



# **Grouping Strategies for Feeding Lactating Dairy Cattle**

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# What seems to be the problem?

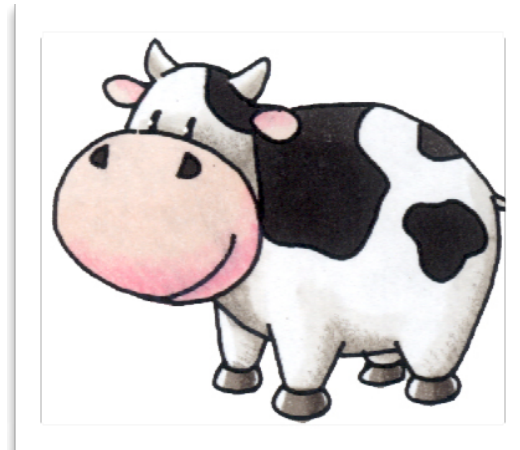
Dairy farmers might be over-feeding lactating cows

## 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**

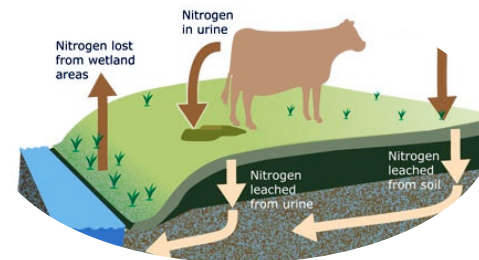
Diet closer to cow requirements

**Less overfed animals**

Decreased overweighted cows

**Less nutrient excretion**

Decreased environmental concerns



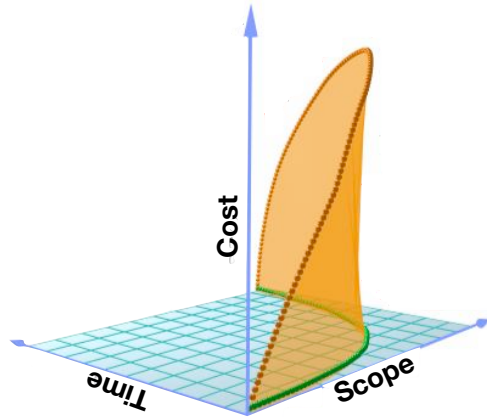
**Lower feeding costs**

Higher milk income over feed cost



# Why dairy farmers do not group more?

There could be a myriad of reasons!



Not enough expertise or  
knowledge available  
Management constraints

Other reasons  
Trying to find them

Farm facilities or  
equipment limitations  
Physical constraints

Not enough labor or  
personnel  
Labor constraints

**A. BASIC DAIRY FARM INFORMATION**

A.1. Number of dairy cattle you typically have on your farm:  
 A.1.1. No. of lactating dairy cows (cows milking) \_\_\_\_\_  
 A.1.2. No. of dry cows \_\_\_\_\_  
 A.1.3. No. of replacement heifers (9 mos. of age to date of first calving) \_\_\_\_\_  
 A.1.4. No. of heifers for annual service \_\_\_\_\_

A.2. Milk production on your farm:  
 A.2.1. What is the typical daily bulk tank or milk shipped for your herd? \_\_\_\_\_ lb/cow per day  
 A.2.2. What is the typical daily bulk tank or milk shipped for your herd? \_\_\_\_\_ lb/cow per day

A.3. Describe the primary management of the dairy operation:  
 A.3.1. Gender:  Male  Female  
 A.3.2. Age \_\_\_\_\_ years  
 A.3.3. Education:  High school or less  Graduated with 2-year degree or technical school  
 Graduated college with BA or higher  
 Postsecondary certificate  
 Vocational  Other \_\_\_\_\_

A.4. Who performs the role of **supervisor** for the dairy operation (check all that apply):  
 Owner or one other enterprise representative  Feed supplier representative  
 Veterinarian  Other \_\_\_\_\_

A.5. Do you consider your farm to be managed professionally as **pasture-based systems** during the grazing period?  
 YES  NO

A.6. Is your farm certified organic (or in the certification process)?  
 YES  NO

A.7. Describe your primary housing facility for lactating cows:  
 A.7.1. Percentage (%) of cows housed individually in tie-stall or machine barn:  
 100% **NO**  In question A.8.C.  Other % \_\_\_\_\_  None  
 A.7.2. Cows housed in groups:  
 A.7.2.1. No. of groups, pens, or stalls \_\_\_\_\_  
 A.7.2.2. Type of group housing (check all that apply):  
 Free stall barn  Stanchion system  Open dry lot  
 Bedded pad yard under roof  Covered bedded pad under roof  
 Other \_\_\_\_\_

A.8. **Physical Constraints of Lactating Cows.** Indicate your level of agreement with the following statements regarding your management-related criteria for grouping lactating cows. In each row, circle a number.

I group lactating cows based on:	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Tie-stall is easiest to keep cows full	1	2	3	4	5
Free stall milk	1	2	3	4	5
Free stall milk	1	2	3	4	5
Free stall milk	1	2	3	4	5
Milk production	1	2	3	4	5
Body condition/body weight	1	2	3	4	5
Health (i.e., mastitis, SCC, etc.)	1	2	3	4	5
Reproductive (i.e., breeding, pregnant, DHI, etc.)	1	2	3	4	5
Do we believe enough people are working the milking	1	2	3	4	5
Other _____	1	2	3	4	5

**B. FEEDING & RATIONS FOR LACTATING COWS**

B.1. Describe your feeding system for lactating cows (check all that apply):  
 One or more total mixed rations (TMR). All feed ingredients for a given ration are mixed into one mix and offered to cows. **STOP**  In question B.2.  
 Partial mixed rations (forage and concentrate mixed, but additional feed offered):  
 Additional concentrate fed to complete forage  
 Additional concentrate fed to complete milking forage  
 Additional concentrate top-dressed to the milk machine milking forage  
 Additional forage fed (describe \_\_\_\_\_)  
 Other \_\_\_\_\_  
 Forage and concentrate each delivered separately (see notes):  
 Concentrates fed to complete milking  Concentrates fed to robotic milking system  
 Concentrates fed to milking parlor  Concentrates top-dressed to robotic milking system  Other \_\_\_\_\_

B.2. Do you feed different rations (diets) to lactating milking cows?  
 YES (How many different rations? \_\_\_\_\_)  NO **STOP**  In question B.4.

B.3. **Feeder Group of Lactating Cows.** Indicate your level of agreement with the following statements regarding grouping lactating cows for feeding purposes. In each row, circle a number.

**I feed different rations based on:**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Fresh to all other lactating cows	1	2	3	4	5
Stage of lactation for dry-lact cows	1	2	3	4	5
Parity (lactation number)	1	2	3	4	5
Milk production	1	2	3	4	5
Body condition/body weight	1	2	3	4	5
Health related issues	1	2	3	4	5
Reproductive status (pregnant vs. open)	1	2	3	4	5
I do not believe more than one diet is needed	1	2	3	4	5
Concentrate diet	1	2	3	4	5
Other _____	1	2	3	4	5

B.4. **Constraints in Feeder Group of Lactating Cows.** Indicate your level of agreement with the following statements regarding the constraints to having more feeding groups for your lactating cows. In each row, circle a number.

**I have \_\_\_\_\_ feeding groups.**

**Reasons I do not feed more rations (diets)**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Current farm facilities do not support it	1	2	3	4	5
Not enough labor or personnel to handle it	1	2	3	4	5
Difficult to keep it simple	1	2	3	4	5
Milk groups that are moved to different groups	1	2	3	4	5
Conditions with grouping for reproductive purposes	1	2	3	4	5
Management does not want to	1	2	3	4	5
I do not believe more than one feeding group is needed	1	2	3	4	5
Other _____	1	2	3	4	5

B.5. Would you consider becoming a demonstration farm for implementation of diets?  YES  NO  
 Thank you very much for completing the survey! Your input is valuable and important!

# 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

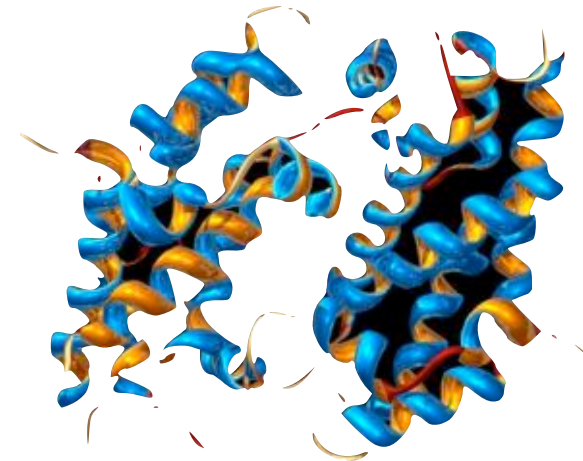
## Protein

**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)



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

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



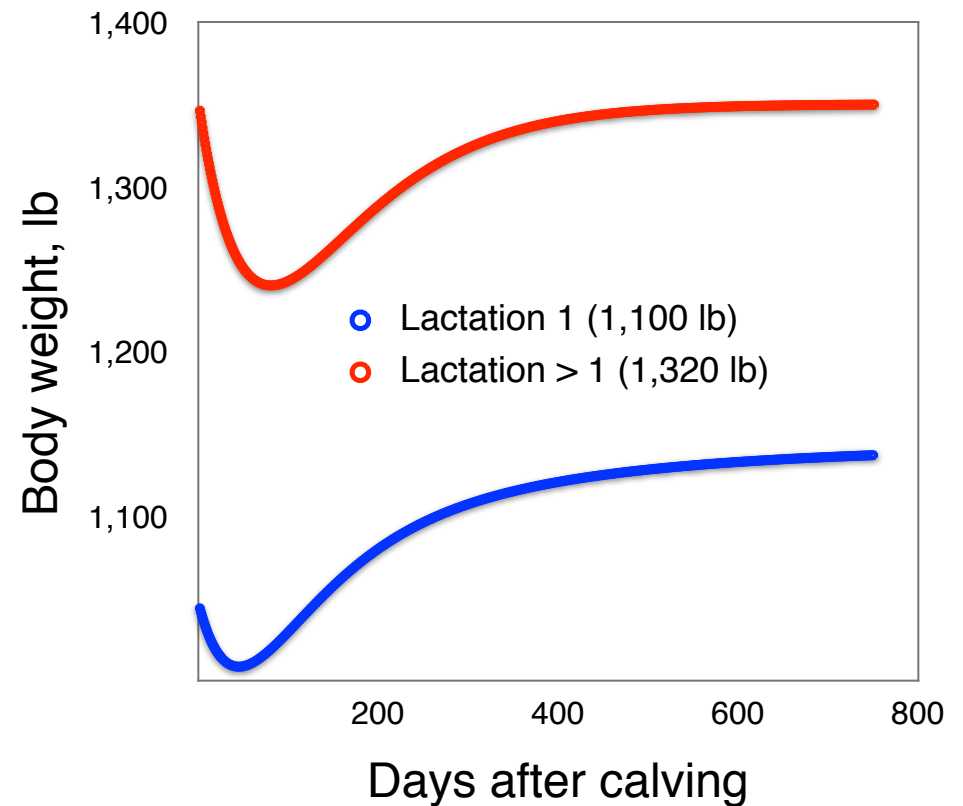
# Cow body weight

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

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

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



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

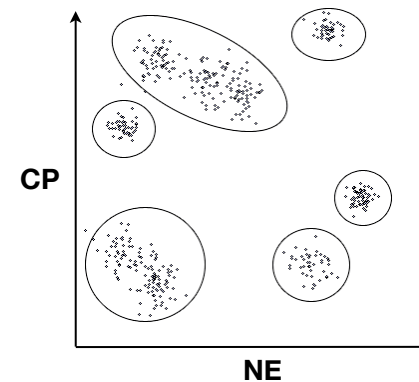
Based on level of production measured as FCM

## 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

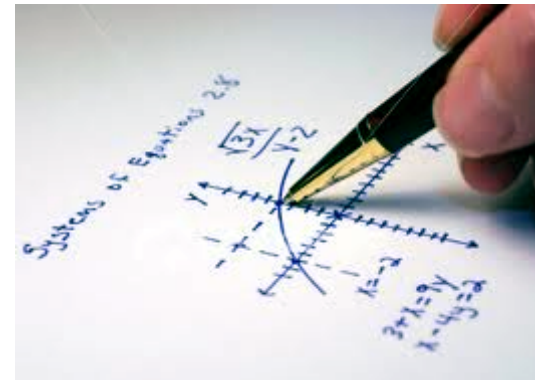
Value of NE and CP could  
be deducted  
Using referee feeds

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

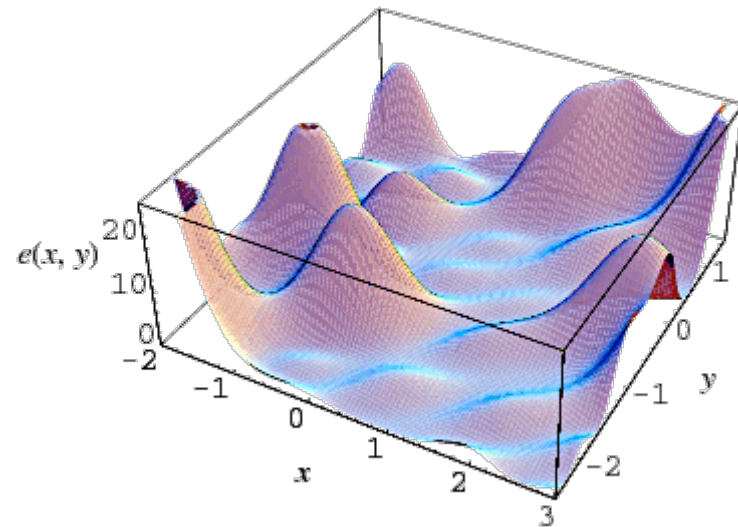


# Optimize cows belonging to a feeding group

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

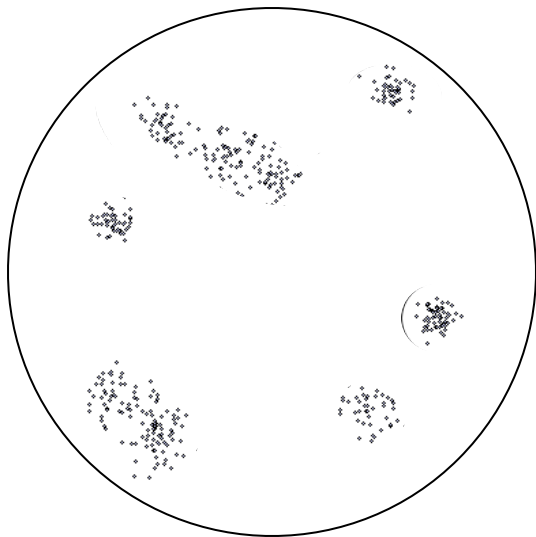


# Overall net return

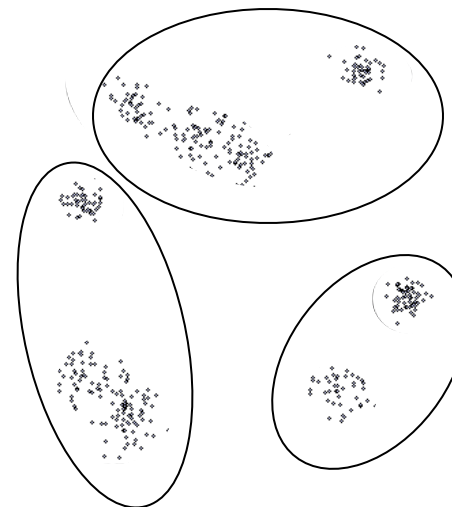
Bottom line grouping strategies

## 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 is a sub-menu with "Overview", "Upload Farm Details", "Group Cows", and "Reap Benefits", and a status indicator "Sample Farm: Total Cows = 470".

**Prices**

	CP%	Nel, MCal/lb	\$(Unit)
Corn	<input type="text" value="0.1"/>	<input type="text" value="0.9"/>	<input type="text" value="6.72"/> (\$/bu)
Soybean Meal	<input type="text" value="0.5"/>	<input type="text" value="0.88"/>	<input type="text" value="350"/> (\$/ton)

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

**Calculated Values**

\$/lb CP	<input type="text" value="0.14337"/>	<input type="button" value="Edit"/>
\$/Mcal NEL	<input type="text" value="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 DairyMGT.info website. At the top is a banner with the text "Dairy Management UW-Extension University of Wisconsin-Madison" and logos for "THE UNIVERSITY OF WISCONSIN" and "UW Extension". 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 content area is titled "Dairy Management" and contains a paragraph about the site's purpose. On the left, there are sections for "Latest Projects" (listing Genomic Selection and Herd Management, Dairy Reproduction Decision Support Tools, Strategies of Pasture Supplementation, Improving Dairy Cow Fertility, and LGM-Dairy), "UW" (listing University of Wisconsin - Madison, UW - Cooperative Extension, UW - Dairy Science, Understanding Dairy Markets, UW Dairy Nutrient, and UW Center for Dairy Profitability), and "Dairy News" (listing UW-Extension Dairy News). On the right, there is a "Helpful Link" section for "Repro Money Program" and "Contact", a profile for "Victor E. Cabrera, Ph.D." (Assistant Professor, Extension Specialist Dairy Management, 279 Animal Sciences, 1675 Observatory Dr., Madison, WI 53706, (608) 265-8506, vcabrera@wisc.edu, Professional Page), and a "TOOLS" section titled "Dairy Management Tools" with a "READ MORE" button.

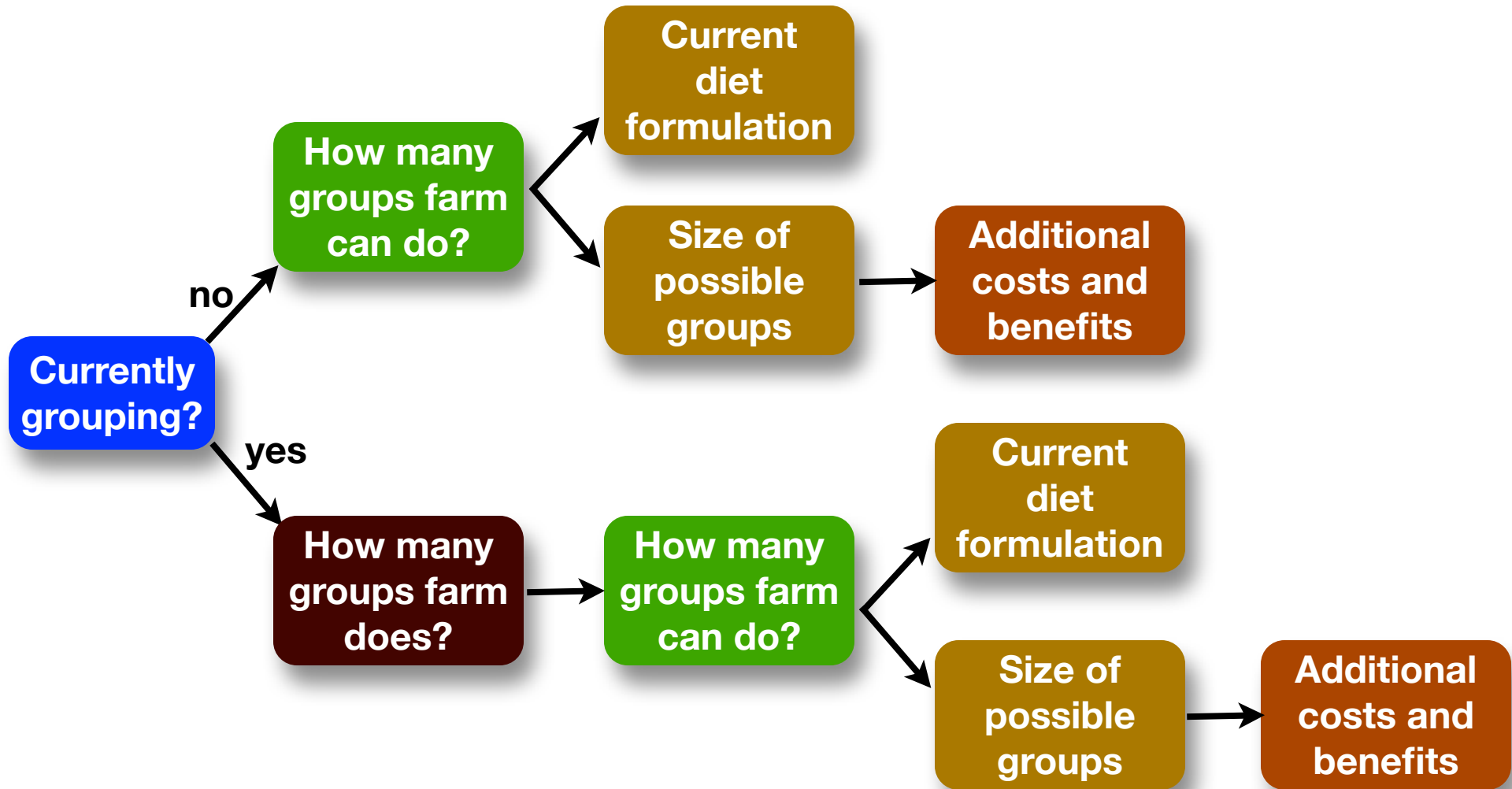


## Tools

The screenshot shows the "Tools" page on DairyMGT.info. It has a navigation menu with items: Home, Tools, Projects, Publications, Presentations, Links, Find, Feeding, Heifers, Reproduction, Production, Replacement, Financial, Price Risk, and Environment. The main content area is titled "Management Tools" and contains a paragraph: "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." Below this is a section for "Feeding" with a list of tools: Grouping Strategies for Feeding Lactating Dairy Cattle, Optigen® Evaluator, Income Over Feed Supplement Cost, Dairy Extension Feed Cost Evaluator, Com Feeding Strategies, Income Over Feed Cost, and Dairy Ration Feed Additive Break-Even Analysis. There is also a section for "Heifers" with tools: Cost-Benefit of Accelerated Liquid Feeding Program for Dairy Calves, Economic Value of Sexed Semen Programs for Dairy Heifers, Heifer Replacement, and Heifer Break-Even. A section for "Reproduction" includes: 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, and Dairy Reproductive Economic Analysis. A "Production" section is partially visible at the bottom.

# Grouping strategies

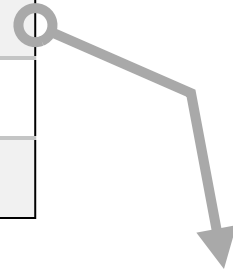
Farm possibilities



# Decision support system illustration

## Economic impact of grouping

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

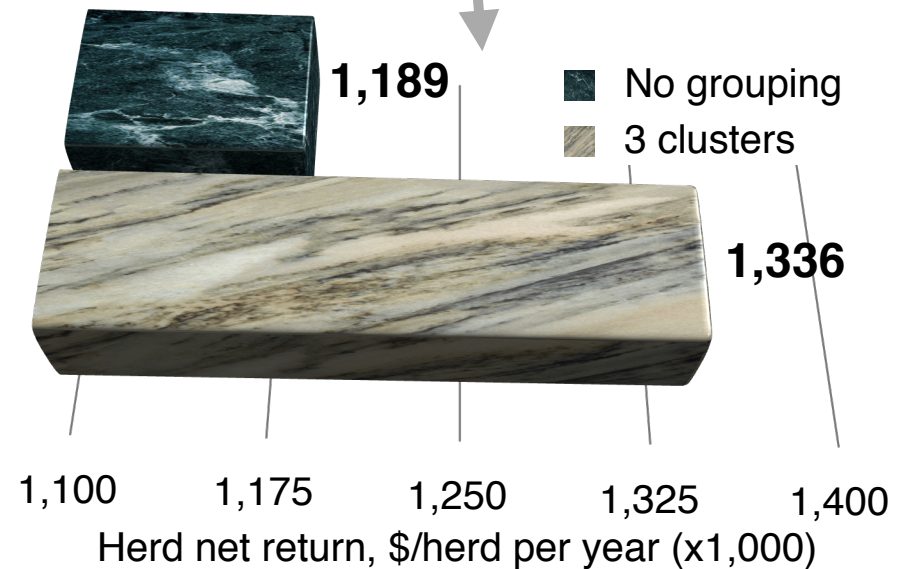


	Possible situation
Number groups	3
Group sizes	100, 100, 270
Added cost, \$	\$1,000/month
Milk loss	5 lb/cow
Milk loss time	4 days
Saved cost, \$	\$0

# 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

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United States Department of Agriculture  
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**Thanks**