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A cluster analysis to describe profitability on Wisconsin dairy farms

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INTRODUCTION

Dairy producers are facing increased volatility in milk prices and feed costs within and between years. To stay profitable, farmers may explore alternative low input management strategies such as pasture-based feeding systems or turn to organic feeds for high-value organic milk production. When well-managed, pasture can be a low-cost, high quality feed for dairy cows (Peyraud and Delaby, 2001). However, grazing can be challenging when it comes to balancing the ration. The impact of feed supplementation strategy on overall cost of milk production and milk composition is a major concern among dairy producers (Paine and Gildersleeve, 2011).

An integrated long-term research project is being conducted to investigate impacts of feed supplementation on selected economic and production variables.

The main goal of this study was to assess the impact of feeding strategies associated with organic (ORG), grazier (GRA) or conventional (CON) practices on farm profitability.

MATERIALS AND METHODS

An interdisciplinary and comprehensive survey instrument was developed and field-tested with 5 dairy farms during the summer of 2010. The 50-page survey (Figure 1) included 10 sections covering production, environment, and economic aspects of the farm.

Figure 1: Screenshot of 50-pages survey cover page

On-farm data were collected between October 2010 and January 2012. Farms were randomly selected from the Wisconsin's official lists of certified milk producers and organic milk producers as well as a list of graziers compiled from extension agents from the University of Wisconsin. Dairy farms were classified across 3 different feeding systems: CON, GRA, and ORG.

The ORG were certified organic, the GRA used pasture as a major source of feed during the grazing season, and the CON were the non-organic, non-grazier farms.

The data were collected from 131 farms by 2 graduate students. The location of the surveyed farms is presented in Figure 2.

Preliminary analysis of selected variables and profitability (Income over Feed Costs, IOFC) from 20 selected farms is presented here. Within this sample, 4 farms were ORG, 4 GRA, and 12 CON.

A cluster analysis using complete linkage (*see side note on the bottom right*) was used to describe the data (Everitt *et al.*, 2001).

PRELIMINARY RESULTS AND DISCUSSION

Figure 2: Wisconsin map indicating the location of surveyed farms.

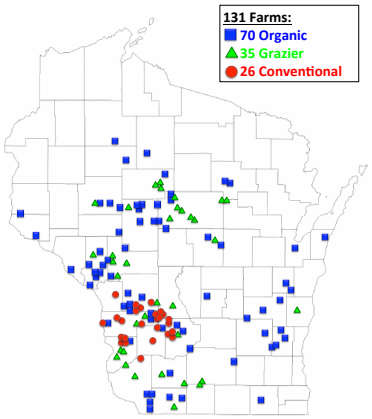
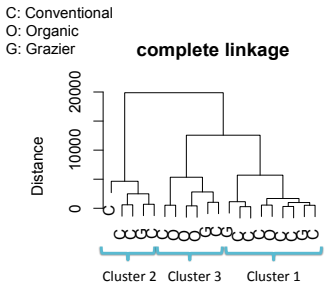


Figure 3: Results of the cluster analysis on 20 selected farms.



The Y axis on Figure 3 represents the distance between 2 farms. The smaller the distance, the more similar the farms are based on the variables selected.

The analysis resulted in 3 clusters that included farms from each feeding system. Farms in each cluster differed substantially on all the selected variables, except age of the respondent (Table 1).

Cluster 1 included farms with the largest land base but intermediate values for milk production, composition and price. Although estimated dry matter intake was the highest, percentages of each diet ingredients were intermediate compared with farms in clusters 2 and 3. Farms in cluster 1 can be defined as "intermediate farms" with an IOFC of $5.97/cow/day.

Cluster 2 included farms essentially similar to cluster 1 in term of structure (number of cows and land area). The estimated dry matter intake was intermediate on those farms compared with farms in cluster 1 and 3. Milk production and percentage of concentrate in the diet were the highest while milk composition and price were the lowest. Farms in cluster 2 can be defined as "*productive efficient farms*" with an IOFC of $8.09/cow per day.

Cluster 3 included farms with the smallest land base and the smallest number of cows. Milk composition and price were the highest while milk production and estimated dry matter intake were the lowest. Forages were the main constituent of the diet of the cows on those farms. Farms in cluster 3 can be defined as "*resources limited farms*" with an IOFC of $5.22/cow/day.

Each cluster included farms from different systems. Cluster 1 included 1 ORG, 2 GRA and 6 CON farms; cluster 2 included 4 CON and 1 GRA farms; and cluster 3 included 3 ORG, 1 GRA and 2 CON farms. Farms in each cluster are more similar to those in the same cluster than to another farm with the same system in another cluster. Consequently, the farm system was not a good predictor of profitability by itself. Variables such as milk production, milk price, or feeding management play a more important role in describing profitability.

Table 1: characteristics of the 3 clusters

	Cluster 1	Cluster 2	Cluster 3
# Organic farms (O)	1	0	3
# Grazing farms (MG)	2	1	1
# Conventional farms (C)	6	4	2
Total hectares	115.7	95.4	54.2
Age of the respondent	49	44	49
Numbers of cows	72	71	48
Milk production (kg/cow per year)	7,053	10,741	4,138
Fat content (%)	3.78	3.56	4.36
Protein content (%)	3.00	3.03	3.25
SCC (x1,000 cells/ml)	287	204	317
Milk price ($/100 kg)	36.90	34.90	48.13
% milk not sold	1.65	0.49	3.08
Total DMI[1] in winter (kg/cow per day)	24.0	20.2	18.0
% grass/legume silage in the winter	19.3	37.8	15.0
% hay in the winter	37.8	0.9	61.8
% corn silage in the winter	12.0	18.2	4.6
% concentrates in the winter	30.0	42.4	16.2
% vitamin and mineral in the winter	0.9	0.7	2.4
IOFC ($/cow per day) in winter	5.97	8.09	5.22

[1]Dry Matter Intake

CONCLUSION

Preliminary results indicated that the 3 clusters contained farms from different systems suggesting a wide range of profitability within each feeding strategy (ORG, GRA or CON).

The scope of inference from this analysis should be restricted to the sample population from which the data was collected. Results presented here reflect only a small portion of all the data collected with the 131 surveys.

Detailed impact of feeding management strategies on production variables, environmental outcomes and economics performances will emerge from the analysis of the entire survey results.

Further analysis will identify more variables influencing profitability on the farm. Moreover, it will assess strategic feeding management practices that lead to desirable production, environmental and economic outcomes.

REFERENCES

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SIDE NOTE ON CLUSTER ANALYSIS

A cluster analysis can help reveal the characteristics of any structure or patterns present. It creates groups (clusters) of objects that are more similar to each other within a cluster than across clusters.
The distances between farms was calculated using complete linkage, which is computed as the maximum distance between two farms, one in one cluster, and one in the other.

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