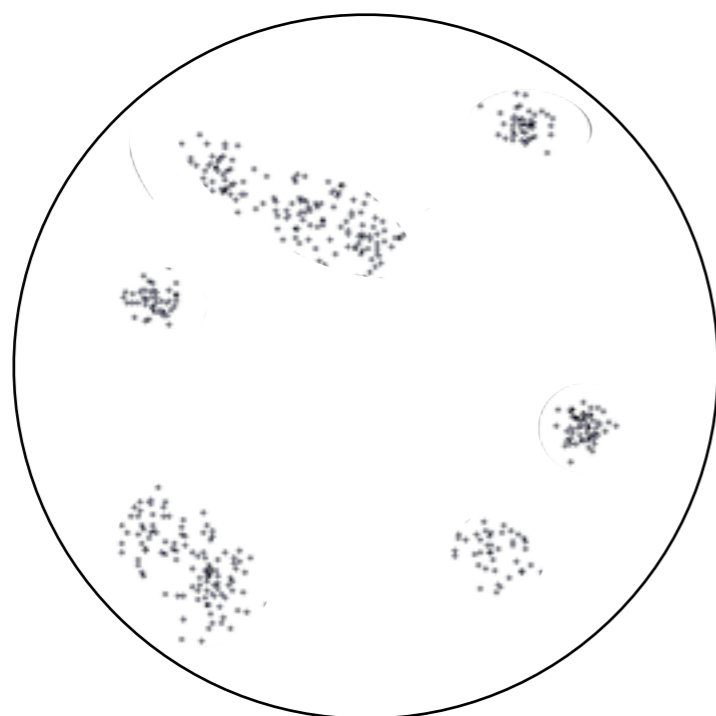


# Overall net return

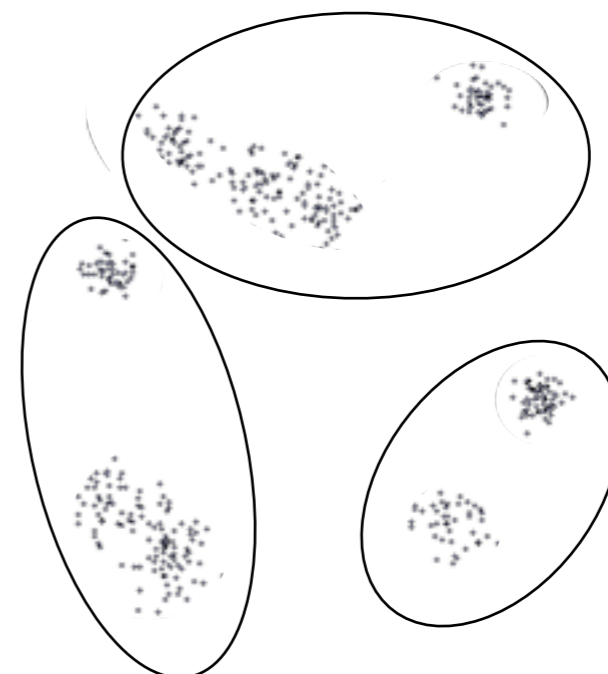
## Bottom line grouping strategies

### Net return

- + Max (IOFC)
- Extra management
- Milk depression
- + Savings



VS





# Decision support system

Perform your own calculations

**Group feeding strategies  
are farm specific**

Every farm is different



**Herd demographics  
changes 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

The screenshot shows the Dairy Management UW-Extension website. The header includes the University of Wisconsin-Madison logo and the UW Extension logo. A navigation menu contains links for Home, Tools, Projects, Publications, Presentations, LGM-Dairy, Links, About, Contact, Comments, News, People, Opportunities, and Gallery. The main heading is "Grouping Strategies for Feeding Lactating Dairy Cattle". Below this, there are tabs for Overview, Upload Farm Details, Group Cows, and Reap Benefits. A status bar indicates "Sample Farm: Total Cows = 470".

**Prices**

|              | CP% | Nel, MCal/lb | \$(Unit)     |
|--------------|-----|--------------|--------------|
| Corn         | 0.1 | 0.9          | 6.72 (\$/bu) |
| Soybean Meal | 0.5 | 0.88         | 350 (\$/ton) |

Please note that the values highlighted with this color will be used by the tool.

**Calculated Values**

|             |         |                                     |
|-------------|---------|-------------------------------------|
| \$/lb CP    | 0.14337 | <input type="button" value="Edit"/> |
| \$/Mcal NEL | 0.1174  | <input type="button" value="Edit"/> |

Milk Price:  (\$/cwt)

**Download Parameter Excel File**

**Upload Parameters as Excel File**

Upload the Excel File:  No file chosen

**Current File/Data Status**

Using Data from Default Parameters File on Server

# Feeding grouping strategies

Where to find it

## DairyMGT.info

The screenshot shows the homepage of DairyMGT.info. At the top, there is a banner image of cows in a field with the text "Dairy Management UW-Extension University of Wisconsin-Madison" and the "WISCONSIN Extension" logo. Below the banner is a navigation menu with items: Home, Tools, Projects, Publications, Presentations, Links, Find, About, Contact, Comments, News, People, Opportunities, Gallery, and a search box. The main heading is "Dairy Management". Below this is a paragraph describing the site's purpose: "Dairy Management 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 systems to help dairy farms improve their economic performance. Dr. Victor Cabrera focuses on model-based decision support in dairy cattle and in dairy farm production systems. Dr. Cabrera's primary interest is to improve cost-efficiency and profitability along with environmental stewardship in dairy farms by using simulation techniques, artificial intelligence, and expert systems. Dr. Cabrera's research and Extension programs involve interdisciplinary and participatory approaches towards the creation of user-friendly decision support systems. As an Extension Specialist, Dr. Cabrera works in close relationships with county-based Extension faculty, dairy producers, consultants, and related industry."

There are several sidebar sections:

- Latest Projects:** Genomic Selection and Herd Management, Dairy Reproduction Decision Support Tools, Strategies of Pasture Supplementation, Improving Dairy Cow Fertility, LGM-Dairy.
- Helpful Link:** Beers Money Program, Contact.
- UW:** University of Wisconsin - Madison, UW - Cooperative Extension, UW - Dairy Science, Understanding Dairy Markets, UW Dairy Nutrient, UW Center for Dairy Profitability.
- Dairy News:** UW-Extension Dairy News.

A profile for Victor E. Cabrera, Ph.D., is shown, including his title as Assistant Professor and Extension Specialist Dairy Management, his contact information (279 Animal Sciences, 1675 Observatory Dr, Madison, WI 53706, (608) 265-4500, v Cabrera@wisc.edu Professional Page), and a link to his Admin Portal.

A "TOOLS" section is also visible, featuring a "Dairy Management Tools" link with a "HERE" button and the text "Click to find out more about tools provided by DairyMGT".



## Tools

The screenshot shows the "Tools" page on DairyMGT.info. The navigation menu at the top includes: Home, Tools, Projects, Publications, Presentations, Links, Find, Feeding, Heifers, Reproduction, Production, Replacement, Financial, Price Risk, and Environment. The main heading is "Management Tools". Below this is a description: "A collection of state-of-the-art dairy management tool that are: user-friendly, interactive, robust, visually attractive, and self contained. All these tools have clear or self-explanatory instructions and technical support available." and a link to "Click on the Tool title to learn more."

The page is organized into categories:

- Feeding:** 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:** 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:** Economic Value of Sexed Semen Programs for Dairy Heifers, UW DairyRepro®: A Reproductive Economic Analysis Tool, Exploring Timing of Pregnancy Impact on Income Over Feed Cost, Dairy Reproductive Economic Analysis.

- [Dairy Extension Feed Cost Evaluator](#)
- [Dairy Ration Feed Additive Break-Even Analysis](#)
- [Corn Feeding Strategies](#)
- [Income Over Feed Cost](#)
- [Income Over Feed Supplement Cost](#)
- [Optigen® Evaluator](#)
- [Grouping Strategies for Feeding Lactating Dairy Cattle](#)

### Reproduction

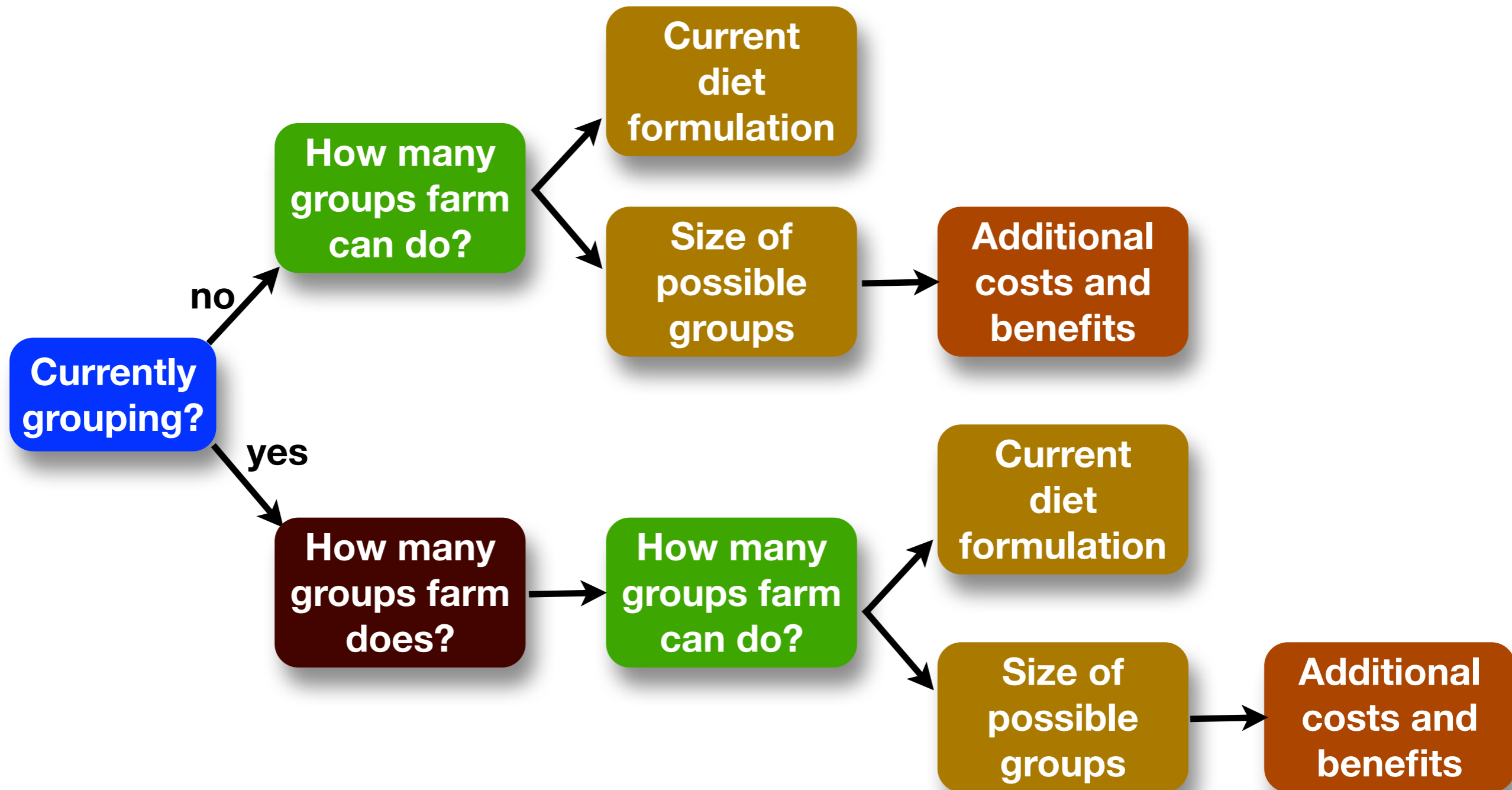
- [Dairy Reproductive Economic Analysis](#)
- [Exploring Timing of Pregnancy Impact on Income Over Feed Cost](#)
- [UW DairyRepro®: A Reproductive Economic Analysis Tool](#)
- [Economic Value of Sexed Semen Programs for Dairy Heifers](#)

# Grouping Strategies for Feeding Lactating Dairy Cattle



# Grouping strategies

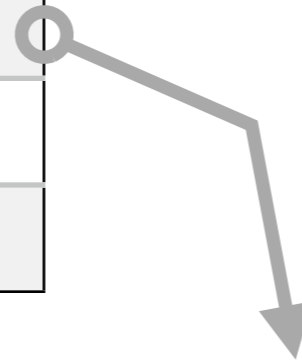
Farm possibilities



# Decision support system illustration

## Economic impact of grouping

|                | Current situation |
|----------------|-------------------|
| Lactating cows | 470               |
| Number groups  | None              |
| NE, Mcal/lb    | 0.80              |
| CP, %          | 17%               |

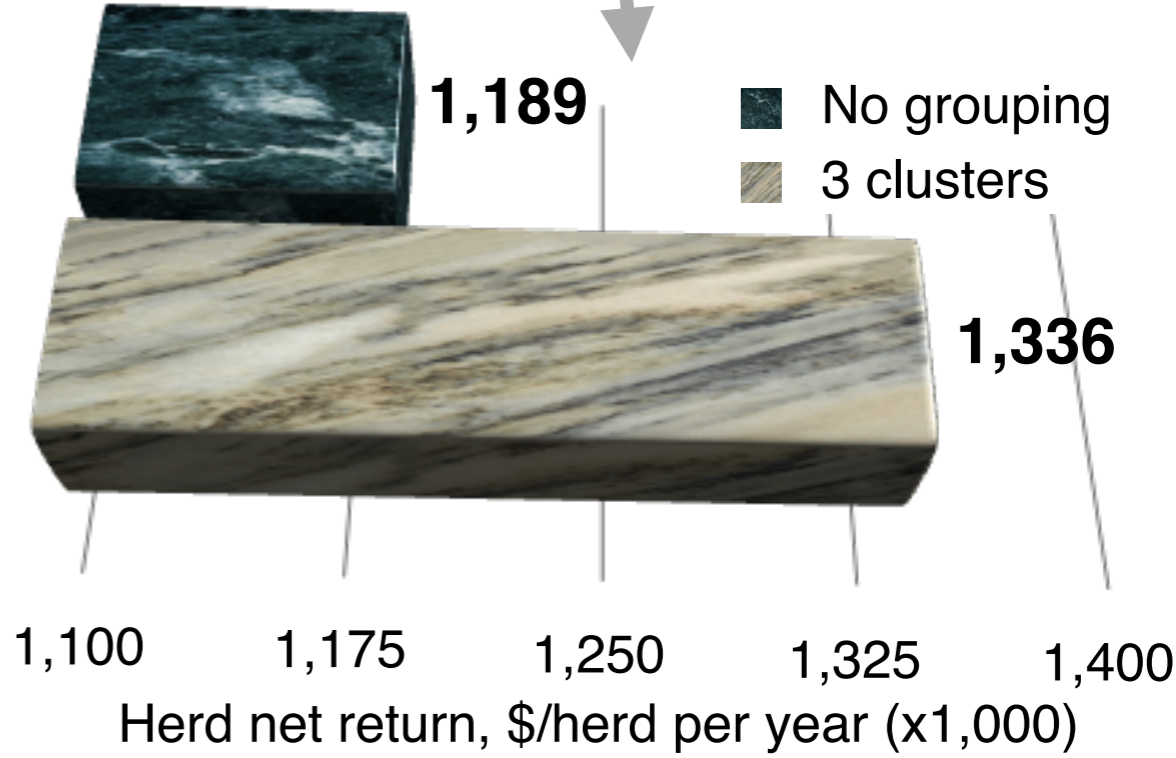


|                | Possible situation |
|----------------|--------------------|
| Number groups  | 3                  |
| Group sizes    | 100, 100, 270      |
| Added cost, \$ | \$1,000/month      |
| Milk loss      | 5 lb/cow           |
| Milk loss time | 4 days             |
| Saved cost, \$ | \$0                |

# Decision support system illustration

## Cluster grouping criteria

|         | Possible situation |             |       |                  |
|---------|--------------------|-------------|-------|------------------|
|         | Cow numbers        | NE, Mcal/lb | CP, % | IOFC, \$/cow/day |
| Group 1 | 270                | 0.71        | 16.05 | 9.3              |
| Group 2 | 100                | 0.65        | 14.18 | 7.2              |
| Group 3 | 100                | 0.62        | 13.07 | 4.7              |



# 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

- 83<sup>rd</sup> percentile CP and NEI





# Analysis from dairy farm records

30 Wisconsin dairy farms

|         | Number of lactating cows (n=30) | Income over Feed Cost (no grouping) | Income over Feed Cost (3 groups) |
|---------|---------------------------------|-------------------------------------|----------------------------------|
|         |                                 | \$/cow per year                     |                                  |
| Mean    | 788                             | \$2,311                             | \$2,707                          |
| Minimum | < 200                           | \$697                               | \$1,059                          |
| Maximum | > 1,000                         | \$2,967                             | \$3,285                          |

## 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

Project support

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United States Department of Agriculture  
National Institute of Food and Agriculture



**Thanks**