



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



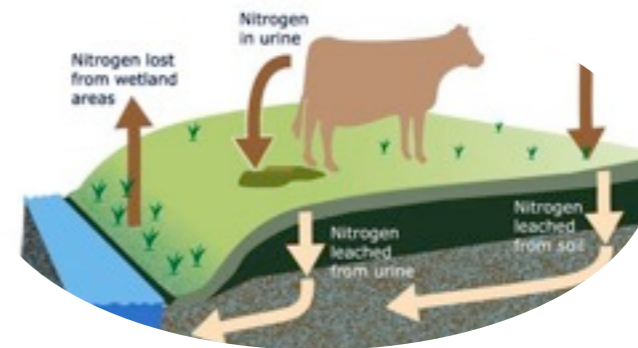
Improved nutrient use efficiency

Diet closer to cow requirements

Less overfed animals

Decreased overweighted cows

Less nutrient excretion
Decreased environmental concerns



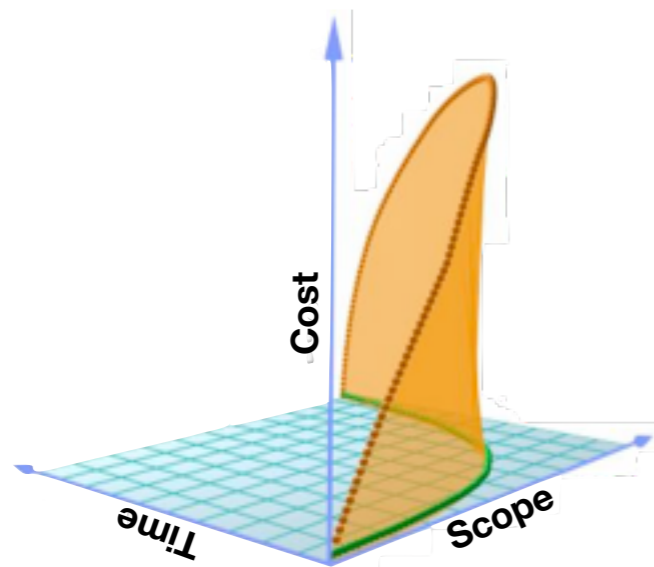
Lower feeding costs

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

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

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



Cow nutrient requirement

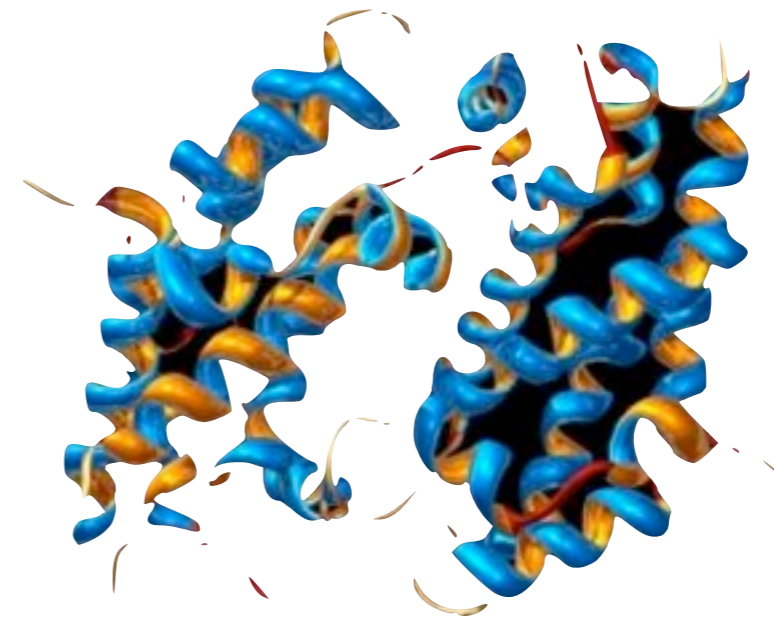
Protein

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)



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

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

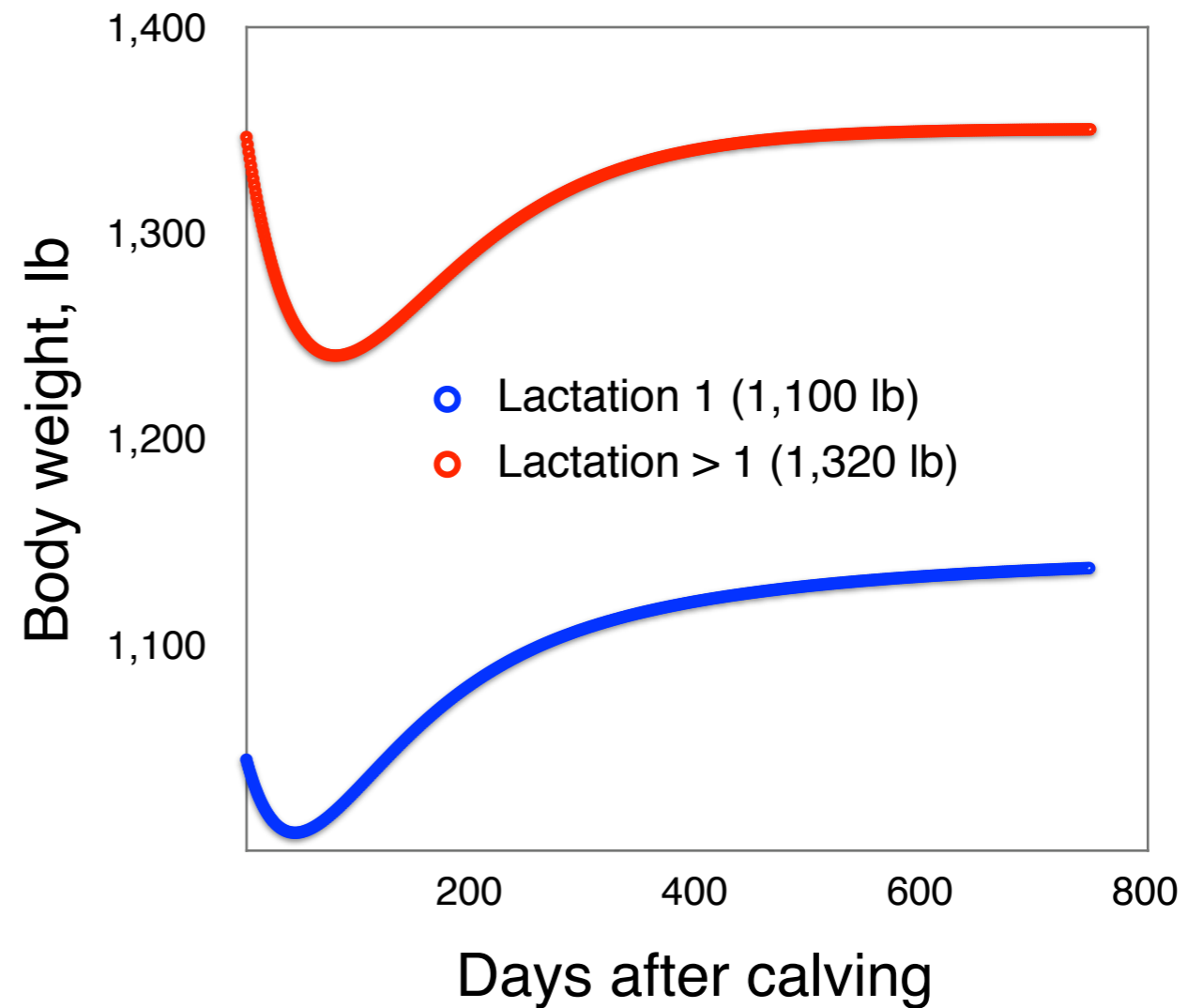
Cow body weight

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

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

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



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

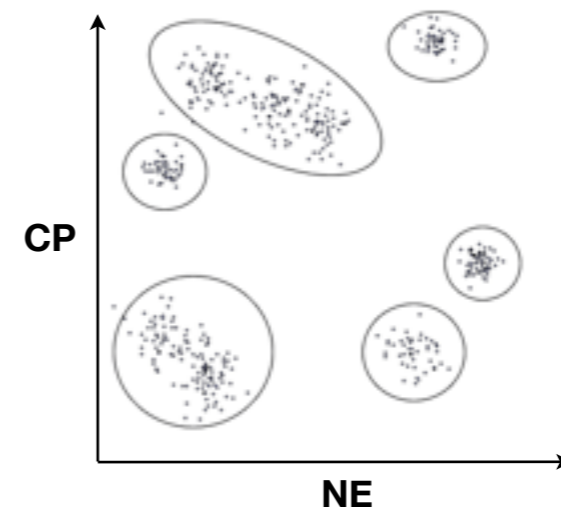
Based on level of production measured as FCM

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

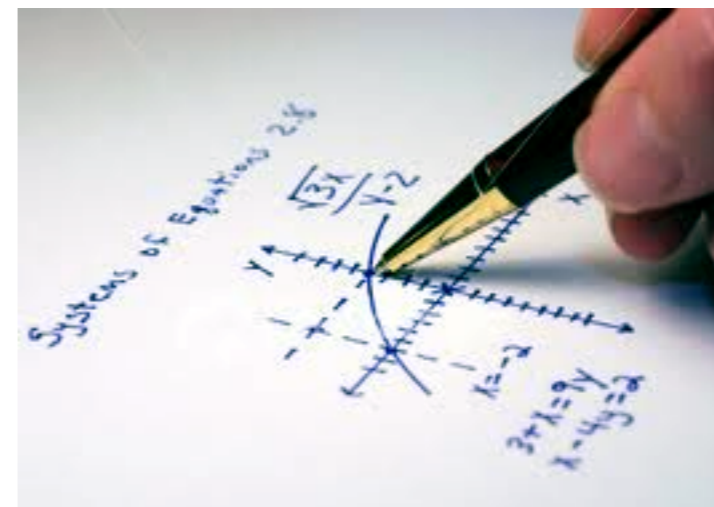
Value of NE and CP could
be deducted
Using referee feeds

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

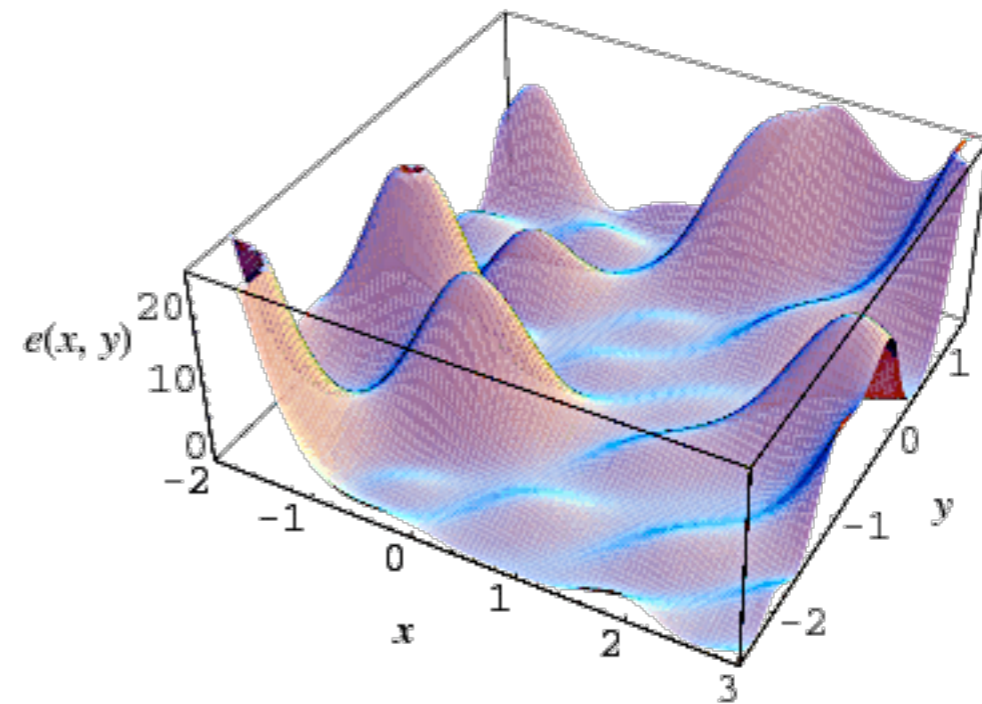


Optimize cows belonging to a feeding group

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

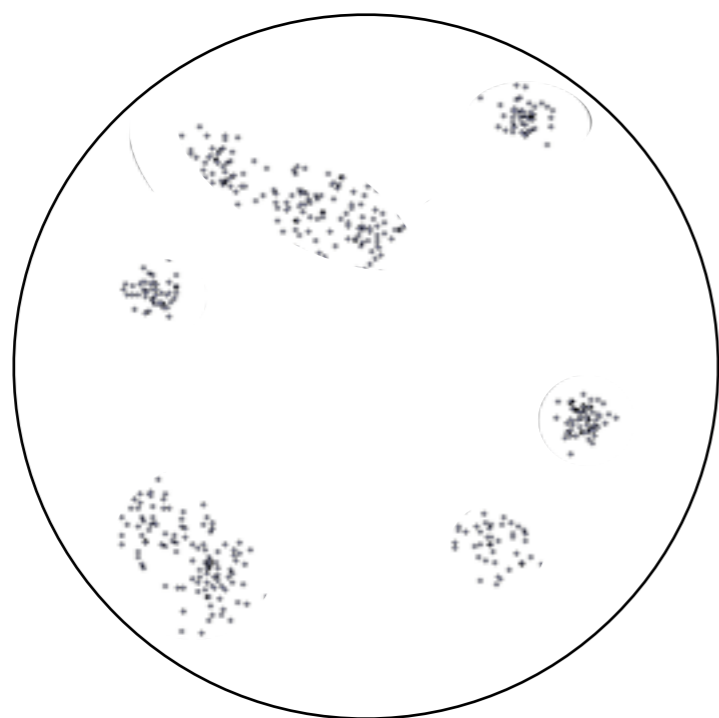


Overall net return

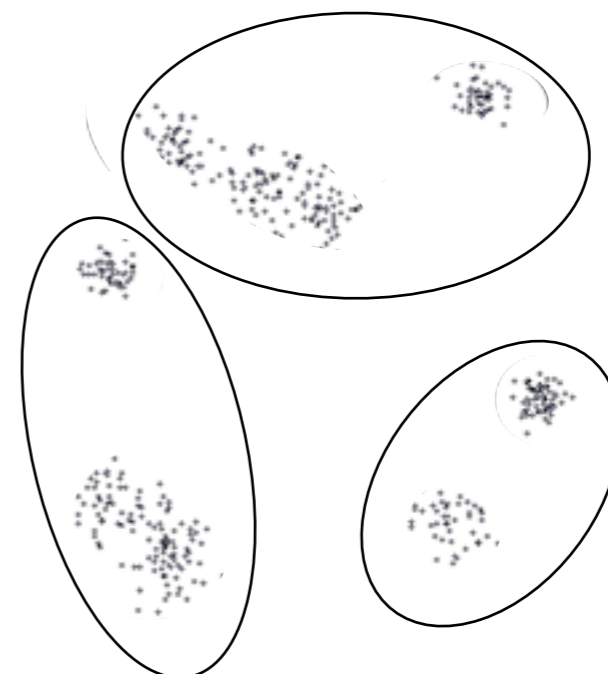
Bottom line grouping strategies

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**

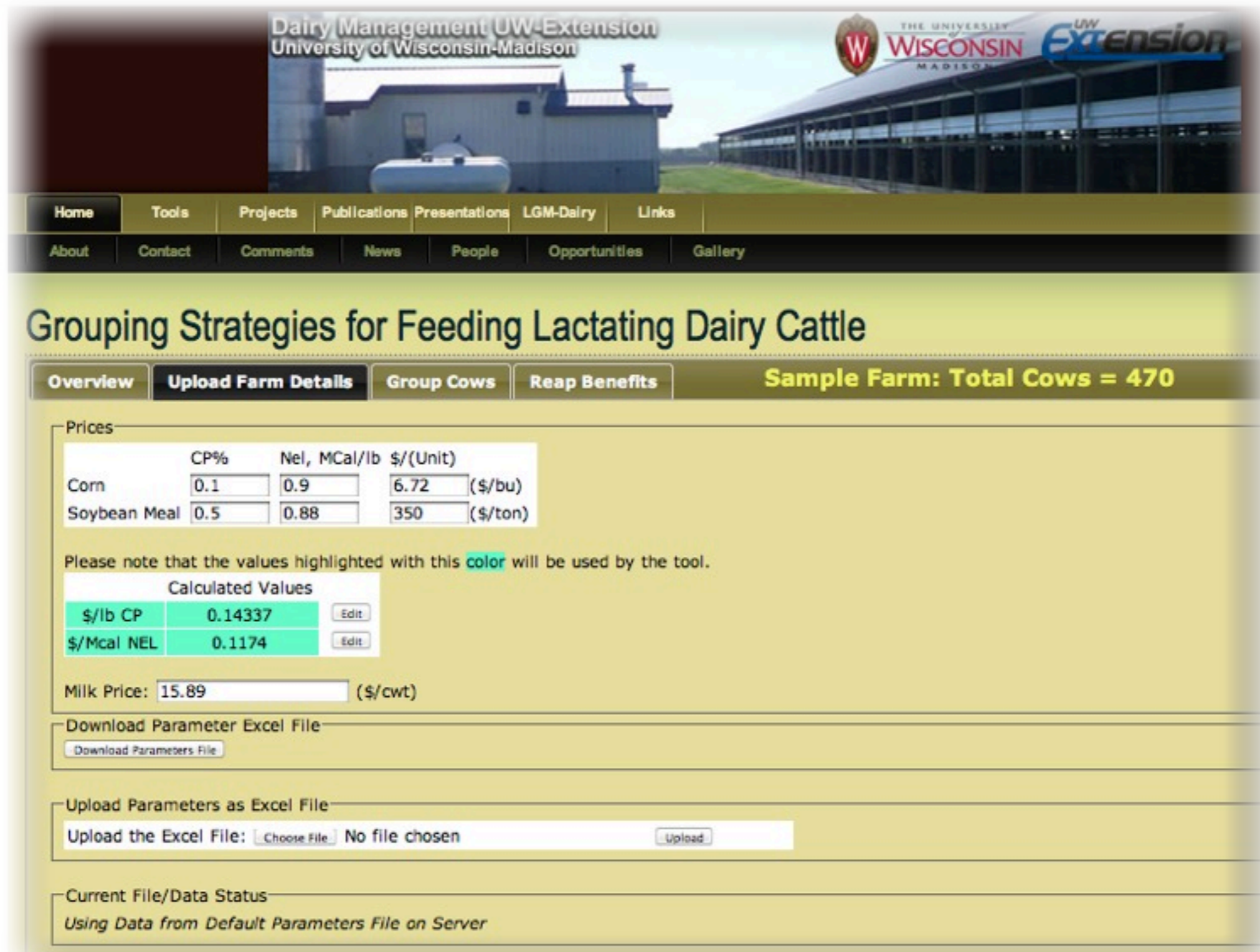
Might impact decisions



User-friendly application
Easy to use, still robust

Grouping strategies

For feeding lactating dairy cattle



Dairy Management UW-Extension
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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	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	Edit
\$/Mcal NEL	0.1174	Edit

Milk Price: 15.89 (\$/cwt)

Download Parameter Excel File
Download Parameters File

Upload Parameters as Excel File
Upload the Excel File: Choose File No file chosen Upload

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 links for Home, Tools, Projects, Publications, Presentations, Links, and Find. A secondary menu includes 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." There are three sidebar sections: "Latest Projects" with links like "Genomic Selection and Herd Management"; "Helpful Link" with "Bears Money Program" and "Contact"; and a profile for "Victor E. Cabrera, Ph.D.", Assistant Professor and Extension Specialist in Dairy Management, with contact information and a "HERD VIEW" button. A "TOOLS" section is also visible, featuring a "Dairy Management Tools" link and a "HERD VIEW" button.



Tools

The screenshot shows the "Tools" page on DairyMGT.info. The navigation menu at the top includes Home, Tools, Projects, Publications, Presentations, Links, and Find. A secondary menu lists various tool categories: Feeding, Heifers, Reproduction, Production, Replacement, Financial, Price Risk, and Environment. The main heading is "Management Tools". Below this is 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." A note says "Click on the Tool title to learn more." The page is organized into three main sections: "Feeding", "Heifers", and "Reproduction". Each section contains a list of tool titles with a magnifying glass icon. Under "Feeding", tools include "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", and "Dairy Ration Feed Additive Break-Even Analysis". Under "Heifers", tools include "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". Under "Reproduction", tools include "Economic Value of Sexed Semen Programs for Dairy Heifers", "UW DairyRepro®: A Reproductive Economic Analysis Tool", "Exploiting Timing of Pregnancy Impact on Income Over Feed Cost", and "Dairy Reproductive Economic Analysis".

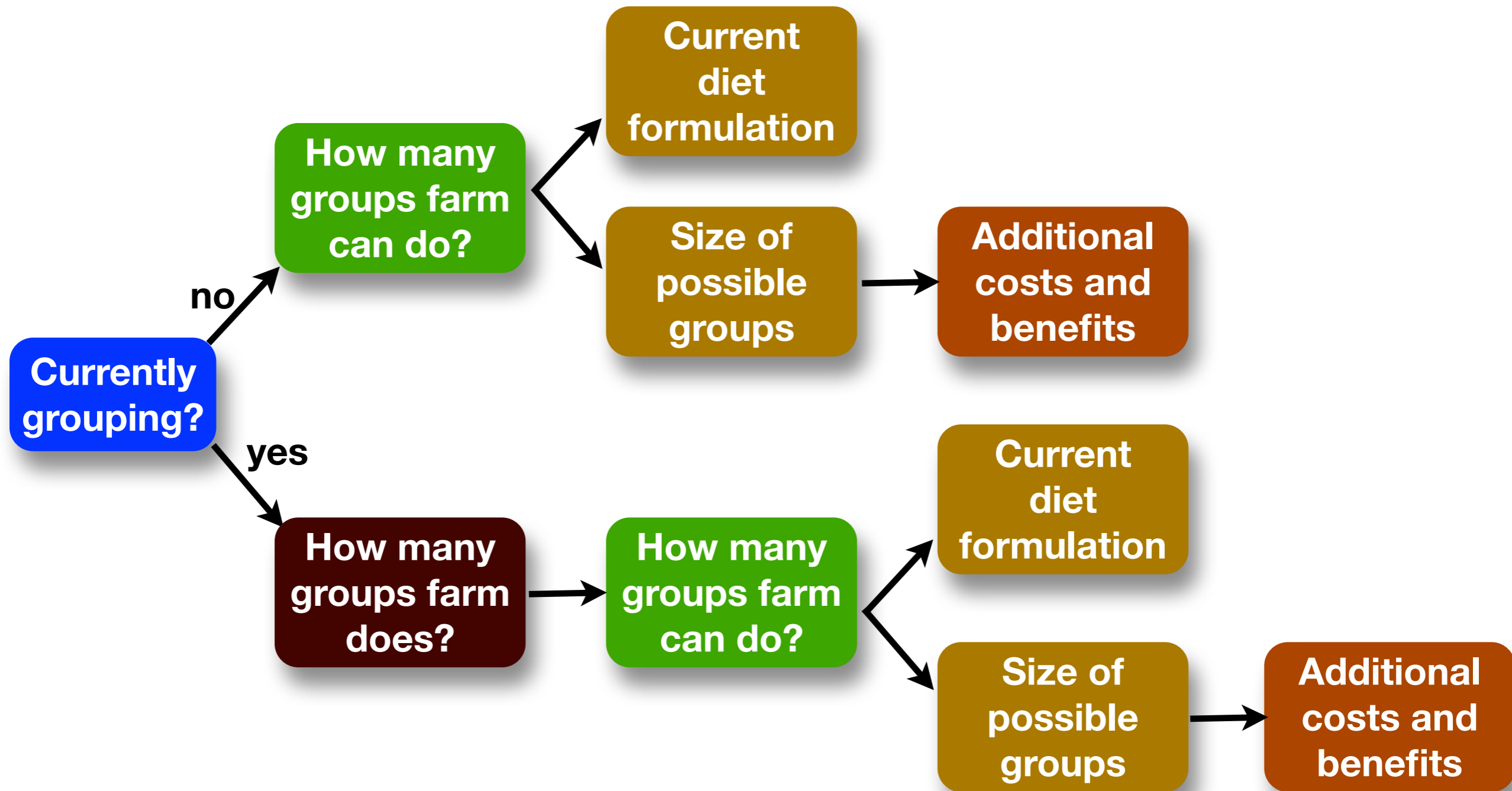
- Dairy Extension Feed Cost Evaluator
- Income Over Feed Supplement Cost
- Dairy Ration Feed Additive Break-Even Analysis

Reproduction

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

Grouping strategies

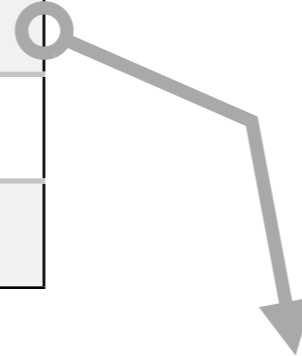
Farm possibilities



Decision support system illustration

Economic impact of grouping

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

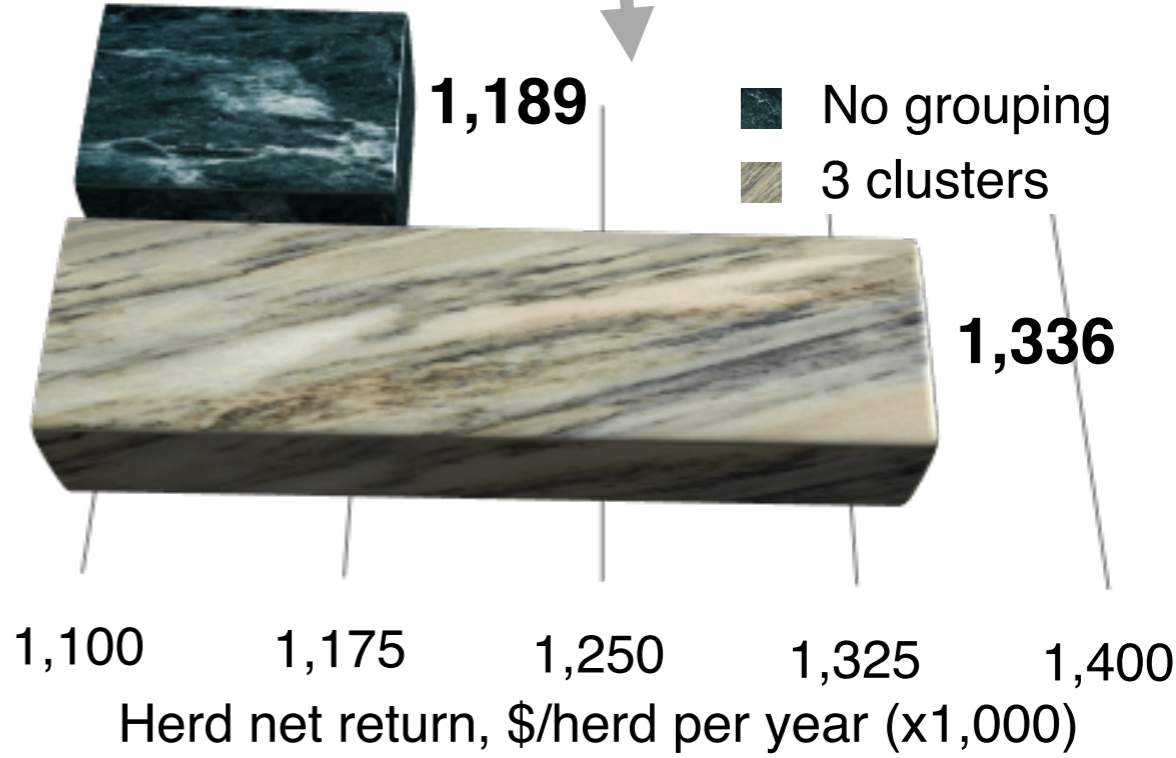


	Possible situation
Number groups	3
Group sizes	100, 100, 270
Added cost, \$	\$1,000/month
Milk loss	5 lb/cow
Milk loss time	4 days
Saved cost, \$	\$0

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

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United States Department of Agriculture
National Institute of Food and Agriculture



Thanks