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RELATIONSHIPS AMONG HEALTH, PRODUCTIVITY AND PROFITABILITY ON ONTARIO DAIRY FARMS

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Cette étude est une recherche sur les relations entre les mesures de santé, la gestion, la productivité et la rentabilité d'un troupeau en utilisant des données issues d'un échantillon de fermes laitières de l'Ontario (Canada). La rentabilité et la productivité ont été mesurées par le déficit d'insémination par vache, utilisant la marge comme un pourcentage du revenu total, les entrées nettes par vache et les revenus liés au lait par vache, moins les coûts de nourriture par vache. Un ensemble de recherches de variable et de constructions de modèles, utilisant les meilleurs jeux de modèles de régression multiple et d'analyse de variance multivariée, a été utilisé pour identifier les mesures de santé et de productivité associées aux performances financières. Seuls la production laitière, ajustée en moyenne par troupeau, les coûts d'alimentation par vache et la santé de la mamelle, mesurée soit par le pourcentage de vaches avec un comptage cellulaire supérieur à 200 000 cellules/ml soit par le pourcentage de mammites, sont régulièrement associés aux 4 mesures de rentabilité.

INTRODUCTION

Falling milk prices and shrinking profit margins have stimulated an interest in the financial factors that drive dairy enterprise efficiency and profitability (Zweigbaum et al., 1989). In Ontario, perhaps largely because of the steady milk price guaranteed by our national dairy supply management system, the interest in dairy enterprise profitability has been slower to develop. Nonetheless, in anticipation of increased global competition in dairy production, mainly as a result of the North American Free Trade Agreement and the General Agreement on Trade and Tariffs, there is mounting interest in defining the characteristics of profitable Ontario dairy farms (Nicholson and Knoblauch, 1993).

Analysis of data from the Ontario Farm Management Analysis Project (OFMAP, 1990) has helped to identify some of the financial characteristics of profitable farms in the province. Whereas attempts have been made to define the relationships between profitability and management factors or biological variables in some regions of the United States (McGilliard et al., 1990; Conlin, 1990), this has not been done in Ontario. One major impediment to an investigation such as this has been the lack of a comprehensive database.

The objective of this study was to use the data collected through the Ontario Dairy Monitoring and Analysis Program to investigate the relationships among herd level measures of management, productivity, health and profitability, in order to define the financial and biological characteristics of efficient and profitable Ontario dairy farms.

MATERIALS AND METHODS

The Ontario Dairy Monitoring and Analysis Program began in 1989 with the recruitment of 27 Ontario veterinary practitioners as collaborators. These veterinarians then purposively selected 108 dairy producers, from among their clients, as participants in the project. Data collection began in February 1990 and proceeded until March 1992. The final database included detailed demographic and attitudinal information collected through enrolment and exit questionnaire-based interviews, farm financial analyses conducted through the Ontario Farm Management Analysis Project for the years 1989, 1990 and 1991, Ontario Dairy Herd Improvement reports for most herds from 1986 to 1993 and monthly tallies of reproductive, disease, removal and mastitis treatment events for each herd. One hundred and four herds completed the first year of the project, while 94 completed both years.

Data analysis began in the fall of 1992 and was completed in 1994. Complete financial, management, health and productivity data from 58 farms in year one and 48 farms in year two were included in the analysis. The associations among four measures of dairy farm profitability and farm demographic, financial, animal health and production characteristics were investigated. The independent variables were based primarily on annual means, but also included inter-quartile ranges for those variables previously demonstrated to have a significant seasonal component. These included measures of milk production, udder health, reproductive performance, culling and the occurrence of some clinical diseases. A best subsets method (using Mallow's C_p as the selection criterion) was used to identify the farm level variables that were most frequently (appeared in at least 10 of 15 best subset models) associated with dairy enterprise net income per cow, milk income minus feed costs per cow, operating margin as a percent of total revenue and debt servicing capacity per cow. A multivariate analysis of variance (Proc GLM, MANOVA option), including all four dependent variables, was used to select the herd level variables most strongly associated with the selected measures of farm profitability (SAS, 1988).

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RESULTS

Based on the multivariate analysis of all *year one* data, the variables significantly related to all four dependent variables were average age, in weeks, at weaning (WEANAGEM), feed costs per cow (FEEDPCOW), percent of all culls that were attributed to mastitis (PCMAST), average adjusted corrected milk (AVGACM), percent of dairy feeds that were purchased, treatment rate for milk fever and rate of displaced abomasum (LDARATE). When financial independent variables were excluded from the analysis, WEANAGEM, PCMAST, AVGACM and LDARATE were joined by treatment rate for cystic ovarian disease and minutes per week spent using herd records.

For *year two* data, when financial variables were included in the analysis, the significant independent variables were FEEDPCOW, AVGACM, debt per cow, mean percent of cows in the herd with somatic cell counts exceeding 200,000 (POVER2), mean herd size and total milk revenue. When financial variables were excluded, only AVGACM and POVER2 were significant.

DISCUSSION

Herd level data from the study herds were collected on a monthly basis. Since the financial information, from which the measures of profitability were derived, was only available for the entire calendar year, the monthly health and productivity data were collapsed to create yearly averages. A drawback to the use of these annual means was that potentially valuable information could have been lost. For example, since some study herds demonstrated seasonal variability in adjusted corrected milk production, one could speculate that the degree of seasonal variability might be more closely associated with herd profitability than the annual mean. To investigate this possibility, the interquartile ranges for monthly values of all health and productivity variables that had previously been shown to have a significant seasonal component, were included as independent variables in the analysis. However, none of the interquartile range variables appeared in any of the best subset models. Thus, although there were significant seasonal changes in these measures of health and productivity, the between month variability was not important in characterizing the yearly dairy farm profitability.

The process of screening variables and model building used in this study was intended to identify herd level financial, management and biological characteristics that were associated with profitability and production efficiency. Based on information from both years of the study, the herd level data were best able to predict milk income minus feed costs per cow (MFPCOW). Best subset models for MFPCOW yielded adjusted R^2 values ranging from 52% to 94%. In contrast, the available herd level variables only managed to explain a maximum of 33% of the variability in operating margin as a percent of total revenue (OMPERREV), between 22% and 48% of the variability in debt servicing capacity per cow (DSCAPCOW), and from 17% to 53% of the variability in dairy enterprise net income per cow (DNIPCOW).

The relatively poor fit of models for OMPERREV are likely attributable to the way in which the dependent variable was calculated. By expressing the operating margin as a percent of total revenue, rather than on a per cow basis, the effect of independent variables that measure biological production efficiency, such as milk production per cow and feed costs per cow, are muted. In the case of DNIPCOW and DSCAPCOW, these measures include not only costs directly related to the biology of milk production, but also other farm and/or enterprise revenues and costs, which are less likely to be as closely associated with many of the biological variables included in this data set. These two measures also reflect the farm's relative asset base and approach to debt management, both of which are not related to the biology of the farm. MFPCOW, more a measure of biological production efficiency than profitability, is most likely to be associated with measures of cow health and management, and hence these models have a better fit.

Some of the important independent variables, as identified by the best subset process and the multivariate analyses, varied from *year one* to *year two* of the study. Factors which likely contributed to these differences include the reduction in the number of farms with complete financial data from 58 in *year one* to 48 in *year two*, the lack of consistency brought about through the failure of all but 39 of the *year one* farms to provide complete financial data for *year two*, and changes in the financial position of some farms during the study period. The only consistency among the four multivariate analyses was the selection of AVGACM, a measure of milk and component production per cow, and either POVER2 or PCMAST, measures of udder health, as being associated with all measures of profitability. Increased profitability was associated with increased production per cow in all model groups, and with decreased removals attributed to mastitis or udder problems in *year one*. In *year two*, the percent of cows with somatic cell counts exceeding 200,000 cells/ml was negatively associated with dairy net income per cow.

Beyond the association of milk production per cow and udder health with profitability, this study was unable to identify biological or management characteristics of dairy farms that were consistently associated with farm or enterprise profitability. One possible explanation for the inability to consistently relate herd health to profitability may lie in our understanding, or lack thereof, of the underlying distribution of disease in the herd. The economic impact of some diseases and management strategies, on both individual animal and herd performance and profitability has been investigated. The challenge in working at the herd level, is to define the underlying distribution of disease, both clinical and subclinical, in the individuals making up that population, and then to relate that to herd profitability. In this study, we have assumed the relationship between herd disease and farm profitability to be linear. It may well be that for some diseases, the prevalence must reach a critical threshold before the disease has a significant impact on herd revenue or expenses. Further investigation of these relationships is needed.

Based on the inability of the available health and productivity variables to explain the variability in some of the dependent variables, it is clear that the monitoring of these herd health and productivity measures alone does not give insight into the financial health of the farm unit. Further investigation of these relationships is necessary to determine if other biological and management measures of dairy herd performance, or better refinement of the existing variables, will yield better fitting models.

CONCLUSIONS

Under changing economic pressures from external forces under the General Agreement on Trade and Tariffs, and the North American Free Trade Agreement, the Ontario dairy industry must continue to improve its production efficiency in order to remain competitive in a less restricted world market. The present study has attempted to identify associations among herd measures of health, management, productivity and profitability in Ontario dairy herds. The relatively short study period, and the small number of farms that contributed data to both years of the study, may have precluded the identification of temporal or causal relationships among these measures. Future studies should include more farms, each contributing data over several years, in order to better elucidate the impact of changes in health, management and productivity on measures of dairy farm profitability and production efficiency. We hope that this initial project can serve to identify areas of further study and support the movement towards the establishment of an industry-wide database of animal and herd production, health and financial information.

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