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

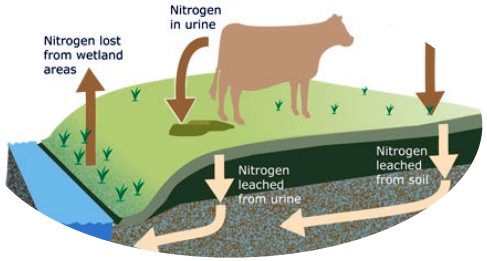
What could be a possible solution?

Consider additional feeding groups for lactating cows

Improved nutrient use efficiency
Diet closer to cow requirements

Less overfed animals
Decreased overweighted cows

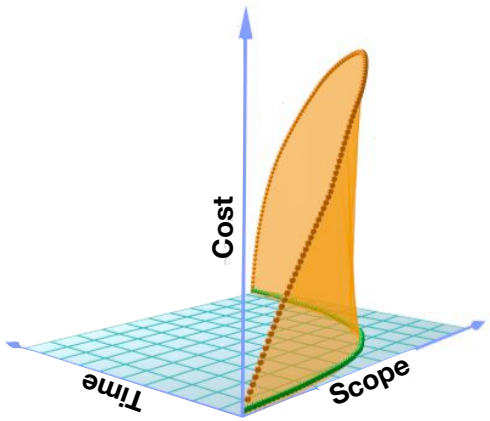
Less nutrient excretion
Decreased environmental concerns



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

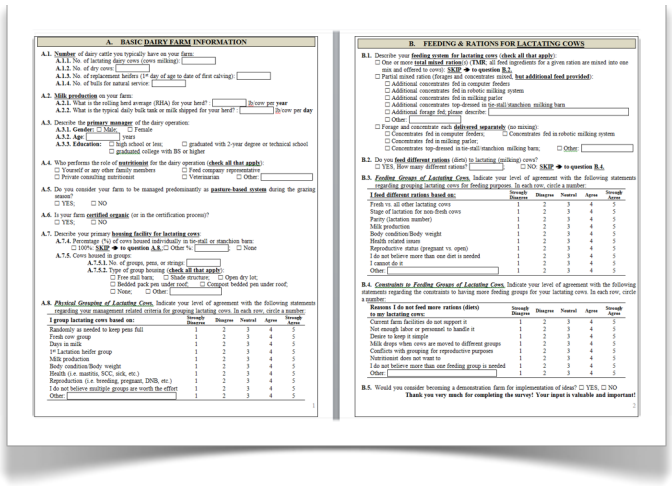
Trying to find them

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

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

$NE_{maintenance}$
Function of animal body weight

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

NE_{milk}
Function of milk and fat production

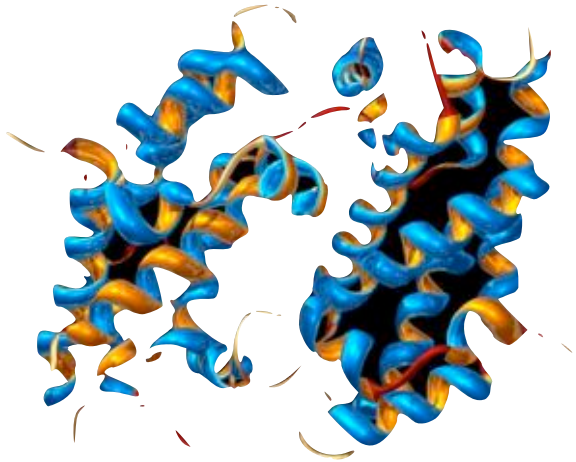
$$NE_{milk} = Milk \times (0.36 + 0.0969 \times Fat\%)$$

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 feed requirement

Dry matter intake

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

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

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

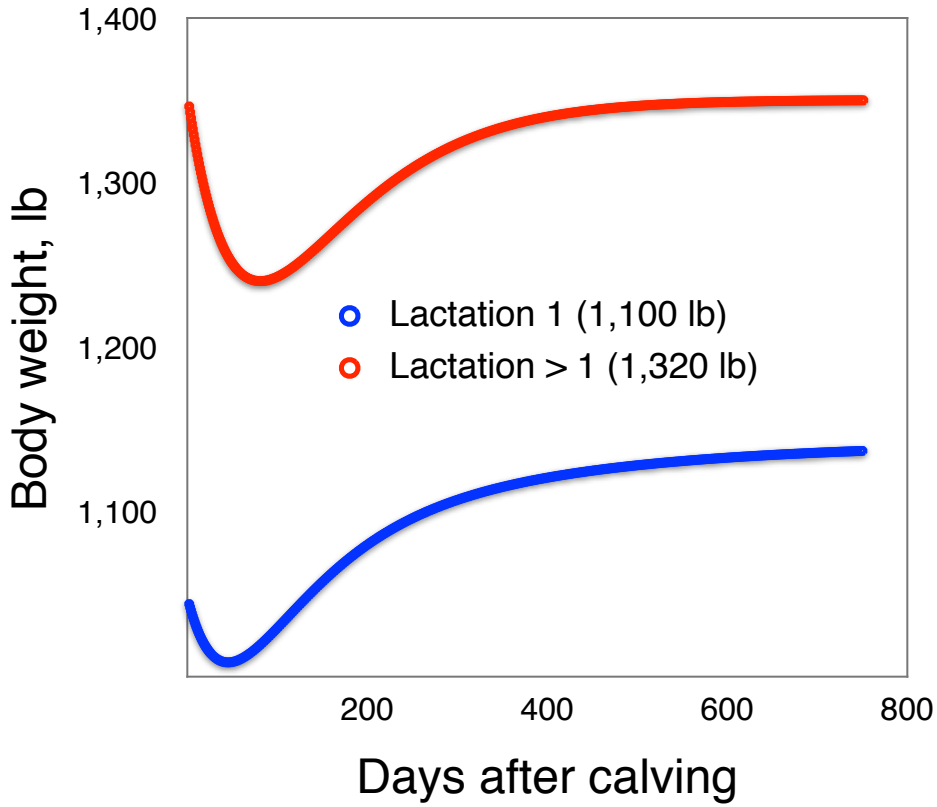
NRC, 2001

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

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

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

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

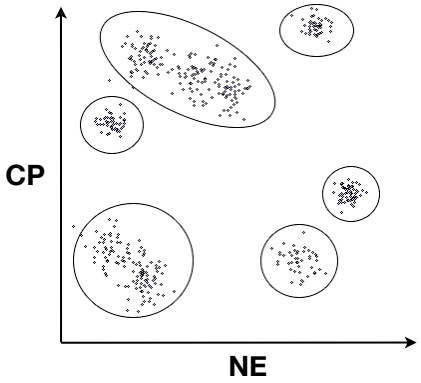
Several criteria exist

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)

Corn %CP + Corn Mcal NE = $/kg Corn Price

SBM %CP + SBM Mcal NE = $/kg SBM Price

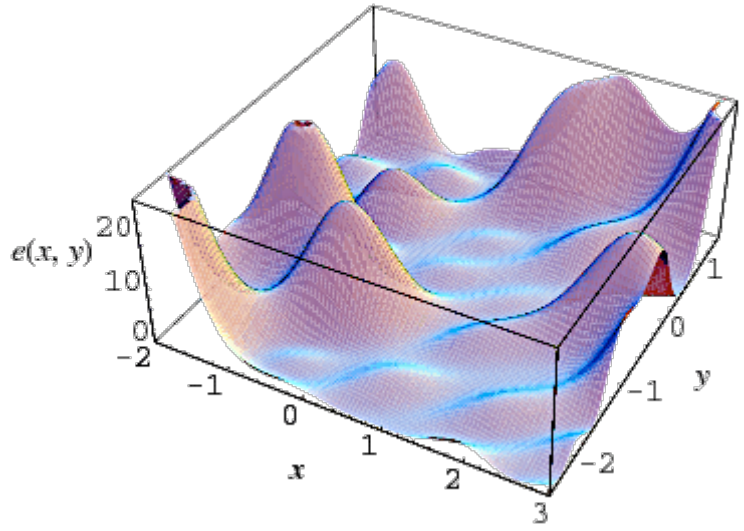
Value of NE and CP could be available on a farm
Based on farm experience

Optimize cows belonging to a feeding group

Maximize the income over feed cost

Non-linear optimization

- **Iterative process**
- **Search for global maxima IOFC**



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

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

Milk Value = SUM ($Milk_{cow}$) x Milk Price

Feed Cost = SUM (DM_{cow}) x 83% CP x CP price
+ SUM (DM_{cow}) x 83% NEl x NEl 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

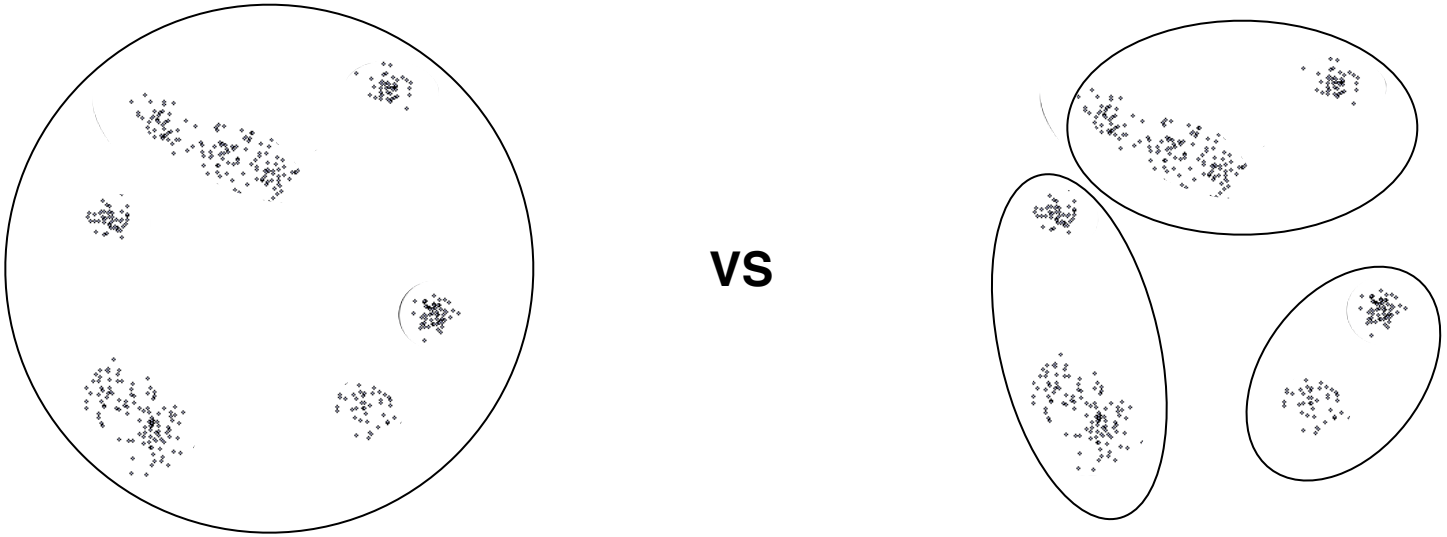
Net return

+ Max (IOFC)

- Extra management

- Milk depression

+ Savings



Decision support system

Perform your own calculations

Group feeding strategies are farm specific
Every farm is different



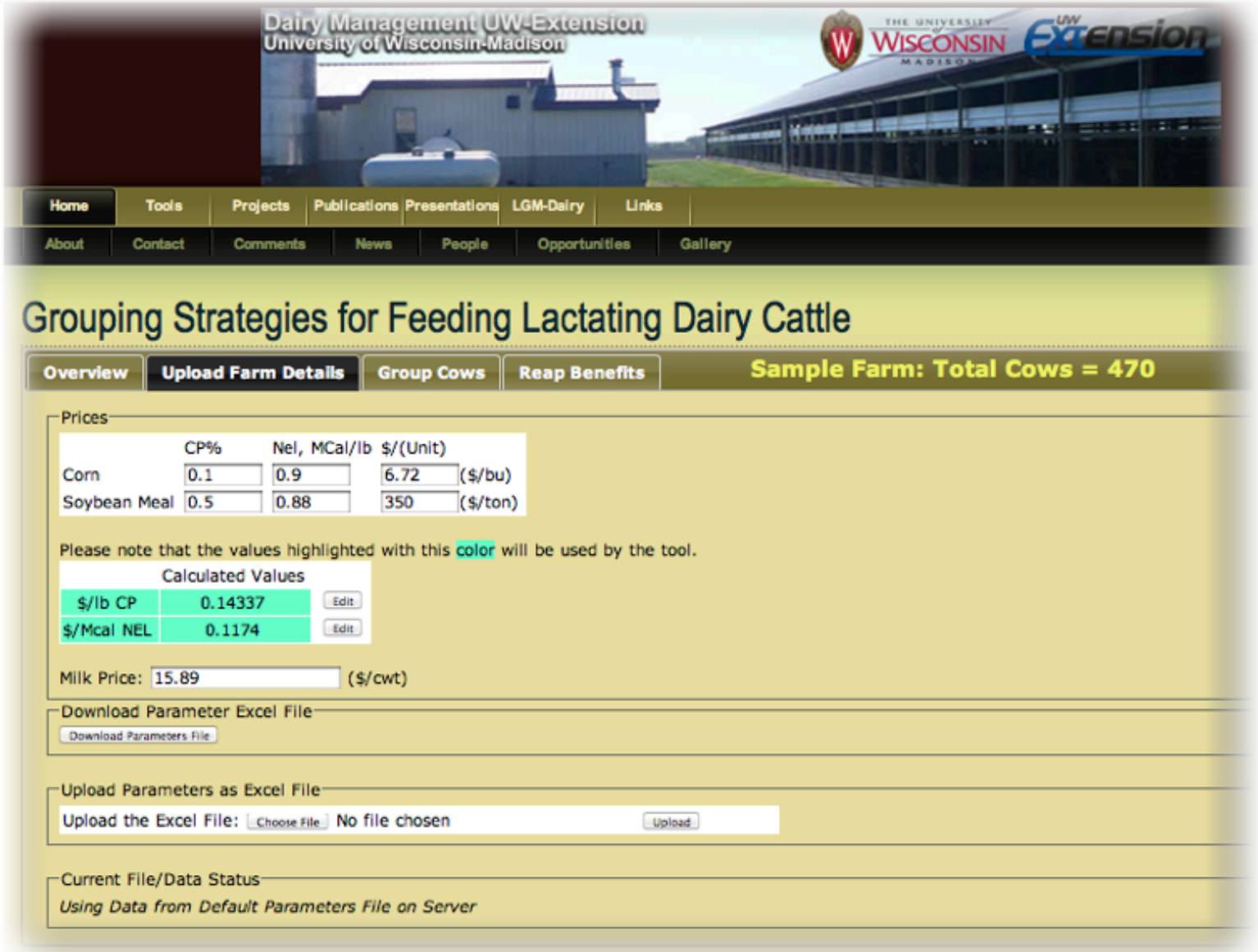

Herd demographics changes dynamically
Re-grouping is permanent

Market conditions change permanently
Might impact decisions

User-friendly application
Easy to use, still robust

Grouping strategies

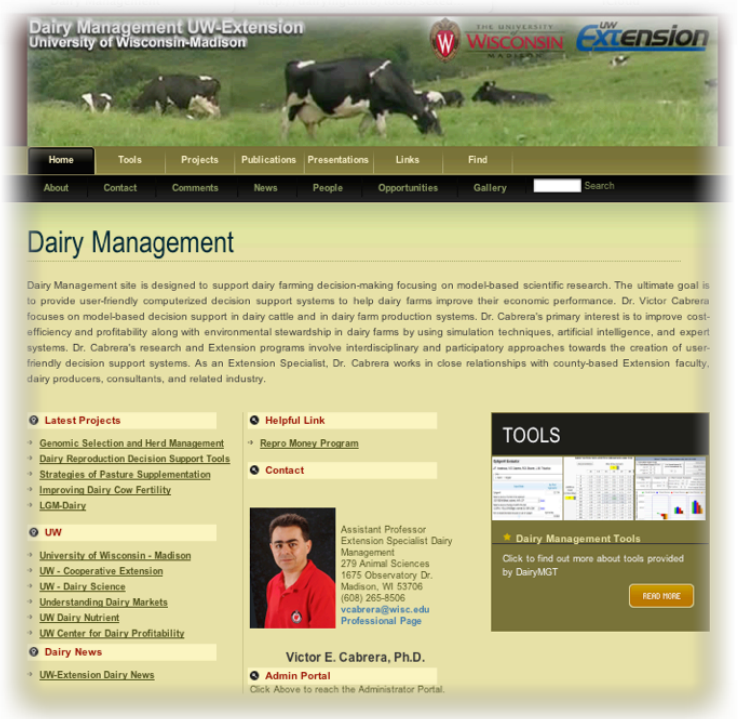
For feeding lactating dairy cattle



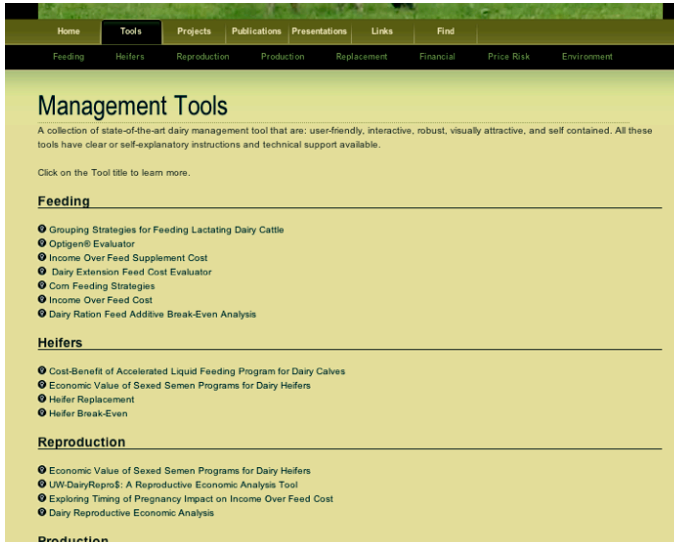
Feeding grouping strategies

Where to find it

DairyMGT.info

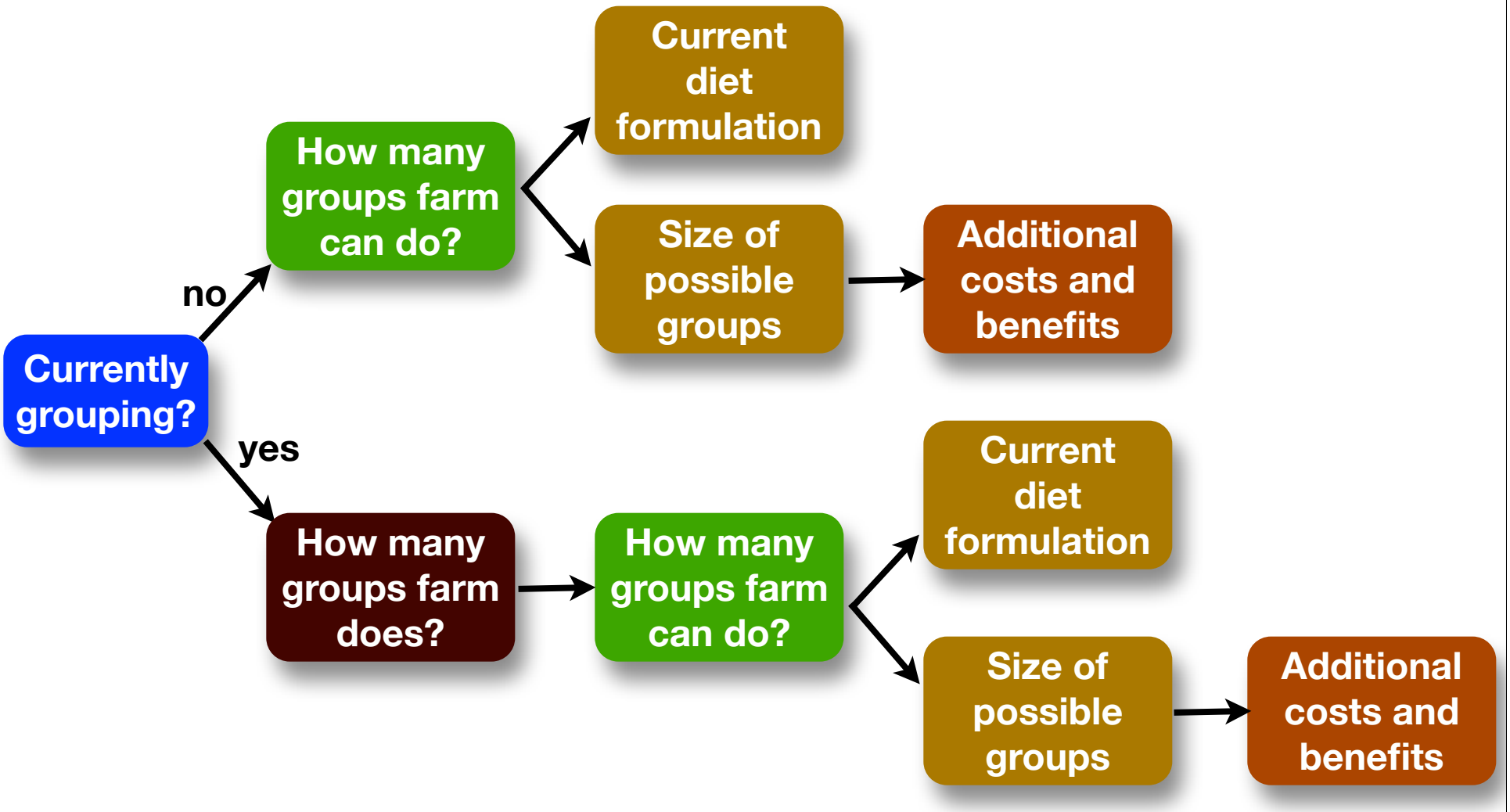


Tools



Grouping strategies

Farm possibilities



Decision support system illustration

Economic impact of grouping

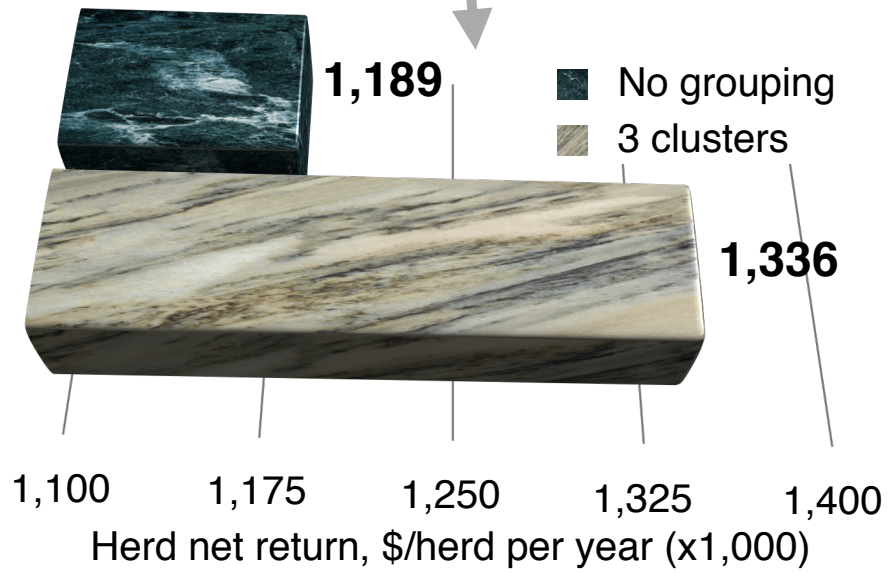
	Current situation
Lactating cows	470
Number groups	None
NE, Mcal/lb	0.80
CP, %	17%

	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 NEl

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

Cluster grouping
- 83rd percentile CP and NEl

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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