



Grouping Strategies for Feeding Lactating Dairy Cattle

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What seems to be the problem?

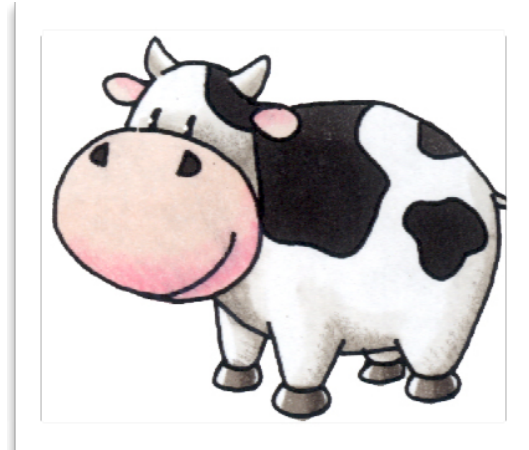
Dairy farmers might be over-feeding lactating cows

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

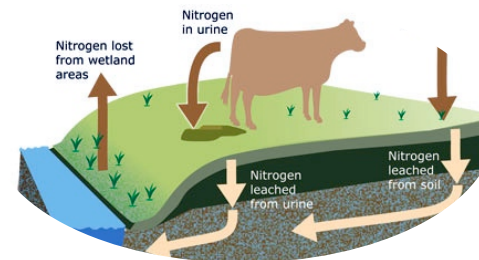
Diet closer to cow requirements

Less overfed animals

Decreased overweighted cows

Less nutrient excretion

Decreased environmental concerns



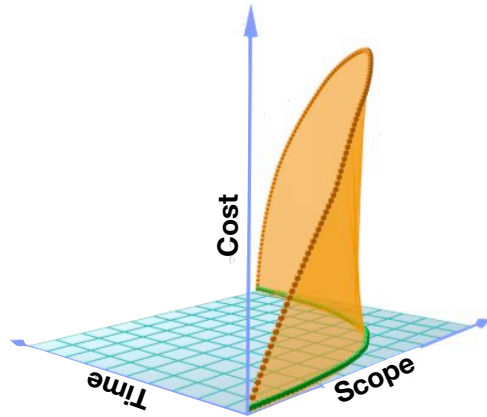
Lower feeding costs

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 bulls for natural service:					
A.2. Milk production on your farm:					
A.2.1. What is the typical total average (TBA) for your herd? _____ lbs/cow per year					
A.2.2. What is the typical daily bulk tank or milk shipped for your herd? _____ lbs/cow per day					
A.3. Describe the primary management of the dairy operation:					
A.3.1. Gender: <input type="checkbox"/> Males <input type="checkbox"/> Females					
A.3.2. Age: _____ years					
A.3.3. Education: <input type="checkbox"/> High school or less <input type="checkbox"/> graduated with 2-year degree or technical school <input type="checkbox"/> graduate college with BA or higher <input type="checkbox"/> postdoctoral certificate					
A.4. Who performs the role of veterinarian for the dairy operation (check all that apply):					
<input type="checkbox"/> based at an off-farm veterinary	<input type="checkbox"/> full-time equine representative				
<input type="checkbox"/> private consulting veterinarian	<input type="checkbox"/> veterinarian	<input type="checkbox"/> Other			
A.5. Do you consider your farm to be managed professionally as pasture-based systems during the grazing season? <input type="checkbox"/> YES <input type="checkbox"/> NO					
A.6. Is your farm certified organic (or in the certification process)? <input type="checkbox"/> YES <input type="checkbox"/> NO					
A.7. Describe your primary lactating facility for lactating cows:					
A.7.1. Percentage (%) of cows housed individually in tie-stall or machine barn:	<input type="checkbox"/> 100% <input type="checkbox"/> 80-99% <input type="checkbox"/> 60-79% <input type="checkbox"/> 40-59% <input type="checkbox"/> 20-39% <input type="checkbox"/> 10-19% <input type="checkbox"/> 0-9%				
A.7.2. Cows housed in groups:	<input type="checkbox"/> 100% <input type="checkbox"/> 80-99% <input type="checkbox"/> 60-79% <input type="checkbox"/> 40-59% <input type="checkbox"/> 20-39% <input type="checkbox"/> 10-19% <input type="checkbox"/> 0-9%				
A.7.3. Type of group housing (check all that apply):	<input type="checkbox"/> Free stall barn <input type="checkbox"/> Double open stall <input type="checkbox"/> Open dry lot <input type="checkbox"/> Bedded pad you make roof <input type="checkbox"/> Covered bedded pad under roof <input type="checkbox"/> 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
1. Lactation is critical to keep cows fit:	1	2	3	4	5
2. Fresh cow group:	1	2	3	4	5
3. Dairy milk:	1	2	3	4	5
4. Lactation health group:	1	2	3	4	5
5. Milk production:	1	2	3	4	5
6. Body condition/body weight:	1	2	3	4	5
7. Health (i.e., mastitis, SCC, milk, etc.):	1	2	3	4	5
8. Reproductive (i.e., breeding, pregnant, DHI, etc.):	1	2	3	4	5
9. Do you believe more than one diet is needed:	1	2	3	4	5
10. 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):					
<input type="checkbox"/> One or more total mixed rations (TMR). All feed ingredients for a given ration are mixed into one mix and offered to cows. SKIP # to question B.2.					
<input type="checkbox"/> Partial mixed rations (forage and concentrate mixed, but additional feed offered):					
<input type="checkbox"/> Additional concentrates fed in separate troughs					
<input type="checkbox"/> Additional concentrates fed in milking parlor					
<input type="checkbox"/> Additional concentrates top dressed to the milk machines milking barn					
<input type="checkbox"/> Additional forage fed directly to the milk machines milking barn					
<input type="checkbox"/> Other _____					
<input type="checkbox"/> Forage and concentrate each delivered separately (no mixing):					
<input type="checkbox"/> Concentrates fed in separate troughs <input type="checkbox"/> Concentrates fed in robotic milking system					
<input type="checkbox"/> Concentrates top dressed to feed machines milking barn <input type="checkbox"/> Other _____					
B.2. Do you feed different rations (diets) to lactating milking cows?					
<input type="checkbox"/> YES (How many different rations?) _____ <input type="checkbox"/> NO SKIP # to question B.3.					
B.3. Feeding Groups 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
1. Fresh to all other lactating cows:	1	2	3	4	5
2. Stage of lactation for each fresh cow:	1	2	3	4	5
3. Parity (lactation number):	1	2	3	4	5
4. Milk production:	1	2	3	4	5
5. Body condition/body weight:	1	2	3	4	5
6. Health related issues:	1	2	3	4	5
7. Reproductive status (pregnant vs. open):	1	2	3	4	5
8. Do you believe more than one diet is needed:	1	2	3	4	5
9. Lactation diet:	1	2	3	4	5
10. Other _____:	1	2	3	4	5
B.4. Constraints to Feeding Groups 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 cannot:	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. Have lactating cows:	1	2	3	4	5
2. Current farm facilities do not support it:	1	2	3	4	5
3. Get enough labor or personnel to handle it:	1	2	3	4	5
4. Desire to keep it simple:	1	2	3	4	5
5. Milk groups that are moved to different groups:	1	2	3	4	5
6. Conflicts with grouping for reproductive purposes:	1	2	3	4	5
7. Management does not see need for:	1	2	3	4	5
8. Do you believe more than one feeding group is needed:	1	2	3	4	5
9. Other _____:	1	2	3	4	5
B.5. Would you consider becoming a demonstration farm for implementation of diets? <input type="checkbox"/> YES <input type="checkbox"/> 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

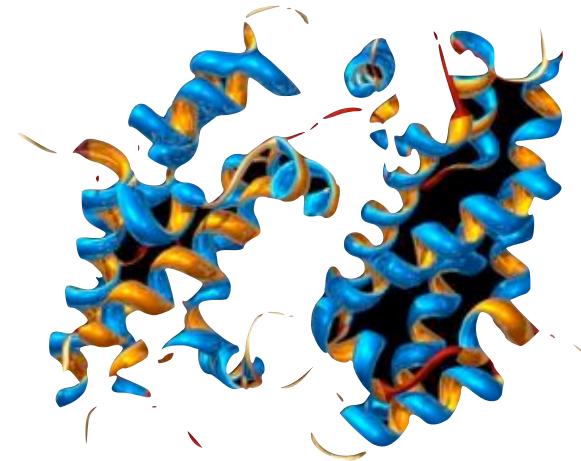
Protein

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 feed requirement

Dry matter intake

Total dry matter intake (DMI)

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



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

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

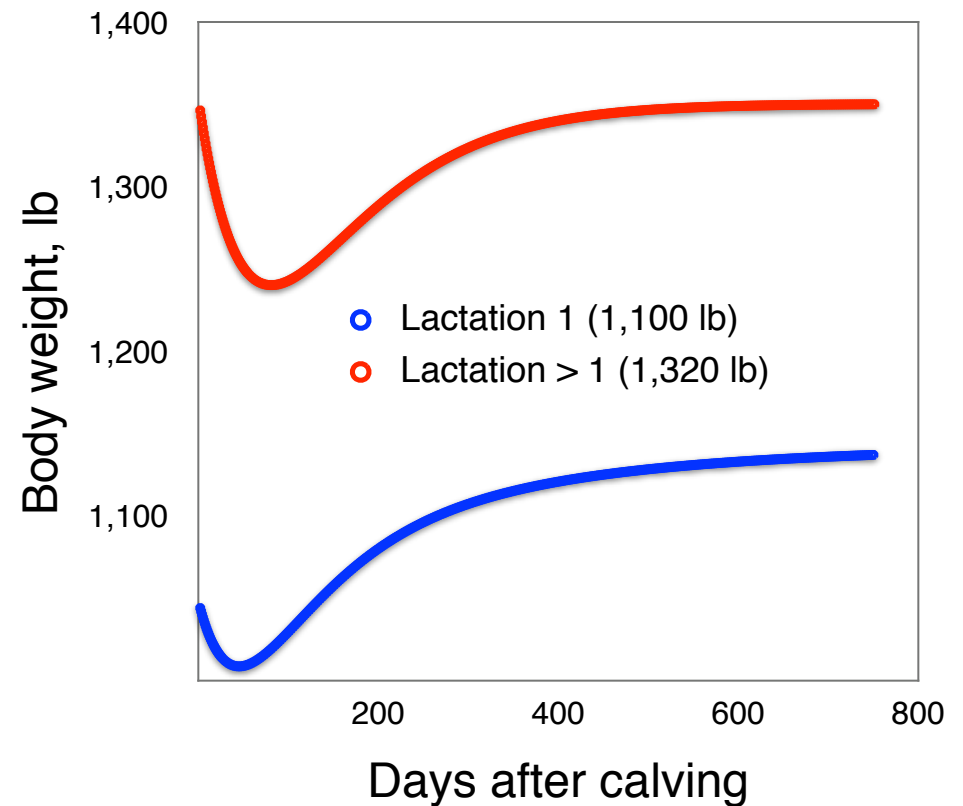
Cow body weight

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

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

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



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

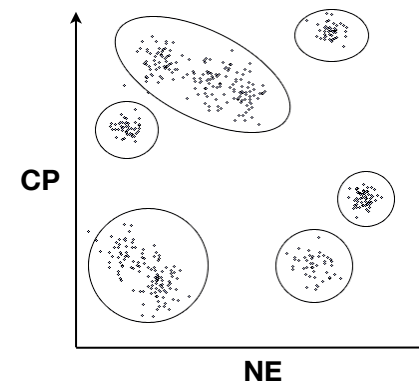
Based on level of production measured as FCM

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

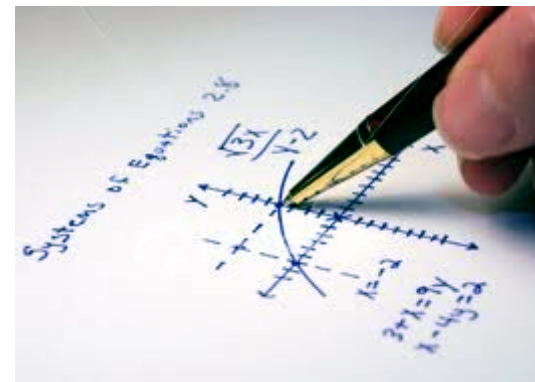
Value of NE and CP could
be deducted
Using referee feeds

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

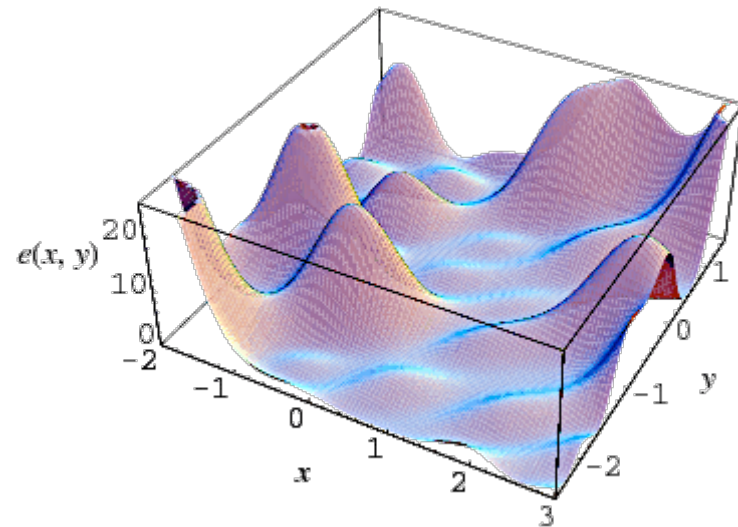


Optimize cows belonging to a feeding group

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

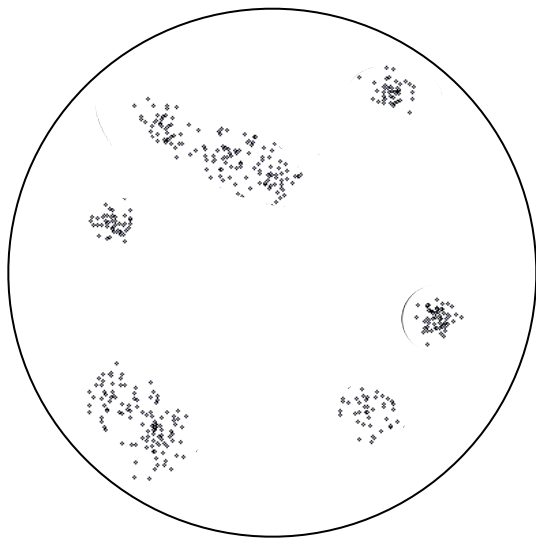


Overall net return

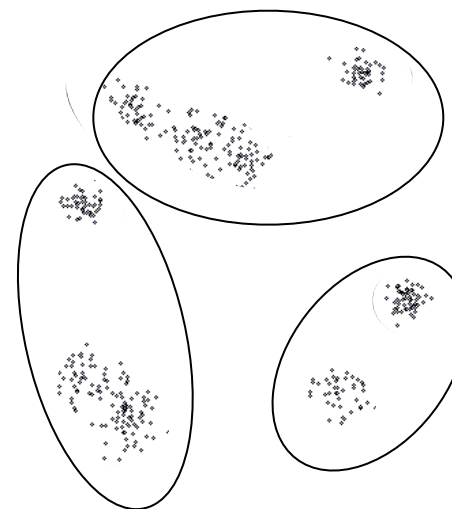
Bottom line grouping strategies

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. The navigation menu contains: Home, Tools, Projects, Publications, Presentations, LGM-Dairy, Links, About, Contact, Comments, News, People, Opportunities, and Gallery.

Grouping Strategies for Feeding Lactating Dairy Cattle

Overview | **Upload Farm Details** | **Group Cows** | **Reap Benefits** | **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 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 logos for "THE UNIVERSITY OF WISCONSIN MADISON" 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 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." Below this are several sections: "Latest Projects" with links like "Genomic Selection and Herd Management" and "Dairy Reproduction Decision Support Tools"; "UW" with links to various university resources; "Dairy News" with a link to "UW-Extension Dairy News"; "Helpful Link" with "Repro Money Program" and "Contact"; and a "TOOLS" section featuring a "Dairy Management Tools" box with a "READ MORE" button. A profile for "Victor E. Cabrera, Ph.D." is also visible, including his title as "Assistant Professor Extension Specialist Dairy Management" and contact information.

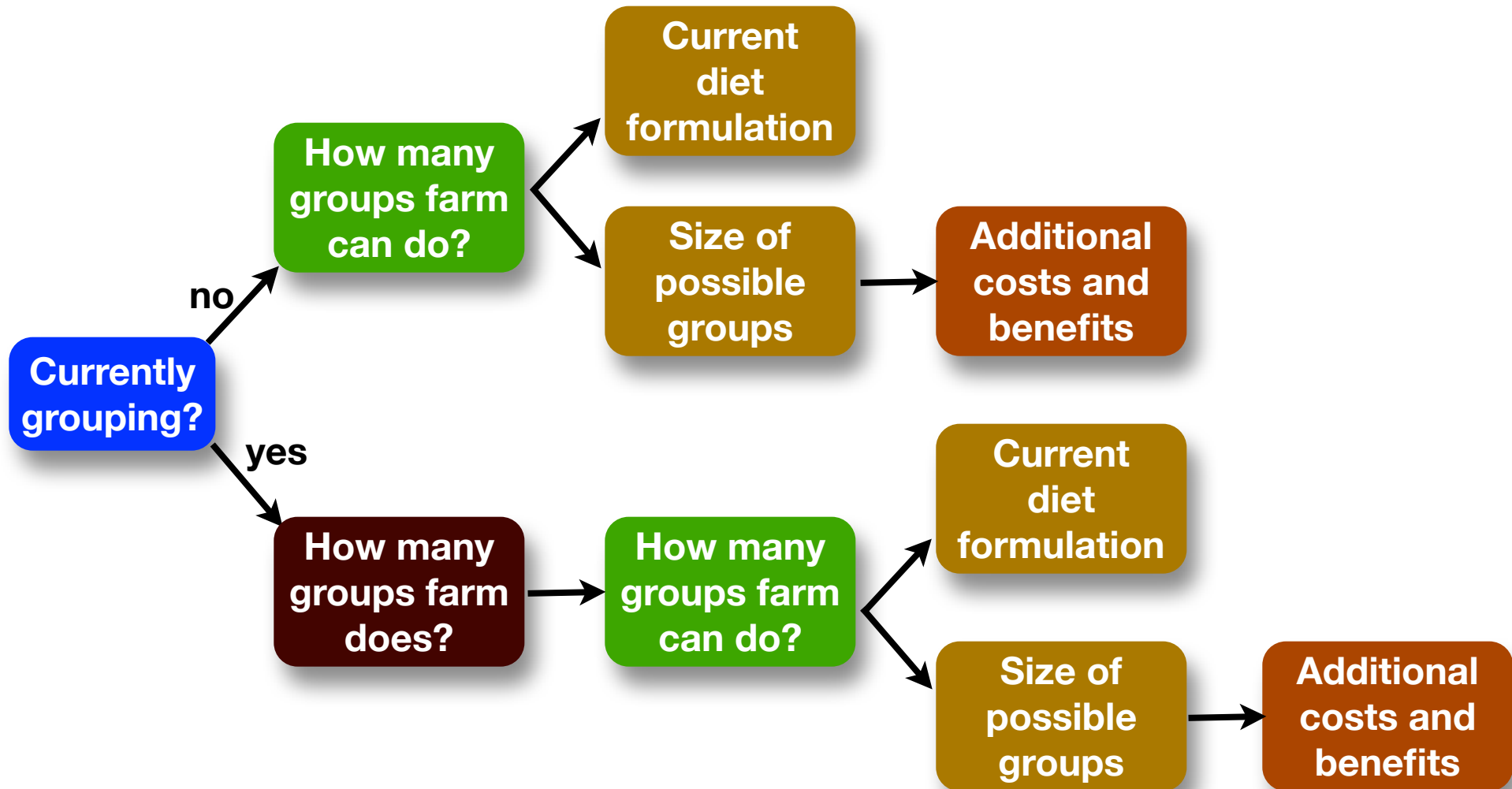


Tools

The screenshot shows the "Tools" page on DairyMGT.info. It features a navigation menu at the top with "Home", "Tools", "Projects", "Publications", "Presentations", "Links", and "Find". Below the menu is a sub-menu with categories: Feeding, Heifers, Reproduction, Production, Replacement, Financial, Price Risk, and Environment. The main heading is "Management Tools", followed by 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." Below this is a section titled "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". Other sections include "Heifers" with tools like "Cost-Benefit of Accelerated Liquid Feeding Program for Dairy Calves" and "Economic Value of Sexed Semen Programs for Dairy Heifers"; "Reproduction" with "Economic Value of Sexed Semen Programs for Dairy Heifers" and "UW DairyRepro: A Reproductive Economic Analysis Tool"; and "Production" with "UW DairyRepro: A Reproductive Economic Analysis Tool" and "Dairy Reproductive Economic Analysis".

Grouping strategies

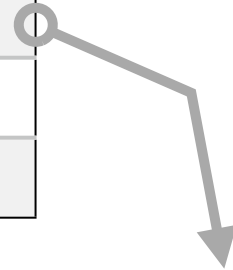
Farm possibilities



Decision support system illustration

Economic impact of grouping

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

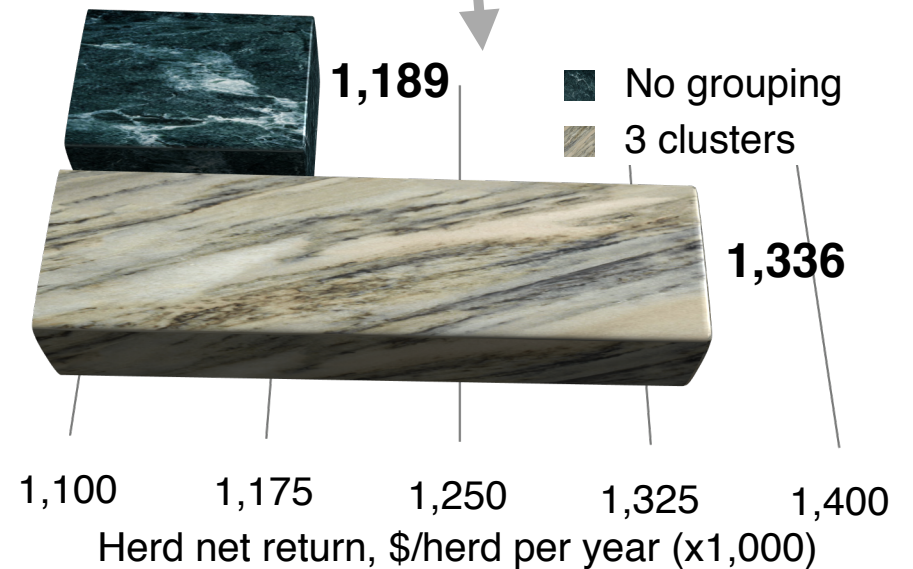


	Possible situation
Number groups	3
Group sizes	100, 100, 270
Added cost, \$	\$1,000/month
Milk loss	5 lb/cow
Milk loss time	4 days
Saved cost, \$	\$0

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

- 83rd 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%**

Acknowledgement

Project support

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United States Department of Agriculture
National Institute of Food and Agriculture



Thanks