This is to certify that the

thesis entitled

A Comparison of Management-Intensive Grazing and Conventionally Managed Michigan Dairies: Profitability, Economic Efficiencies, Quality of Life, and Management Priorities

presented by

Dr. Barbara A. Dartt

has been accepted towards fulfillment
of the requirements for

Master of Science degree in **Agricultural Economics**

James W. Lloyd
Major professor

Date 7-1-98

A COMPARISON OF MANAGEMENT-INTENSIVE GRAZING AND CONVENTIONALLY MANAGED MICHIGAN DAIRIES: PROFITABILITY, ECONOMIC EFFICIENCIES, QUALITY OF LIFE, AND MANAGEMENT PRIORITIES

By

Dr. Barbara A. Dartt

A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

MASTER OF SCIENCE

DEPARTMENT OF AGRICULTURAL ECONOMICS

1998

ABSTRACT

A COMPARISON OF MANAGEMENT-INTENSIVE GRAZING AND CONVENTIONALLY MANAGED MICHIGAN DAIRIES: PROFITABILITY, ECONOMIC EFFICIENCIES, QUALITY OF LIFE, AND MANAGEMENT PRIORITIES

By

Dr. Barbara A. Dartt

A retrospective cohort study was designed to determine differences in profitability, asset efficiency, operating efficiency, labor efficiency, quality of life, and management priorities between Michigan dairy farm operators implementing management-intensive grazing (MIG) and conventionally managing dairy farm operators. Financial information, labor use and quality of life data, and management priorities were collected with surveys and personal interviews from 35 MIG and 18 conventionally managed dairies with similar herd sizes and locations. Multivariate linear regression indicated that MIG dairies tended to have higher economic profit and asset efficiency and had significantly higher operating and labor efficiencies than conventionally managed dairies. Univariate analysis and logistic regression also suggested that MIG and conventionally managing dairy producers had a very similar perception of their quality of life and had similar management priorities. Overall, the study population was quite satisfied with their quality of life. These results suggest that MIG could provide a sustainable alternative management tool for portions of Michigan's dairy industry.

This thesis is dedicated to my husband, Brian, whose patience and understanding were instrumental to my success as a researcher. Thank you for listening carefully, even when you had no idea what I was talking about. To my daughter, Alex, born during this graduate career, who has brought new perspective to my life. To my unborn child, (Connor or Samantha?), who added both a deadline for the end of this graduate career and a fresh outlook on my career search. To my parents, Ben and Denise, who have, above all, instilled in me an unending quest to learn. Thank you for helping me understand that knowledge comes in all shapes and sizes. And finally, to my grandparents, Jay and Hazel. Thank you for making me part of the past and being proud of my future.

ACKNOWLEDGMENTS

Though I am sole author of this thesis, it could not have been completed without the collaboration of many individuals. First and foremost, I appreciate the guidance and mentorship of my major professor, Dr. Jim Lloyd. Under his tutelage, I have gained a great deal of insight. Much of it is reflected in this work. Dr. Roy Black provided much needed perspective on analytical methodology, and Drs. Kaneene and Nott helped keep the project's outcomes practical.

Dr. Ben Bartlett (also known as Dad) and many other Michigan State University Extension agents contributed their time, experience, and encouragement. B.J. Bartlett helped immensely with data collection and entry. My fellow graduate student, Dr. Brian Radke, offered much practical advice and insight.

Finally, and perhaps most importantly, I appreciate the willingness of the participating dairy producers who gave of their personal time and records. Their cooperation and interest allowed this project to be completed.

TABLE OF CONTENTS

CHAPTER 1

CHAPTER 2

CHAPTER 3

Chapter 1

Introduction

PROBLEM STATEMENT

Michigan's dairy industry is a large part of Michigan's agricultural economy. In 1996, milk receipts represented 22% of Michigan's total cash receipts from agricultural commodities and milk products represented 21% of Michigan's $3.8 billion agricultural sector output (9). However, Michigan's dairy industry is undergoing tremendous structural and organizational change. During the period of 1987 to 1996, the number of dairy farms in Michigan decreased by 59% (8, 9). Those farms that remain are starting to look much different than their predecessors: between 1987 and 1996, average herd size increased over 29% (from 52 to 73 cows) and average production per cow increased by 14% (from 14,537 pounds to 16,969 pounds) (8, 9). Two other notable financial characteristics were found in a 1991 survey. Approximately 48% of Michigan dairy farms had debt-to-asset ratios over 0.4 and nearly 50% of principal operators were at least 50 years of age (7).

In 1993, issues of very high priority as identified by farmer group representatives and Extension agents included management and survival of small farms, economic vitality of small towns, and sustainability of agricultural production (13). Primary obstacles to a more efficient and rewarding farm sector in Michigan were identified as a weak, unfavorable economy, a lack of competitiveness in marketing and inadequate processing facilities, and the capital necessary to continue farming (13). These qualitative factors, as well as the above financial characteristics, indicate that a large proportion of the agricultural industry is in financial difficulty, and that a large turnover in management can be expected within the not too distant future. In addition to the rapid structural changes occurring within the industry, milk markets have become increasingly unstable (2). Michigan stands at a critical crossroads if it is to maintain a healthy dairy industry. Producers are faced with a dilemma: expand their business or devise appropriate new strategies to remain competitive and survive under increasingly stringent conditions (3).

To successfully sustain their positions in the presence of these unstable conditions, individual producers are continuously challenged to improve their management skills. As shown by the above data, previous survival methods have been to increase outputs by increasing herd size and increasing milk production per cow. However, the high debt-to-asset ratios, advanced age of the principal operator and lack of capital characterizing many Michigan dairy farms rules out expansion as a method for remaining competitive in a substantial part of the industry (12). In addition to these structural constraints, 67% of Michigan's dairy producers are unwilling to take on additional debt (1). Strategies such as management-intensive grazing (MIG), which may require a minimum of capital investment and could offer other advantages such as increased flexibility in family labor contributions, are being explored as competitive and sustainable dairy management alternatives.

Descriptive studies have shown that moderately sized farms (80-100 cows) remained competitive when they reduced net feed and crop expenses, labor expenses and machinery costs (4, 11). Though MIG reduced these costs, milk production per cow often declined concurrently (5, 6). Despite lower milk yields, the accompanying lower costs yielded a comparable or even higher net income per cow than conventional drylot or continuous pasture systems (5, 6, 10).

The goal of this project was to examine MIG as a low input alternative management strategy that may assist the average dairy farm in Michigan (75 cows) in developing a financially stable, competitive, sustainable farm business. Specifically, this thesis will compare the profitability and economic efficiencies of MIG and conventionally-managed dairy farms matched on herd size and Michigan region. It will also examine the quality-of-life and labor use patterns of the operators of MIG and conventionally-managed Michigan dairies.

OUTLINE

Chapter 2 will review completed literature about the profitability and efficiency of MIG dairies throughout the United States as well as literature published regarding the quality of life of farm families. Chapter 3 will examine the profitability and economic efficiencies of Michigan MIG dairies as compared to conventionally managed Michigan dairies. Chapter 4 will explore the quality of life and management priorities of the operators of MIG dairies as compared to the operators of conventionally managed Michigan dairies. Chapter 5 will summarize the study's findings and propose areas for further research.

REFERENCES

1. Bokemeier, J., E. Allensworth, A. Skidmore. 1995. Decisions for the future: Dairy farming in Michigan. Michigan State Univ. Ag. Exp. Station Research Report 540, Michigan State Univ., East Lansing, MI.

2. Cropp, R. December, 1993. Dairy Outlook. University of Wisconsin-Madison, Madison, WI.

3. Davidson, A. and H. Schwarzweller. 1993. Dairying in Michigan's Upper Peninsula: Restructuring for the Future. Michigan State Univ. Ag. Exp. Station Report 534, Michigan State University, East Lansing, MI.

4. Emmick, D. L., L. F. Toomer. 1991. The economic impact of intensive grazing management on fifteen dairy farms in New York state. Page 7 *in* Proceedings of the American Forage and Grassland Council. Columbia, MO.

5. Ford, S., G. Hanson. 1994. Intensive rotational grazing for Pennsylvania dairy farms. Penn State Coop. Ext. Farm Economics. May/June issue. Pennsylvania State Univ., State College, PA.

6. Hanson, G. D., L. C. Cunningham, M. J. Morehart, R. L. Parsons. 1998. Profitability of moderate intensive grazing of dairy cows in the Northeast. J. Dairy Sci. 81:821-829.

7. Harsh, S., J. Lloyd, A. Wysocki, J. Rutherford, J.B. Kaneene, W.J. Moline, S. Nott, A.C. Rotz. 1996. Michigan dairy farm industry: Summary of the 1991 Michigan State University dairy farm survey. Michigan State Univ. Ag. Exp. Station Research Report 544, East Lansing, MI.

8. Michigan Agricultural Statistics. 1988. Michigan Agricultural Statistics Service, Michigan Dept. of Ag., Lansing, MI.

9. Michigan Agricultural Statistics. 1996-97. Michigan Agricultural Statistics Service, Michigan Dept. of Ag., Lansing, MI.

10. Rust, J. W., C. C. Sheaffer, V. R. Eidman, R. D. Moon, R. D. Mathison. 1995. Intensive rotational grazing for dairy cattle feeding. Amer. J. Alt. Ag. 10:147-151.

11. Smith, S. 1994. Moderate size farms can be successful. Page 2 *in* Agricultural Update: Farm Business and Financial Management. Vol. 4, No.4. Cornell Coop. Ext., Cornell Univ., Ithaca, NY.

12. Sniffen, C., L. Hamm, T. Ferris, R. Mellenberger, M. VandeHaar, A. Tucker, I. Mao, J. Ireland, B. Cook, A. Skidmore, P. Coussens, R. Emery, R. Fogwell, J. Partridge, Z. Ustunol, B. Bickert, J. Lloyd. 1992. Status and Potential of Michigan Agriculture - Phase II: Dairy Industry. Michigan State Univ. Ag. Exp.Station Special Report 43. Michigan State University, East Lansing, MI.

13. Schwarzweller, H. and E. Roach. 1993. Issues and Problems Confronting Rural Michigan in the '90s. Michigan State Univ. Ag. Exp. Station Report 530, Michigan State University, East Lansing, MI.

Chapter 2

Literature Review

INTRODUCTION

Little peer-reviewed research has been published about the profitability or efficiency of management-intensive grazing (MIG) dairy farms. Even less has been done comparing the quality-of-life or labor use on MIG dairies to that on conventionally managed dairies. The work that has been done is primarily descriptive in nature and has been carried out on a fairly limited sample of cows or farms. The most common studies of the financial performance of MIG dairies have been in the form of case studies and partial- or whole-farm simulations. Some statewide financial record keeping systems have been employed to compare MIG dairies to conventionally managed dairies. Finally, a few miscellaneous studies have been performed, generally through surveys, specifically to investigate the profitability levels of MIG dairies.

FINANCIAL PERFORMANCE

Case Studies

In 1986, Murphy and others in Vermont studied six dairy farms over two years (17). During the first year, the farms used continuous grazing methods. In the second year, the farms switched to Voison grazing management methods. Production and economic factors were calculated for three of the six farms studied.

These three farms documented increased profit per cow in the second year of the study, primarily due to savings realized by feeding less concentrate and through selling excess forage. Two of the three farms had less milk income in the second year of the study. Net profit per cow for the five month grazing season ranged from $37 to $98.

Fifteen dairy farms in New York state were studied (5), beginning in 1989, both before and after adopting an intensive pasturing system. Herd size ranged from 32 to 135 cows, with an average of 55. Milk production ranged between 12,803 and 20,091 pounds per cow per year, with an average of 15,380 pounds per cow. Average savings of $153 per cow in production costs were realized, with a $40 to $290 range. Production costs per hundredweight decreased an average of $1.56 with a range of $0.26 to $3.21.

A Minnesota study (22) completed over the summers of 1991 and 1992 compared net income per cow in rotationally grazed (13 cows in 1991; 12 in 1992) and conventionally managed (13 cows in 1991; 9 in 1992) settings. Net returns for rotationally grazed cows were $380 and $622 per cow compared to net returns for conventionally managed cows of $327 and $578 in 1991 and 1992, respectively. Rotationally grazed cows showed these higher returns despite lower milk production in both years. Returns only reflect the pasturing periods of each year. Increases in net income reflected cost savings in purchased feed and labor.

t

p

7

sa

av

A Virginia dairy farm's economic data (2) were studied during their conversion to a controlled grazing system. Their purchased feed cost in 1991, with a conventionally managed dairy, was $3.91 per hundredweight. In 1992, utilizing controlled grazing, their purchased feed cost dropped to $1.54 per hundredweight. Net cash income less depreciation increased 70%, however, herd size and milk sold were both higher in 1992. Farm gate milk prices for these two years were not cited.

Through 1991 and 1992, Frank and colleagues studied the costs and returns to the dairy enterprise of one Wisconsin farm that switched from a confinement system to a rotational grazing system (12). Net farm income rose in 1992 as compared to 1991 for this farm. However, this increase was primarily due to an increase in herd size, milk sold and milk price. In contrast to other studies, milk production per cow was higher in the rotational grazing system. Lowered 1992 expenses accounted for some of the increased net income.

An Ohio study compared 12 management-intensive grazing (MIG) dairies to the average of 32 participating farms in 1994 and 9 MIG dairies to the average of 19 participating farms in 1995 (19). Management-intensive grazing dairies averaged 74 cows and 15,018 pounds of milk per cow in 1994 while the average for the whole sample was 79 cows and 18,088 pounds of milk. In 1995, MIG dairies had an average of 88 cows producing 14,292 pounds of milk while the whole sample averaged 102 cows and 17,924 pounds of milk per cow. The MIG dairies averaged $448 and $468 of net income per cow for 1994 and 1995, respectively. The average of all the farms in the study was $401 and $430 of net income per cow for 1994 and 1995.

These case studies illustrate the difficulty in drawing conclusions from work done on one or a few farms. A recurring problem in interpretation of the financial performance of "grazing" dairies has been the lack of a uniform definition for "grazing." In these six studies alone, four separate terms have been used to describe a grazing system: Voison grazing management, rotational grazing, controlled grazing and management-intensive grazing (MIG). Usually the terms are loosely defined and it must be assumed that they approximate similar management systems. For the remainder of this literature review, author comments will refer to all "grazing" systems as MIG or to their operators as graziers.

A further difficulty in studying "before-and-after" effects is that annual differences in net income on one farm were often at least partly attributable to changes in herd size, milk production or milk price. Weather changes can also cause substantial differences in crop yields. These year-to-year changes make it difficult to discern the effect of a management change on financial performance. Finally, case studies investigate only one or a few farms. Users of the results must be very cautious in extrapolation of farm-specific outcomes.

Case studies certainly have their place. They are an important first step in many types of research. Studying one farm allows researchers to work through, on a small scale, unanticipated difficulties that arise during collection and analysis of economic data. In addition, comparing consecutive annual data on one farm holds many things constant, including the productivity of the land base and the operator's management style. These two factors alone contribute enormous variability when studying financial data between farms. A somewhat more comprehensive method of examining the switch from a conventionally managed dairy to a MIG system is to use cross-sectional data in a computer simulation to model this farm level management change.

Simulations

Using a present value of income streams method, two crop rotation systems were compared (13). The first included pasture as the first three years in an eight year crop rotation with hay and corn. The second was a six year rotation of only hay and corn. Expenses were taken from Wisconsin Crop Enterprise Budgets. Income was based on the value of harvested forage. The simulation assumed the conversion of fourth year alfalfa and grass hay fields into rotationally grazed pasture for dry cows and heifers. The rotation including pasture had a $9.14 annuity-equivalent per acre benefit. Sensitivity analysis indicated that the rotation that included pasture had the advantage for a wide variety of expected hay yields, expected pasture yields and pasture fencing costs. The expected advantage of including pasture in the rotation increased as the expected pasture yield of the converted hay field increased.

FINPACK's whole farm budgeting feature was used to compare four alternative cropping systems on a "typical" Wisconsin 50 cow dairy with a 35% debt to asset ratio (24). The scenarios included, 1 - conventional corn and hay; 2 - corn, hay and rotationally grazed pasture; 3 - no corn, only hay and rotationally grazed pasture; 4 - rotationally grazed pasture and purchased feed. Returns were based on equal milk production among all four scenarios. Scenario 3 had the highest net profit, dollars to unpaid labor and management hours and dollars returned on equity capital. Net profit per cow for Scenario 3 was about $358, approximately $100 higher than Scenario 2, the next best alternative. Risk analysis using ranges of input prices indicated that Scenarios 3 and 4 had the highest risk, as measured by the percent change of return from the midpoint of its range to the extremes.

A linked spreadsheet simulation based on a typical Pennsylvania dairy farm (200 acres, 53 cows, 48 replacements, 15,000 pounds milk per cow) was performed (20). Grazing and confined feeding system models were developed, both containing detailed and comprehensive assumptions about forage utilization. Equal milk production per cow was assumed for the two systems. The grazing system showed

$121 per head increased return over operating costs compared to the confined feeding system due to decreases in cropping expenses, concentrate and protein purchases, and barn bedding material. The return over operating costs was $1,151 per cow for the grazing system. This analysis did not account for fixed costs or differences in herd reproductive performance. At the assumed milk price of $11.75 per hundredweight, cows in the grazing system could produce about 1,050 pounds less milk per cow before the confined feeding system became more profitable than the grazing system. With a 10% decrease in veterinary, utility and breeding costs, as has been reported anecdotally, the grazing system showed a $134 higher per head return over operating costs than did the confined feeding system.

A whole-farm budget that compared three different cropping systems available to a Pennsylvania dairy farm was completed by Ford (8). The three systems included a confinement feeding system with no pasture and two rotationally grazed pasture systems, one including corn grain acreage and one without corn grain. The dairy ran 60 head of cows, 46 replacement animals and produced about 15,000 pounds of milk per cow per year. Net cash farm income was highest for the scenario of rotationally grazed pasture without corn ($358 per cow). The advantage of rotationally grazed pasture in the system over no pasture in the system was approximately $137 per cow.

The Dairy Forage Systems Model (DAFOSYM), a computer model simulating the growth, harvest and storage of alfalfa, feeding of the herd and manure scraping, storage and spreading on a dairy farm, was used to model a central Pennsylvania grazing farm that employed rotational grazing and custom hired baling, chopping and manure hauling operations (21). The farm owned 60 milking cows, 38 replacement animals and produced about 18,500 pounds of milk per cow per year. Rotational grazing and confined feeding scenarios, using both custom hired and owned equipment, were compared. The rotational grazing scenario using custom hired equipment had the highest net return over feed and manure costs ($1,290 per cow). This was about $85 higher than the net return for the rotational grazing scenario that used owned equipment and $246 higher than the confined feeding scenario that used custom hired equipment. Advantages for the grazing scenarios were captured through lowered fuel, labor, seed and fertilizer, and purchased feed costs.

Whole farm budgeting was again used to compare the profitability of four dairy forage systems (10). They included, 1 - year round calving with confinement feeding; 2 - year round calving with rotationally grazed pasture; 3 - spring calving with rotationally grazed pasture; and 4 - fall calving with rotationally grazed pasture. A 70 cow herd on 180 acres of land was assumed. Budgets were constructed for two different milk production levels (18,000 and 16,500 pounds per cow per year) under each of the four systems. Feed costs and forage requirements were calculated to meet stated production levels. Year round calving with rotationally grazed pasture had profits of up to $94 per cow higher than other scenarios. Rotationally grazed pasture scenarios were profitable if milk production was maintained within 5% of its original level. Spring and fall calving had profits of up to $199 per cow higher than the other scenarios even at the lower milk production level. Fall calving on pasture had slightly lower returns than spring calving.

A mixed-integer programming model was developed to determine optimal crop mixes for a 60 cow dairy with 180 acres of tillable land, family labor and one full-time employee (9). Milk and livestock sales less dairy and crop costs (profit) were maximized. Milk production was fixed at 18,000 pounds per cow per year. The model found that the optimal cropping rotation included rotationally grazed pasture, but only when it was supplemented with other forages and concentrates. Profit was $117 per cow higher if rotationally grazed pasture was included in the cropping rotation. When hired labor was unavailable, the use of rotationally grazed pasture increased and profits rose.

Whole farm budgeting was used to compare five scenarios for herds of 50, 60 or 70 cows at production levels of 15,000, 18,000 or 21,000 pounds of milk per cow per year (11). Scenarios included: 1 - confinement system; 2 - year-round calving, pasture-based system; 3 - seasonal calving, pasture-based system; 4 - Scenario 2 with a decreased machinery investment; and 5 - Scenario 3 with a decreased machinery investment. At all cow numbers, pasture based dairies had higher returns to management and equity than did confined dairies, however, returns were negative for all but one scenario at 15,000 milk per cow. Returns to management and equity per cow for Scenario 2 ranged from $(178) to $367. These were about $55 to $60 higher than per cow returns for Scenario 1. Seasonal calving herds had lower total returns than year-round calving herds, but, at the highest production level had a slightly higher return per labor hour. A decreased machinery investment (and more reliance on custom harvesting) yielded higher returns for pasture based dairies.

A simulation of dairy farm forage systems using a Monte-Carlo farm level simulation model with stochastic yield and price variables was performed for 10 harvested forage combinations (4). At equal milk production levels of 18,800 pounds per cow per year, annual net cash farm income was $140 to $207 per cow higher for farms using intensive grazing. Net cash farm income for intensive grazing farms ranged from $872 to $1180 per cow. Risk assessment using stochastic dominance analysis showed that usually, farms with intensive grazing were preferred to those without when milk production remained constant. However, milk yield could only decrease 4-5% before farms without intensive grazing were preferred.

Winsten and Petrucci, using whole-farm budgeting techniques, examined the profitability of five different scenarios for an average Vermont dairy farm (25). The average farm, a confinement operation, had 72 cows producing 17,538 pounds of milk per cow and generated about $8 of net farm income per cow. Scenario 1 introduced MIG, Scenario 2 introduced MIG, seasonal spring calving and reduced herd size to 65 cows, and Scenario 3 maintained a confinement herd, but used machine-harvested grass forage to replace corn silage. Scenario 4 introduced MIG and seasonal spring calving, doubled herd size and built a 16-unit New Zealand style parlor. In Scenario 5, MIG and seasonal spring calving were introduced, the herd sized expanded to 100 cows and the current facilities retrofitted. Milk production was expected to decline by 1,000 pounds per cow in Scenario 1 and by 3,500 pounds per cow in Scenarios 2 - 5. Net income per cow was higher for all five scenarios than for the average Vermont farm, but was highest for Scenario 4, at $434 per cow. Purchased feed cost per cow was lower than the average Vermont farm for all five scenarios, but was lowest for Scenario 2.

The above simulations, while taking analysis of the financial performance of grazing systems one step further than case studies, still leave unanswered questions. Many simulations focused on comparing forage systems and did not account for possible changes in farm capital structure or even assess returns to the dairy enterprise. In addition, all simulations except one held milk production constant. Anecdotal and descriptive evidence suggest that milk production s

w

c

m

pc

me

ne

wa

generally declines when MIG is implemented. Finally, neither case studies nor simulations lend themselves to statistical analysis. To determine if there is a profitability difference between MIG and conventionally managed farms, more must be done than simply a comparison of averages.

Shortfalls in simulations were sometimes due to a lack of information on which to base assumptions about expected revenues and expenses of MIG dairies. Representative cross-sectional databases of information about grazing dairies are beginning to be generated, often by current statewide financial record keeping systems.

Statewide Financial Record Keeping Systems

In 1997, the Dairy Farm Business Summary (DFBS) compared 59 New York state intensively grazed dairy farms to 97 non-grazed DFBS dairies (3). Groups were similar in herd size, production per cow, and location. Data was from the 1996 calendar year. Intensive grazing farms had 78 cows and sold 17,270 pounds of milk per cow, on average, while non-grazing farms had 75 cows and sold 17,547 pounds of milk per cow, on average. Purchased feed cost per cow, veterinary and medicine cost per cow, and capital per cow were lower for grazing farms. Average net farm income per cow for grazing dairies was $409 and for non-grazing farms was $328.

Data from Michigan's 1996 TelFarm records project for 11 dairy grazing herds were compared to 33 farms of similar herd size that may or may not have grazed their cows (18). Grazing herds had an average of 88 cows producing 15,100 pounds of milk per cow while the comparison group averaged 99 cows producing 18,500 pounds of milk per cow. Purchased feed cost per cow and veterinary cost per cow were lower for graziers, however, net farm income per cow was $434 for graziers and $500 for the comparison group.

These cross-sectional databases offer a broader sample of the financial performance of graziers that neither the case-studies nor simulations could provide. One difficulty in collecting this information is in the identification and definition of a grazing dairy. Also, financial record keeping databases provide a sample of producers that are biased by their voluntary participation. It is expected that producers choosing to keep this type of financial records are somewhat better managers than the average dairy operator. Finally, though statewide financial record keeping systems do provide controls to compare to grazing dairies, they have not generally been matched by location within a state. Different growing seasons and soil fertility can have substantial impacts on production and financial performance.

Other Studies

A study conducted during 1991 and 1992 compared farm costs and returns for sixteen dairy farms in western Wisconsin and southeastern Minnesota (16). Eight farms primarily used intensive rotational grazing to harvest forage during the summer, while the eight other farms used mechanical methods and were labeled confinement farms. Average herd size for grazing farms was 53 cows with milk production of 15,300 pounds per cow. Herd size for the non-grazing farms was an average of 43 cows with milk production of 18,600 pounds per cow. Purchased feed cost per cow and investment per cow were both somewhat lower for grazing farms. Net return for grazing farms was $211 per cow and for non-grazing farms was $426 per cow.

A survey of a randomly selected sample of Wisconsin dairy farmers was conducted in 1995 and reported on by Jackson-Smith and others (15). About 14% (157) of the 1151 respondents indicated that they practiced intensive grazing. The intensive graziers had an average herd size of 40 cows producing about 15,941 pounds of milk per cow. Confinement operators (nearly 50% of respondents) had an average herd size of 67 cows producing 18,468 pounds of milk per cow. The remaining respondents relied somewhat on pastures for forage needs but did not manage them intensively. Intensively grazed farms had an average net farm income t

c

l

a

fir

tha

per cow of $679 while confinement operators' average net farm income per cow was $474. Graziers had slightly lower levels of capital per cow than confinement farms.

In 1998, the economic results of a random, stratified (by cows per farm) sample of 50 Pennsylvania dairy farms on which cows grazed pasture was published by Hanson and colleagues (14). The sample was split into those dairies practicing moderate intensive grazing (n = 37) and those employing an extensive grazing system (n = 13). Information was collected for the 1992 calendar year. Moderately-intensive graziers had an average herd size of 56, producing 15,585 pounds of milk per cow. Extensive grazing operators had an average herd size of 64.5, producing 17,226 pounds of milk per cow. The difference in milk production was statistically significant. Net farm income per cow was $646 for the moderately-intensive graziers and $545 for those using an extensive grazing system. Though this difference in profit was not statistically significant, the study found that many cash costs, including feed cost and veterinary, medicine and breeding costs, were lower (not significantly) for moderately-intensive graziers. These descriptive findings are consistent with previous work.

Hanson's work represents one of the first grazing studies to analyze the financial performance of a random sample of dairy producers. It is important to note that this work supports many of the descriptive and anecdotal reports cited above.

However, Hanson went one step further and performed statistical tests on the data. These results suggest that even though the difference in mean net income between the groups was $101 per cow, a 16% increase that is similar to the difference found in many of the previous studies, graziers were not significantly more profitable. The large farm-to-farm variation found in most financial data is an important consideration when simply comparing averages, as has been done in the past.

Hanson's work is important, but can be improved upon. His random sample was of dairies utilizing pasture and may not represent a fair comparison between MIG and conventionally managed, or confinement herds. In addition, the sample was not matched by location or herd size. Though the location represented by the survey was only a five county area of Pennsylvania, it is possible that climate and soil fertility could differ for moderately-intensive and extensively grazed herds. Moving beyond Hanson's univariate comparisons to multivariate modeling would also present an even more rigorous examination of the financial performance of grazing dairies.

Hanson's study, as well as many of the others cited, found that the revenue of MIG dairies was lower than that of conventionally managed dairies, primarily because of lowered milk production. However, these studies also noted expenses that were more than proportionately lower than revenue, yielding higher net income for graziers. This method of obtaining higher profit suggests that graziers are

l
a
c
w
st

co
ad
sus

capturing one or more efficiencies. Often mentioned areas of cost containment include purchased feed expense and labor expense. Lower capital costs per cow are also frequently noted for MIG dairies. These findings suggest that graziers may be capturing operating, labor, or asset efficiencies. No study was found that examines the differences in efficiencies between MIG and conventionally managed dairies, either by comparison of averages or through statistical analysis.

The calculations of profit in the above works range from return over operating costs for the dairy enterprise to more traditional examples of whole farm accrual net income measures. Accounting profit, as defined by the Farm Financial Standards Council (7), represents a return to the operator's labor, management and equity. Economic profit, by including charges for the operator's labor and equity, represents a return to management only. By including a charge for equity, Jackson-Smith is the only researcher who used an economic measure of whole farm accrual net income with which to compare MIG and conventionally managed farms. However, no statistical analysis was performed on these results.

If graziers truly are more labor and asset efficient, it may be very important to compare farms' profitability on an economic, rather than an accounting basis. In addition, economic profits may be somewhat more suggestive of the long term sustainability of a business than are accounting profits. If MIG is to be represented as a sustainable alternative management technology, its profitability should be compared to other technologies on an economic basis.

In light of earlier work, a study is needed that begins with a clear definition of a MIG and conventionally managed dairy. This observational study should collect data from a matched, random, stratified sample of MIG and conventionally managed dairies. A sample size sufficient to detect practical differences in outcomes should be calculated. If possible, data would be collected by personal interview to increase compliance and decrease variability. Ideally, data would be collected for several calendar years. Following data collection, multivariable modeling of both accounting and economic profit, as well as asset, operating, and labor efficiency should be completed. While the extrapolation of results from such a study would clearly be limited to the area in which the trial was conducted, these methods would provide a solid base from which to determine if MIG dairies truly exhibit better financial performance than do conventionally managed dairies.

QUALITY OF LIFE

In the past, farm management research has been dominated by production economics (1). However, the focus has recently shifted to other than purely financial methods by which to measure farming "success." Attempts to measure farm families' perceptions about their quality of life have led to research about operators' u

a

s

A

ty

ap

fo

sig

se

of c

Usi

wou

attitudes regarding time management, life goals, leisure options, and community involvement as well as farm financial performance (23, 6). Indeed, anecdotal reports about reasons for the adoption of MIG include, among others, claims of decreased family labor contributions, enjoyment of working outside with the cows, and increased flexibility in farm labor demands as well as numerous assertions of increased farm profitability.

Jackson-Smith and colleagues measured dairy farmers' attitudes toward the use of purchased inputs and values associated with a family farming system (15). In a multivariate logit model, intensive grazing operations had significantly smaller herd size and were less likely to have their herd enrolled in the Dairy Herd Improvement Association. "Pro-family farm" attitudes were not significantly different by operation type. Hanson et al. examined graziers' attitudes toward grazing and management approaches to the adoption of grazing technology (14). Logistic regression analysis found that moderately-intensive graziers were significantly younger in age and were significantly more likely to have adopted major technological change in the last seven years than were operators of extensive grazing dairies.

However, no literature was found that attempted to compare the quality of life of operators of MIG farms to that of operators of conventionally managed farms. Using questions modeled after those used by Bokemeier and colleagues (1), it would be useful to measure the difference between MIG and conventionally-managing dairy operators' perceptions about their quality of life. Data necessary for this exercise should be prospective or cross-sectional and collected from a sample as described above. Logistic regression models could be used to statistically examine the effect of farm financial performance and grazing upon quality of life indexes.

1

2

3

4.

5.

6.

7.

8.

9.

10.

11.

12.

REFERENCES

1. Bokemeier, J., E. Allensworth, A. Skidmore. 1995. Decisions for the future: Dairy farming in Michigan. Michigan State Univ. Ag. Exp. Station Research Report 540, Michigan State Univ., East Lansing, MI.

2. Carr, S. B., H. E. White, J. M. Swisher, D. M. Kiracofe. 1994. Results of intensive, rotational grazing on a Virginia dairy farm. J. Dairy Sci. 77:3478.(Abstr.)

3. Conneman, G., C. Crispell, J. Grace, K. Parsons, L. D. Putnam. 1997. Dairy Farm Business Summary: Intensive grazing farms New York 1996. Ext. Bull. 97-14. Dpt. Agric., Resource, and Managerial Econ., Cornell Univ., Ithaca, NY.

4. Elbehri, A., S. A. Ford. 1995. Economic analysis of major dairy forage systems in Pennsylvania: the role of intensive grazing. J. Prod. Ag. 8:501-507.

5. Emmick, D. L., L. F. Toomer. 1991. The economic impact of intensive grazing management on fifteen dairy farms in New York state. Page 7 *in* Proc. American Forage and Grassland Council. Columbia, MO.

6. Filson, G., M. McCoy. 1993. Farmers' quality of life: Sorting out the differences by class. Rural Sociologist. 13:15-37.

7. Financial Guidelines for Agricultural Producers. 1995. Farm Financial Standards Council, Naperville, IL.

8. Ford, S. A. 1994. Economics of pasture systems. Dairy Economics. Dpt. of Ag. Econ. and Rural Soc. Fact Sheet. No. 1. Penn. State Univ., State College, PA.

9. Ford, S. A., C. Comer. 1994. Optimal cropping systems including pasture from a mixed-integer programming model of a representative dairy farm. J. Dairy Sci. 77(Suppl. 1):127.(Abstr.)

10. Ford, S. A., L. D. Muller, M. Randall, L. A. Holden. 1994. Economics of seasonal dairying on pasture. J. Dairy Sci. 77(Suppl. 1):126.(Abstr.)

11. Frank, G., R. Klemme, B. RajBhandary, L. Tranel. 1995. Economics of alternative dairy grazing scenarios. Managing the Farm. Vol. 28, No. 3. Dpt. Ag. Econ., Univ. of Wisc., Madison, WI.

12. Frank, G., A. Krusenbaum, J. Posner, J. Hall. 1993. Conversion to rotational grazing and the dairy enterprise, a case study. Univ. of Wisconsin-Madison. Madison, WI.

13. Frank, G. 1990. Economics of converting fourth year alfalfa-grass hay fields to rotation-grazed pasture for dry cows and heifers. Managing the Farm. Vol. 23, No 2. Dpt. Ag. Econ., Univ. of Wisc., Madison, WI.

14. Hanson, G. D., L. C. Cunningham, M. J. Morehart, R. L. Parsons. 1998. Profitability of moderate intensive grazing of dairy cows in the Northeast. J. Dairy Sci. 81:821-829.

15. Jackson-Smith, D., B. Barham, M. Nevius, R. Klemme. 1996. Grazing in Dairyland: The use and performance of management intensive rotational grazing among Wisconsin dairy farms. Tech. Rep. #5. Agric. Tech and Family Farm Institute. Univ. of Wisconsin-Madison. Madison, WI.

16. Klemme, R. 1994. Profitability in Wisconsin dairying - reduced input costs. Page 77 *in* Proc. 18th Forage Production and Use Symposium. Wisconsin Forage Council, Madison, WI.

17. Murphy, W. M., J. R. Rice, D. T. Dugdale. 1986. Dairy farm feeding and income effects of using Voison grazing management of permanent pastures. Amer. J. Alt. Ag. 1:147-152.

18. Nott, S. N. 1998. Economics measures of grazing systems. Dpt. of Agric. Econ. Staff Paper 98-1. Michigan State Univ., E. Lansing, MI.

19. Noyes, T. E., M. L. Bennett, D. J. Breece. 1997. Economic survey of management intensive grazing dairies in northeast Ohio. Proc. American Forage and Grassland Council. San Antonio, TX.

20. Parker, W. J., L. D. Muller, D. R. Buckmaster. 1992. Management and economic implications of intensive grazing on dairy farms in the northeastern states. J. Dairy Sci. 75:2587-2597.

21. Rotz, C. A., J. R. Rodgers. 1994. A comparison of grazing and confined feeding systems on a Pennsylvania dairy farm. Page 252 *in* Proc. American Forage and Grassland Council. Lancaster, PA.

22. Rust, J. W., C. C. Sheaffer, V. R. Eidman, R. D. Moon, R. D. Mathison. 1995. Intensive rotational grazing for dairy cattle feeding. Amer. J. Alt. Ag. 10:147-151.

23. Stover, R. G., V. L. Clark, L. L. Jansser. 1991. Successful family farming: The intersection of economics and family life. Page 113 *in* Research in Rural Sociology and Development. Vol 5, Household Strategies. JAI Press. Greenwich, CT.

24. Tranel, L., G. Frank. 1991. Dairy pasture economics. Managing the Farm. Vol 24, No. 4. Dpt. Ag. Econ., Univ. of Wisc., Madison, WI.

25. Winsten, J. R., B. T. Petrucci. 1996. The Vermont dairy profitability project: An analysis of viable grass-based options for Vermont farmers. American Farmland Trust Center for Agriculture in the Environment, DeKalb, Ill.

Chapter 3

A Comparison of Profitability and Economic Efficiencies Between Management-Intensive Grazing and Conventionally Managed Dairies in Michigan

I

I

c

f

fr

d

m

h

ef

co

co

be

be

da

mo

sug

alte

ABSTRACT

A retrospective cohort study was designed to determine differences in profitability, asset efficiency, operating efficiency and labor efficiency between Michigan dairy farms implementing management-intensive grazing and conventionally managed dairy farms. Financial information and labor use data for the calendar year 1994 were collected with surveys and personal interviews from 35 management-intensive grazing dairies and 18 conventionally managed dairies. Multivariate linear regression indicated that MIG and conventionally managed farms had similar accounting profits, but that MIG dairies tended to have higher economic profit. In addition, MIG farms tended to have higher asset efficiency and had significantly higher operating and labor efficiency than conventionally managed dairies. Because the geographic distribution of MIG and conventionally managed farms in this study did not include the main Michigan "dairy belt," extrapolation of these results to an average Michigan or Midwest dairy should be made with care. Within the areas represented, however, it is clear that MIG dairies have higher long term profitability and that they capture this profit by being more efficient in asset use, operating practices, and labor use. These results suggest that management-intensive grazing could provide a sustainable alternative management tool for portions of Michigan's dairy industry.

INTRODUCTION

Structural change has occurred within Michigan's dairy industry. The number of operating dairy farms has decreased (13) and herd size and milk production per cow on remaining dairy farms have increased (2, 10). Factors including high debt-to-asset ratios (2, 10) and reluctance to take on additional debt (1) indicate that a large proportion of Michigan's dairy industry could be in a measure of financial difficulty. Common survival methods in the face of unstable milk markets have been to increase outputs by increasing herd size and increasing milk production per cow. However, the financial uncertainty characterizing many Michigan dairy farms rules out expansion as a method for remaining competitive in a substantial part of the industry (10). Alternative, low input strategies such as management-intensive grazing (MIG), are being explored as competitive dairy management alternatives.

Descriptive studies have shown that moderately sized farms (80-100 cows) can remain competitive when they reduce net feed and crop expenses, labor expenses and machinery costs (3, 11, 16). Though MIG has been reported to reduce these costs, milk production per cow often declines concurrently (4,16). Despite lower milk yields, the accompanying lower costs can yield a comparable or even higher net income per cow than conventional drylot or continuous pasture systems (4, 11, 15). One of the few studies that compared a stratified random sample of grazing and non-grazing farms (9) found that grazing farms produced significantly less milk per cow than did the comparison group. However, no significant difference in net income per cow was found between groups.

These previous studies have generally used an accounting measure of profit through calculation of net farm income per cow or per hundred weight. Accounting profit was defined as a return to the producer's labor, management and assets. Accounting profits are an important first step in the determination of firm level profitability, however, they fail to recognize opportunity costs. Family labor is generally an integral input and ought to be valued, because presumably, these "employees" could be working elsewhere for a wage. Also, the substantial dollar value usually represented by farm equity could be invested elsewhere in profit generating enterprises. By charging for both family labor and equity invested, an economic measure of profit more objectively measures the profitability of a farm business. In addition, economic profit is probably a better measure of the sustainability of a dairy. Though a high accounting profit may make a business appear to be quite healthy in the short term, these returns may be generated with unacceptably high levels of labor or assets. Economic profit will capture these inconsistencies.

Dairies can increase profit levels or reduce resource use while maintaining profits through capturing one or more economic efficiencies. If MIG dairies are more profitable, determination of the particular efficiencies that contribute to profitability could provide important suggestions for more effective farm management practices.

The goal of this project was to examine MIG as a low input alternative management strategy that would assist the average dairy farm in Michigan (85 cows) in development of a financially stable, competitive, sustainable farm business. Specifically, this paper will examine the accounting and economic profit, capital efficiency, operating efficiency, and labor efficiency of MIG and conventionally managed dairy farms matched on herd size and Michigan region. Specific hypotheses include:

H_1: Dairy producers implementing MIG have higher accounting net farm income per cow (aNFIpCOW) than conventional producers.

H_2: Dairy producers implementing MIG have higher economic net farm income per cow (eNFIpCOW) than conventional producers.

H_3: Dairy producers implementing MIG have a higher asset turnover (ATO) than conventional producers.

H_4: Dairy producers implementing MIG have a higher net farm income percent (NFI%) than conventional producers.

H_5: Dairy producers implementing MIG have a higher value of farm production per labor hour (VFPpLH) than conventional producers.

MATERIALS AND METHODS

Study Design

A retrospective cohort study was designed to determine differences in profitability and economic efficiencies between MIG and conventionally managed Michigan dairies. Potential MIG farms were identified using 1993 and 1994 Michigan Grazing Conference mailing lists cross-referenced with the 1995 Michigan Department of Agriculture list of Grade-A dairies. Of the studies' MIG herds, a small number were identified by word-of-mouth from cooperating producers, Extension agents, and veterinarians. Producers were then contacted by letter and phone to solicit their voluntary participation in the project and to ensure they fit the MIG herd definition. A MIG herd was defined as obtaining at least 25% of the annual whole herd forage requirement through grazing. Cows must have been grazed or pastured at least four months per year and lactating cattle rotated or changed to new pastures every third day or less. In addition, 1994 had to be at least the second year the MIG farm fit this definition.

Matches by herd size (five categories) and Michigan Department of Agriculture geographical distribution (nine regions) were made. Matching was employed to control for different herd sizes, growing season lengths, and soil types that could, if correlated with the variable of interest, *graze*, could confound the e

G

ir

ac

to

m

wa

the

wa

me

fam

tha

gre

wer

Dat

prelin

full w

estimation of the graze effect.

Conventionally managed dairies were identified by a mailing to the 1,184 Grade-A dairies in the counties where MIG farms were located. The mailing included a letter asking for voluntary participation in the project and a self-addressed, stamped reply card on which producers could indicate their willingness to participate, as well as their herd size (one of five categories). Volunteers were matched to a MIG herd. If more than one potential match existed, a single match was randomly selected. Selected producers were telephoned to ensure they met the definition of a conventionally managed farm. A conventionally managed farm was defined as utilizing at least 95% of their whole herd forage requirement from mechanically harvested forages. In addition, MIG and conventionally managed farms were excluded if greater than 10% of their revenue came from sources other than milk or dairy-related livestock sales, if they were increasing their cow herd by greater than 10%, if they were purchasing greater than 60% of their forage, or if they were undergoing substantial structural or management change during 1994.

Data Collection

The data collected by this study represent the 1994 calendar year. A preliminary data collection packet was mailed to producers prior to a farm visit. The full worksheet used to collect financial information can be found in Appendix 1. All participating farms were subsequently visited by one of two investigators who carried out data collection. Financial data collected included 1994 beginning and ending inventories of cattle and feed, as well as the value of assets for farm production including land, equipment and livestock facilities. Market values were used for all inventories and assets. Farm income and expenses and labor use data, detailed both by laborer and job type, were also collected. The complete worksheet can be found in Appendix 1.

Model Building

For this study, both accounting and economic profit were modeled as a modified profit function (6) dependent on inputs including land, labor, capital, and purchased feed expense, as well as the outputs of milk per cow, total livestock revenue, and other revenue. The stated hypotheses indicate an a priori assumption that the level of financial performance is also dependent upon whether a producer does or does not practice MIG.

The various efficiencies are assumed to be dependent on the same explanatory variables as profitability and are modeled similarly. This work chose to measure three key areas of economic efficiency: capital efficiency, operating efficiency, and labor efficiency. The definitions of aNFIpCOW, ATO, NFI% and VFPpLH employed in this study follow closely those advocated by the Farm

Financial Standards Council (5).

To allow comparison with previous work, this study measured both accounting and economic profit through calculation of net farm income per cow. Net farm income per cow was used rather than net farm income because it allowed each farm to be compared on the basis of an individual production unit. The accounting definition of profit used is similar to the way returns have been measured in most previous studies. By not placing an arbitrary dollar amount on the unpaid labor contribution, accounting profit helps equalize different standards of living. The measure also avoids penalizing dairies with a high debt structure by adding back interest expense.

The economic measure of profit included the opportunity costs of operator labor and capital. This study charged for family labor at slightly greater than minimum wage ($7 per hour). Other Michigan work (14) has used a similar per hour charge for unpaid operator and family labor contributions. The assumption attempted to balance the value of family labor contribution when the primary operator could most likely have earned more than this off farm, while children may not have been able to.

A charge of four percent on farm assets was utilized to capture the opportunity cost of invested capital. To avoid penalizing farms with a higher debt structure, the charge was made on the value of assets rather than equity. Four percent was derived by approximation of the inflation-adjusted average 1994 return to 30-year United States Treasury bonds (18). This investment would be long term and was considered to have a risk level similar to producers' investments in real estate and machinery, which make up the largest portion of a farm's asset value.

Asset turnover was chosen as the measure of capital efficiency. A higher value implies higher efficiency, indicating that the farm is generating more revenue per dollar of assets. Asset turnover was chosen instead of return on assets because return on assets, by definition, must include a subjective valuation of contributed labor and management. Asset turnover is a more "pure" measure of asset efficiency. Net farm income percent was chosen as the measure of operating efficiency. Again, a higher value indicates higher efficiency and shows that the farm is generating more net income per dollar of farm production and that costs per unit of value of farm production are lower. Net farm income percent utilized accounting profit because it is customarily used by farm management analysts.

Finally, value of farm production per labor hour was chosen as the measure of labor efficiency. Hundredweight per worker is another common measure of dairy labor efficiency. Some dairies used in this study operated additional, though limited, alternative enterprises that contributed to farm revenue. Using the value of farm production rather than hundred weights per worker allows fairer comparison of farms that purchase or grow different proportions of their feed.

Definitions of selected financial indicators used in analysis are as follows:

Revenue = Gross farm income from milk sales, cattle and crop sales, and government payments;

Expenses = Cash and non-cash farm costs including depreciation calculated for tax purposes;

aNFIpCOW = ((revenue - expenses) + interest expense + inventory changes)) ÷ average herd size;

eNFIpCOW = ((revenue - expenses) + interest expense + inventory changes - ($7 * unpaid labor hours) - (0.04 * average farm assets)) ÷ average herd size;

VFP = revenue - purchased feed cost + inventory change;

ATO = VFP ÷ average total assets;

NFI% = accounting net farm income ÷ total revenue;

VFPpLH = VFP ÷ (paid + unpaid labor hours).

Analysis

To begin, univariate statistics, including means and standard deviations, were calculated for independent, dependent, and other descriptive variables of interest for both MIG and conventionally managed herds. The mean level of each variable for the two distributions was then compared using a Student's t-test. Results were considered significant at the $P < 0.05$ level.

Multivariate linear regression models using a log-log functional form were then constructed and analyzed using ordinary least squares in STATA 5.0 (17). These models were tested for the presence of heteroscedasticity. When necessary, variance estimators developed by Huber and White (19), which are robust to heteroscedasticity, were used. All explanatory variables, except *graze*, were divided by average herd size to place them on a per cow basis. Regression analysis was carried out using the following five models to measure accounting profit, economic profit, capital efficiency, operating efficiency and labor efficiency, respectively:

$$\begin{aligned} \text{aNFIpCOW} = {} & \beta_{01} + \beta_{11}\, graze + \beta_{21}\, assets + \beta_{31}\, acres + \beta_{41}\, unpdlab + \\ & \beta_{51}\, pdlab + \beta_{61}\, purchfd + \beta_{71}\, milk + \beta_{81}\, lvstckrev + \beta_{91}\, othrev \\ & + e_1 \end{aligned}$$

$$\begin{aligned} \text{eNFIpCOW} = {} & \beta_{02} + \beta_{12}\, graze + \beta_{22}\, assets + \beta_{32}\, acres + \beta_{42}\, unpdlab + \\ & \beta_{52}\, pdlab + \beta_{62}\, purchfd + \beta_{72}\, milk + \beta_{82}\, lvstckrev + \beta_{92}\, othrev \\ & + e_2 \end{aligned}$$

$$\begin{aligned} \text{ATO} = {} & \beta_{03} + \beta_{13}\, graze + \beta_{23}\, acres + \beta_{33}\, unpdlab + \beta_{43}\, pdlab + \\ & \beta_{53}\, purchfd + \beta_{63}\, milk + \beta_{73}\, lvstckrev + \beta_{83}\, othrev + e_3 \end{aligned}$$

$$\text{NFI\%} = \beta_{04} + \beta_{14}\, graze + \beta_{24}\, assets + \beta_{34}\, acres + \beta_{44}\, unpdlab +$$

β_{54} *pdlab* + β_{64} *purchfd* + β_{74} *milk* + β_{84} *lvstckrev* + β_{94} *othrev* + e_4

VFPpLH = β_{05} + β_{15} *graze* + β_{25} *assets* + β_{35} *acres* + β_{45} *purchfd* + β_{55} *milk* + β_{65} *lvstckrev* + β_{75} *othrev* + e_5

where

graze = a binary dummy variable with a MIG farm = 1 and a conventionally managed farm = 0;

assets = average farm assets;

acres = sum of farm-owned and rented acres;

unpdlab = total contributed family labor hours;

pdlab = total hired labor hours;

purchfd = total purchased feed expense;

milk = total milk sold;

lvstckrev = revenue from all livestock sales;

othrev = revenue from all other farm sources;

β_{ij} = regression parameter i in equation j;

e_j = stochastic error term in equation j.

To more accurately model dairy farms, inputs were disaggregated from the simple capital and labor inputs found in a traditional profit function. Because the effect of acres on profitability or efficiency may not be captured by asset value as measured in dollars, both total asset value in dollars and total acres were included as separate independent variables. The number of unpaid and paid labor hours were included as separate independent variables because increasing hours of one or the other were expected to have opposite effects on profitability and efficiency. Finally, purchased feed was included because it represents a substantial portion of farm expense and was expected to be correlated with *graze*. Omitting explanatory variables results in their effect being included in the error term. If these omitted variables are correlated with any of the explanatory variables in the model, the parameter estimates of those variables will be biased due to omitted variable bias (7).

Following the general structure of the profit function, three measures of output, milk per cow, total livestock revenue and other farm revenue, were also included in the models. Milk per cow was used rather than milk income because the milk price received was often unavailable. Both total livestock revenue and other revenue were included due to a priori expectations that they could be important in explaining profitability.

Interpreting the coefficient on the *graze* variable included in the above five models would allow an intercept-shifting difference to be detected. However, it is possible that the profitability and efficiency on MIG and conventionally managed farms are explained by differing slopes as well. To detect slope differences, interaction terms were created between *graze* and each of the other explanatory variables present in the five models. These terms were added, one at a time, to each model. If an interaction term was found to be significant at $P \leq 0.15$ when included in a model individually, this interaction term was used in the final profitability or efficiency model. Ideally, all interaction terms would be added to a regression simultaneously. However, the relatively low number of degrees of freedom necessitated adding interaction terms individually.

Finally, external validity of the sample of conventionally managed farms was reviewed to ensure that the "No" and "Yes" respondents did not differ significantly by region or herdsize. The review was completed through chi square analyses of response ("No" or "Yes") by region, herdsize, and herdsize within region.

RESULTS

Univariate Analysis

Ninety-seven of the 1,184 Grade A dairies contacted by mail (8%) volunteered to participate in the study. No difference by herdsize strata or region was found between "No" and "Yes" respondents to the mailing. Of the respondents that did volunteer to participate, only 24 both matched a MIG farm and agreed to participate after a follow-up phone call. Subsequently, three MIG and six conventionally managed farms were excluded from the data set for not meeting stated definitions, leaving 35 MIG farms and 18 conventionally managed farms for analysis. Figure 1 shows the Michigan counties in which participating MIG and conventionally managed farms were located.

Mean and standard deviation calculations for dependent and independent variables, as well as other variables of interest, are reported in Table 1. As measured by a Student's t-test, significant differences between MIG and conventionally managed dairies were found only in the levels of total livestock revenue and non-dairy livestock revenue. Upon examination of the external validity of the response to the mailing to conventionally managed dairies, chi square analysis indicated no difference between "No" and "Yes" respondents by region, herdsize, or herdsize within region.

Multivariate Regression Analysis

Due to the detection of significant heteroscedasticity, variance estimators robust to heteroscedasticity (19) were used for all five models. The results of the aNFIpCOW, eNFIpCOW, ATO, NFI%, and VFPpLH regressions are shown in Table 2. The F-tests indicate that all five models explained a significant amount of variation in the dependent variable. The positive sign on the *graze* parameter estimate in each model indicated that MIG was associated with increased profitability and efficiencies. The remaining explanatory variables have expected signs and magnitudes.

The aNFIpCOW model indicated that no significant difference in accounting profit existed between MIG and conventionally managed dairies. No interactions between *graze* and the other explanatory variables were found to have a significant impact on accounting profit. However, the eNFIpCOW model found that graziers tended ($P = 0.058$) to generate more economic profit than conventionally managed farmers. In addition, two interaction terms, *graze*lvstckrev* and *graze*othrev*, were found to be slope shifters and have an important part in explaining the variation in eNFIpCOW. These interaction terms imply that the impacts of *lvstckrev* and *othrev* on eNFIpCOW may have been different on MIG and conventionally managed dairies. In this case, neither of these variables or the interaction terms were significant.

The magnitudes of the coefficients on *graze* and the interaction terms must be interpreted with care because of the binary nature of *graze* and because the dependent variable is natural logarithm transformed. The full effect of MIG on eNFIpCOW is captured by adding the coefficient of *graze* to the coefficients of each interaction term multiplied by the MIG mean of the appropriate continuous variable. Performing this calculation and then applying the method described by Halvorsen and Palmquist (8) for interpretation of binary explanatory variables with regard to natural logarithmically transformed dependent variables indicated that MIG dairies tended to have 7% higher economic profit than conventionally managed dairies.

Interpretation of the *graze* variable in the ATO model indicated that MIG dairies tended ($P = 0.057$) to be more asset efficient than conventionally managed dairies. One interaction term was included, *graze*pdlab*, which indicated that the relationship between *pdlab* and asset efficiency was different on MIG dairies and conventionally managed dairies. However, neither *pdlab* nor *graze*pdlab* were found to be significant. Applying the method described above indicates that MIG dairies tended to be 12% more asset efficient than conventionally managed dairies.

The NFI% model shows that MIG dairies had significantly higher operating efficiency. The two interaction terms, *graze*lvstckrev* and *graze*othrev*, both had negative signs. However, neither *lvstckrev*, *othrev*, nor the interaction terms were significant. MIG dairies appeared to have a 26% higher net farm income percent than conventionally managed dairies.

Again applying the above methods to the VFPpLH model shows that MIG dairies were 32% more labor efficient than were conventionally managed dairies. Two of the three interaction terms, *graze*purchfd* and *graze*milk*, were significant. The parameter estimates *acres*, *purchfd*, and *milk* were also significant. The signs on *acres* and *purchfd* were both negative, indicating that when these inputs increased, ceteris paribus, labor efficiency decreased on conventionally managed dairies. The positive sign on *milk* indicated that higher milk production on conventionally managed farms was related to increased labor efficiency. Summing the coefficients on the interaction terms with the appropriate parameter estimates yielded the impact of these variables on labor efficiency for MIG dairies. It appeared that, similar to their effect on the conventionally managed farms, increased purchased feed cost and increased acres were both related to decreased labor efficiency on MIG dairies. Higher milk production was associated with higher labor efficiency on MIG dairies, although to a smaller degree than on conventionally managed farms.

DISCUSSION

Univariate Analysis

The univariate results presented in Table 1 show interesting characteristics of this study population. Milk production for MIG farms was lower than that of conventionally managed farms by approximately 1,100 pounds. Though not a significant difference, this lower milk production is consistent with previous descriptive work (4, 16) finding that a switch to MIG technology lowered milk production. However, average milk production per cow for the study population as a whole (14,365 ± 4,060, $\overline{X}$ ± SD) was somewhat lower than the 1994 state average of 16,905 pounds (12).

Though the sample obtained for this study represented Michigan quite well geographically, it did not represent the Michigan "dairy belt." This band of counties across the central to southern portion of Michigan's lower peninsula is characterized by flat, well drained ground that is moderately to highly productive for row crops and forages. A large portion of Michigan's conventional dairy industry is located within this belt (Figure 2). However, few graziers were located in this belt. Most MIG dairies were located in areas of marginal to poor soil that favor forage growth over grain production. Because conventionally managed dairies were matched to MIG dairies on region, they, too, were located out of Michigan's dairy belt. This geographical distribution may be part of the reason the average milk sold per cow was slightly lower in this study than the state average.

Univariate analysis showed that MIG dairies in this study had similar asset values per cow and acres per cow as conventionally managed dairies. Though MIG is generally considered a "low-input" system, these descriptive results are consistent with those found in other studies. Management-intensively grazed dairies had significantly more livestock revenue per cow than did conventionally managed dairies. Though both management types tended to generate similar revenues through sales of cull cows, calves, and heifers, MIG dairies generated significantly more revenue than conventionally managed dairies through sales of other livestock, including beef cattle, pigs, chickens, and dairy steers. Despite excluding from the study both MIG and conventionally managed farms that had generated greater than

10% of their revenue from cropping enterprises or non-dairy livestock sales, MIG dairies still exhibited greater diversity in revenue sources.

This study found no difference in veterinary and medicine costs or purchased feed costs between MIG and conventionally managed dairies. Previous descriptive studies (11, 16) found that an important part of cost savings on MIG dairies was through decreased feed expense. The magnitude of purchased feed cost found in this study was similar to that found previously. A much more accurate measure of total feed cost would include machinery maintenance, repairs, fuel, and labor attributable to home-harvested feeds. However, few producers assign these costs among particular farm enterprises. Albeit a crude measure of farm feed expense, purchased feed is the most attainable and precise.

Multivariate Regression Analysis

The results from the two profitability models, aNFIpCOW and eNFIpCOW, seemed at first somewhat conflicting. However, the economic net income measure, by charging for unpaid family labor and farm assets, captured the labor and asset efficiencies exhibited by MIG dairies. This allowed for a tendency for MIG dairies to be more economically profitable than conventionally managed farms. If eNFIpCOW is considered a more accurate long term measure of profitability, the difference found in the eNFIpCOW model, but not in the aNFIpCOW model indicated that MIG dairies are somewhat more sustainable than are the conventionally managed farms in this study. Considering that the mean eNFIpCOWs for both farm types were substantially negative, however, it could be questioned whether having a slightly less negative profitability measure made MIG dairies more sustainable in a practical sense.

Higher asset efficiency indicated that MIG farms were generating significantly more farm production per dollar of assets than were conventionally managed farms. The 11% increase in this efficiency, though small, was a consequential one. An increased asset efficiency of 11% for conventionally managed farms, holding all else constant, would bring up their 28% mean ATO to the level of the MIG farms' at 31%. It should be noted that the mean ATOs for this study compare favorably with that of 29% found for Michigan dairies with a herd size of 40 to 79 cows in 1991(10). A portion of the MIG dairies' enhanced asset efficiency can be explained by noting that though assets per cow were higher for MIG dairies, total assets were lower for MIG dairies than for conventionally managed farms (Table 1). Increased asset efficiency has been among anecdotal claims for MIG dairying due to decreased machinery needed to harvest and store feeds and handle manure. Though winter feed must still be harvested in Michigan, it appeared that graziers were able to do so with less capital investment than conventionally managing dairy operators.

The NFI% model indicated that MIG dairies had both significantly and practically higher operating efficiency. The 26% higher NFI% for MIG dairies implied by the model implies that, holding all else constant, the mean NFI% of 16% for the conventionally managed dairies would increase to about 20% if they practiced MIG. This is certainly comparable to the mean NFI% of 19% for the MIG dairies found in this study. Cost containment has been found in many descriptive studies as the primary method by which graziers obtained higher profit than conventionally managed farms. The operating efficiency exhibited by graziers in this work, though a broader measure than cost efficiency, seemed to support this contention.

Results of the VFPpLH model suggest a 32% higher labor efficiency for MIG dairies as compared to conventionally managed dairies. This result is both significant and practical. The result also points out a difference that was not found in univariate analysis. In fact, if examining the data in Table 1 as the sole source of information, one could assume that conventionally managed dairies had higher levels of labor efficiency. These regression results indicate that, if sufficient data are available, researchers must move beyond descriptive and univariate analysis to ensure that they gain a clear understanding of the systems they are studying.

Two of the three interaction terms appropriate in the VFPpLH model, *graze*acres* and *graze*milk* were significant though the third, *graze*purchfd*, was not. The three related explanatory variables, *acres, purchfd*, and *milk* were also significant. The negative signs on *acres* and *purchfd* and on the sums of *acres* and *graze*acres*, and *purchfd* and *graze*purchfd*, indicate that on both MIG and conventionally managed farms, increased acres or increased purchased feed costs are related to decreased labor efficiency. The slopes are slightly different, with increased inputs on MIG dairies related to slightly smaller decreases in labor efficiency. That increased acres would suggest decreased labor efficiency indicated that farms in this sample with lower acres per cow were more labor efficient. Increased purchased feed cost, while holding all else, especially milk production, constant, would lead to a decreased value of farm production. Finally, it is worth noting that despite the increased diversity of the MIG operations, as represented by the significantly higher level of livestock revenue, they still obtained a significantly higher labor efficiency.

The positive signs on *milk* and the sum *milk* and *graze*milk* implied that as MIG and conventionally managed dairies increased milk production per cow, labor efficiency increased. However, this increased efficiency was a little less than half as steep as the gain on conventionally managed farms. This result suggests that on MIG dairies in this study, methods necessary to increase milk production require more labor than on conventionally managed dairies. A common way to boost milk production is to change the lactating cow ration. On conventionally managed dairies, this may entail additional feed bunk management or re-balancing the ration. Changing a ration for grazing cows may require more frequent assessment of sward growth and density, more management time spent on developing a feed budget based on estimations of pasture growth, or concentrate feeding in the parlor or paddock. Most of these options require more time investment than necessary to alter rations on a conventionally managed farm. In addition, the labor efficiency exhibited in relation to milk production may also be related to milking efficiency. Dependent on the proximity of grazing cows to the parlor, milking time on MIG dairies may be increased due to the time necessary to walk cows to the parlor. The labor efficiency found in this work supports many anecdotal claims that MIG is a labor saving technology.

As stated above, firm profitability is generally increased by capturing one or more efficiencies. The results found in this study appeared to support this idea as MIG farms tended to have higher economic profit and asset efficiency and were significantly more operating and labor efficient. Measurement of economic profit instead of simple accounting profit was key to explaining the relationship between profit and efficiency.

CONCLUSIONS

In univariate analysis, little difference was found between Michigan MIG and conventionally managed dairy farms in their levels of profitability and efficiency. However, multivariate regression results indicated that MIG farms tended to have higher economic profit and higher asset efficiency, and were significantly more operating and labor efficient. The profitability and efficiency results from this study support several previous descriptive papers characterizing differences in financial performance between MIG and conventionally managed dairies. Because the geographic distribution of MIG and conventionally managed farms in this study did not include the main Michigan "dairy belt," extrapolation of these results to an average Michigan or Midwest dairy would be tenuous at best. Regardless, these results suggest that management-intensive grazing could provide a sustainable alternative management tool for portions of Michigan's dairy industry.

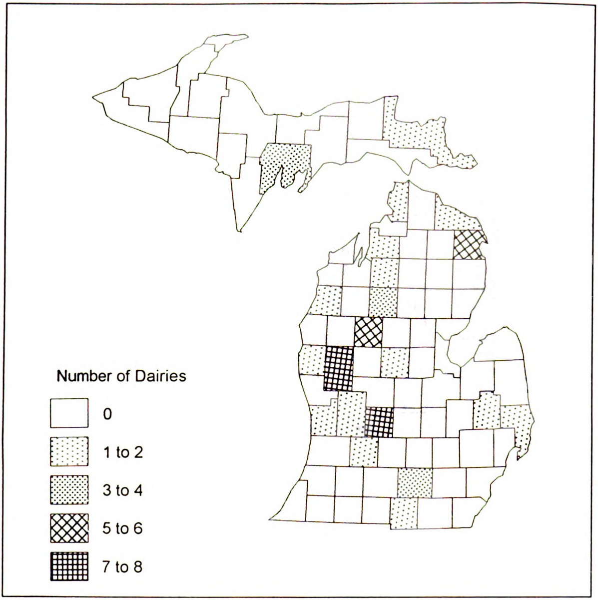

FIGURE 1. Location of MIG and conventionally managed dairies participating in study by Michigan county, 1994.

TABLE 1. **Means and standard deviations of selected variables of interest for conventionally managed and MIG Michigan dairy farms, 1994.**

	MIG n = 35		Conventional n = 18	
Variable	Mean	Standard Deviation	Mean	Standard Deviation
aNFIpCOW ($)	429	381	412	466
eNFIpCOW ($)	(450)	503	(512)	646
ATO (%)	31	11	2	9
NFI% (%)	19	16	1	17
VFPpLH ($)	18.07	8.31	19.1	12.64
Assets per cow ($)	6,495	3,513	6,479	1,827
Acres per cow	5.9	3.3	5	2.3
Unpaid labor per cow (hrs)	89.0	50.9	95.	62.1
Paid labor per cow (hrs)	19.2	21.9	24.	34.5
Purchased feed cost per cow ($)	528	304	482	239
Total livestock revenue per cow ($)	262[a]	170	173[b]	140
Other revenue per cow ($)	122	116	8	94
Milk per cow (lbs)	13,992	3,974	15,090	4,241
Non-dairy livestock revenue per cow ($)	44.1[a]	95.2	1.3[b]	5.6
Total assets ($)	414,259	232,899	502,207	287,839
Vet and medicine cost per cow ($)	50.2	34.2	64.	41.1
Herd size	70.1	38.3	80.	45.3

[a,b] Significantly different at $P < 0.05$ using Student's t-test.

TABLE 2. Results of regression of explanatory variables on aNFIpCOW, eNFIpCOW, ATO, NFI%, and VFPpLH for conventionally managed and MIG Michigan dairy farms, 1994.

Dependent Variable	Explanatory Variable[1]	β_i	SE[2]	p value	Regression Statistics	
aNFIpCOW	*graze*	0.356	0.278	0.21	R^2	0.364
	assets	0.182	0.392	0.65	Prob > F	0.012
	acres	-0.718	0.434	0.11		
	unpdlab	0.884	0.560	0.12		
	pdlab	0.119	0.082	0.15		
	purchfd	-0.436	0.160	0.01		
	milk	2.248	0.662	<0.01		
	lvstckrev	0.083	0.098	0.40		
	othrev	-0.184	0.098	0.07		
	Intercept	-17.135	6.964	0.02		
eNFIpCOW	*graze*	1.459	0.745	0.06	R^2	0.550
	*graze*lvstckrev*	-0.104	0.128	0.42	Prob > F	0.002
	*graze*othrev*	-0.205	0.178	0.26		
	assets	-0.083	0.132	0.53		
	acres	-0.220	0.112	0.06		
	unpdlab	-0.398	0.204	0.06		
	pdlab	0.014	0.039	0.71		
	purchfd	-0.107	0.088	0.23		
	milk	0.458	0.236	0.06		
	lvstckrev	0.131	0.116	0.27		
	othrev	0.150	0.181	0.41		
	Intercept	5.106	1.963	0.01		
ATO	*graze*	0.259	0.132	0.06	R^2	0.295
	*graze*pdlab*	-0.073	0.044	0.11	Prob > F	<0.001
	acres	-0.157	0.110	0.16		
	unpdlab	-0.097	0.076	0.21		
	pdlab	0.018	0.031	0.56		
	purchfd	-0.151	0.055	0.79		
	milk	0.541	0.204	0.01		
	lvstckrev	0.017	0.057	0.77		
	othrev	0.008	0.036	0.82		
	Intercept	-5.897	1.726	<0.01		
NFI%	*graze*	1.759	0.821	0.04	R^2	0.333
	*graze*lvstckrev*	-0.219	0.163	0.19	Prob > F	0.053
	*graze*othrev*	-0.096	0.136	0.48		
	assets	0.269	0.305	0.38		
	acres	-0.356	0.221	0.12		
	unpdlab	0.190	0.231	0.42		
	pdlab	0.032	0.060	0.59		
	purchfd	-0.290	0.160	0.08		
	milk	1.301	0.562	0.03		
	lvstckrev	0.229	0.139	0.11		

TABLE 2 (cont'd).

	othrev	-0.128	0.089	0.16		
	Intercept	-15.488	5.472	<0.01		
VFPpLH	*graze*	10.472	3.899	0.01	R^2	0.603
	*graze*milk*	-1.195	0.482	0.02	Prob > F	<0.001
	*graze*purchfd*	0.040	0.157	0.80		
	*graze*acres*	0.576	0.278	0.04		
	assets	0.036	0.156	0.82		
	acres	-0.788	0.233	<0.01		
	purchfd	-0.369	0.082	<0.01		
	milk	2.028	0.314	<0.01		
	lvstckrev	0.115	0.036	<0.01		
	othrev	0.006	0.031	0.85		
	Intercept	-14.172	3.312	<0.01		

---

[1] Except for *graze*, all explanatory variables are on a per cow basis and natural logarithm transformed.

[1] SE are robust to serial correlation and heteroscedasticity.

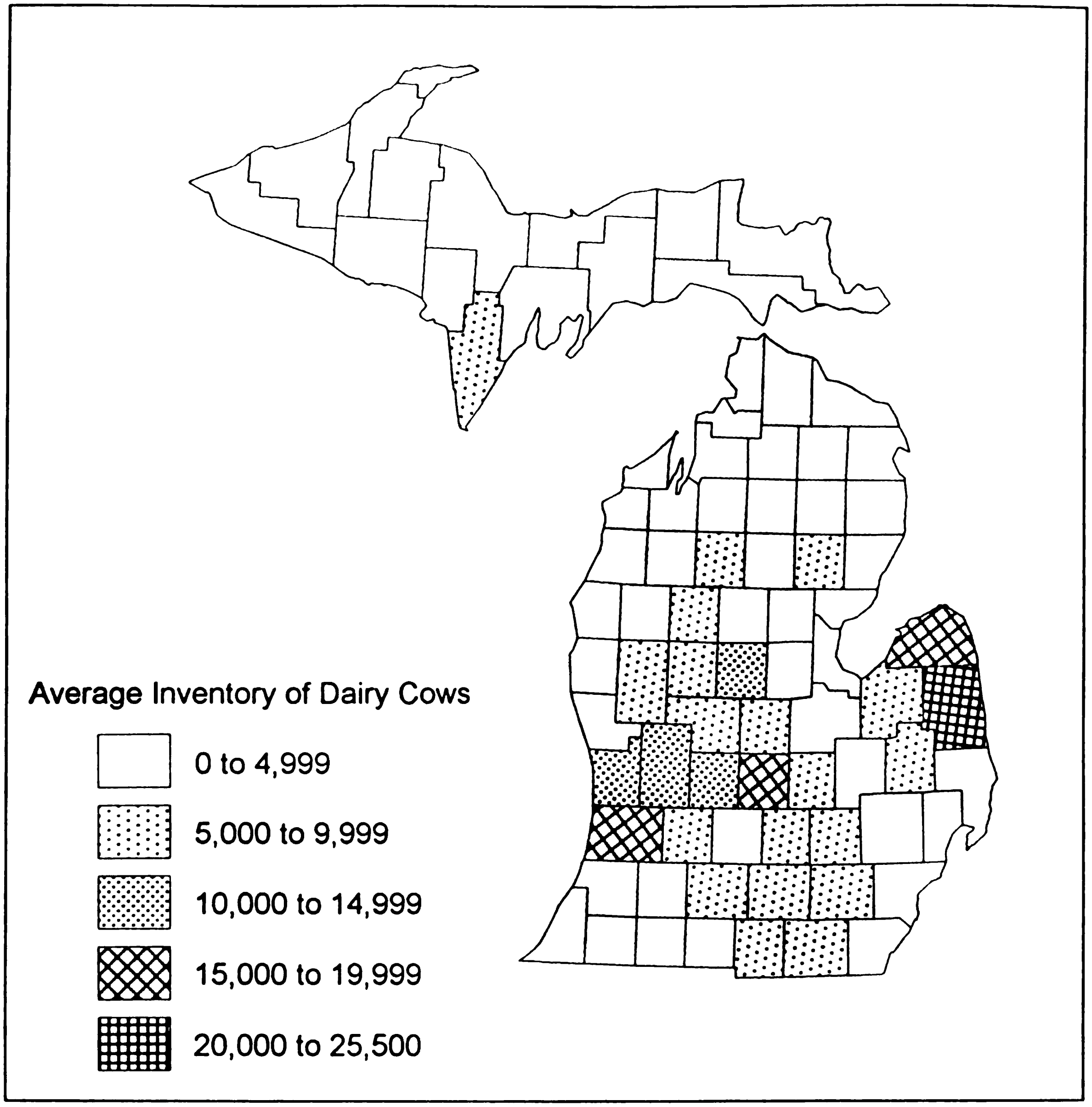

FIGURE 2. Average inventory of dairy cows by Michigan county, 1994, Michigan Agricultural Statistics Service.

REFERENCES

1. Bokemeier, J., E. Allensworth, A. Skidmore. 1995. Decisions for the future: Dairy farming in Michigan. Michigan State Univ. Ag. Exp. Station Research Report 540, Michigan State Univ., East Lansing, MI.

2. Connor, L., L. Hamm, S. Nott, D. Darling, W. Bickert, R. Mellenberger, H.A. Tucker, O. Hesterman, J. Partridge, J. Kirk. 1989. Michigan dairy farm industry: Summary of the 1987 Michigan State University dairy farm survey. Michigan State Univ. Ag. Exp. Station Special Report 498, Michigan State Univ., East Lansing, MI.

3. Emmick, D. L., L. F. Toomer. 1991. The economic impact of intensive grazing managment on fifteen dairy farms in New York state. Page 7 *in* Proc. American Forage and Grassland Council. Columbia, MO.

4. Ford, S., G. Hanson. 1994. Intensive rotational grazing for Pennsylvania dairy farms. Penn State Coop. Ext. Farm Economics. May/June issue. Pennsylvania State Univ., State College, PA.

5. Financial Guidelines for Agricultural Producers. 1995. Farm Financial Standards Council, Naperville, IL.

6. Garcia, P., S. T. Sonka, M. S. Yoo. 1982. Farm size, tenure and economic efficiency in a sample of Illinois grain farms. Amer. J. Agric. Economics. 64:119-123.

7. Greene, W. H. 1993. Econometric Analysis. 2nd ed. Macmillan Publishing Co., New York, NY.

8. Halvorsen, R., R. Palmquist. 1980. The interpretation of dummy variables in semilogarithmic equations. American Economic Review. 70:474-475.

9. Hanson, G. D., L. C. Cunningham, M. J. Morehart, R. L. Parsons. 1998. Profitability of moderate intensive grazing of dairy cows in the Northeast. J. Dairy Sci. 81:821-829.

10. Harsh, S., J. Lloyd, A. Wysocki, J. Rutherford, J.B. Kaneene, W.J. Moline, S. Nott, A.C. Rotz. 1996. Michigan dairy farm industry: Summary of the 1991 Michigan State University dairy farm survey. Michigan State Univ. Ag. Exp. Station Research Report 544, Michigan State Univ., East Lansing, MI.

11. Klemme, R. 1993. Profitability in Wisconsin dairying - reduced input costs: An

economic comparison of grass-based and confinement dairying in Wisconsin. Page 77 *in* Proc. of the Wisconsin Forage Council's 18th Forage Production and Use Symposium. Madison, WI.

12. Michigan Agricultural Statistics. 1995. Michigan Agricultural Statistics Service, Michigan Dept. of Ag., Lansing, MI.

13. Michigan Agricultural Statistics. 1993. Michigan Agricultural Statistics Service, Michigan Dept. of Ag., Lansing, MI.

14. Nott, S. N. 1994. Business analysis summary for specialized Michigan dairy farms. Agric. Econ. Report No. 583. Dpt. of Agric. Econ., Michigan State Univ., E. Lansing, MI.

15. Rust, J. W., C. C. Sheaffer, V. R. Eidman, R. D. Moon, R. D. Mathison. 1995. Intensive rotational grazing for dairy cattle feeding. Amer. J. Alt. Ag. 10:147-151.

16. Smith, S. 1994. Moderate size farms can be successful. Page 2 *in* Agricultural Update: Farm Business and Financial Management. Vol. 4, No.4. Cornell Coop. Ext., Cornell Univ., Ithaca, NY.

17. StataCorp. 1997. Stata Statistical Software: Release 5.0. Stata Corporation, College Station, TX.

18. U. S. Dpt. of Treasury. 1998. Treasury constant maturities, 30-year, weekly. [Online] Available http://www.bog.frb.fed.us/releases/h15/data/wf/tcm30y.txt, June 12, 1998.

19. White, H. 1980. A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity. Econometrica. 48:817-838.

Chapter 4

A Comparison of Quality of Life and Management Priorities Between Michigan Management-Intensive Grazing Dairy Operators and Conventionally Managing Dairy Operators

ABSTRACT

A retrospective cohort study was designed to determine differences in quality of life and management priorities between dairy farm operators implementing management-intensive grazing and conventionally managing dairy farm operators. A questionnaire measuring quality of life and management priorities was administered and financial and labor use data were collected during farm visits of 35 management-intensive grazing dairies and 18 conventionally managed dairies. Farm visits were completed between October, 1995 and March, 1996. Univariate analysis and logistic regression indicated that management-intensive grazing and conventionally managing dairy producers had a very similar perception of their quality of life. The producers also appeared to have similar management priorities. Overall, the study population was quite satisfied with their quality of life.

INTRODUCTION

The microeconomic theory of profit maximization has generally been used as an underlying assumption when agricultural firms have been modeled. However, it is recognized that managers may have goals in addition to profit maximization, including business survival or growth, personal leisure, or social acceptance (7). In fact, studies have found that both at the aggregate level (3) and firm level (9, 13), some agricultural producers seemed either unable or unwilling to maximize profit. In a group of United States commercial grain farmers, Mawapanga (9) found that producers weighted concern for health as more important than profit maximization when choosing between three alternative farming systems. Clearly, producers' perceived quality of life results from interactions among the social and psychological as well as the economic characteristics of their existence.

Anecdotal reports from dairy producers practicing management-intensive grazing (MIG) suggest that there are advantages to adopting this technology that go beyond increased profitability. These include a lowered and more flexible contribution of family labor and increased time spent outdoors and interacting with cattle. Many studies have found descriptive evidence that dairies practicing MIG are more profitable than conventionally managed dairies (5, 8, 10). Other work has measured farm families' perceptions about their quality of life as well as their financial performance (4, 12). However, no work was found that compared producers' quality of life or management priorities between MIG and conventionally managed dairies.

The purpose of this research is to determine the relative quality of life and management priorities of Michigan dairy producers practicing MIG as compared to producers that manage their dairy operations in a conventional manner. Specific hypotheses include:

H_1: Dairy producers implementing MIG have a higher quality of life than conventional producers.

H_2: Dairy producers implementing MIG place more importance on cost lowering management tactics than do conventional producers.

MATERIALS AND METHODS

Study Design

A retrospective cohort study was designed to determine differences in profitability and economic efficiencies between MIG and conventionally managed Michigan dairies. Potential MIG farms were identified using 1993 and 1994 Michigan Grazing Conference mailing lists cross-referenced with the 1995 Michigan Department of Agriculture list of Grade-A dairies. Of the studies' MIG herds, a small number were identified by word-of-mouth from cooperating producers, Extension agents, and veterinarians. Producers were then contacted by letter and phone to solicit their voluntary participation in the project and ensure that they fit the MIG herd definition. A MIG herd was defined as obtaining at least 25% of the annual whole herd forage requirement through grazing. Cows must have been grazed or pastured at least four months per year and lactating cattle rotated or changed to new pastures every third day or less. In addition, 1994 had to be at least the second year the MIG farm fit this definition.

Matching was employed to control for different herd sizes, season lengths and soil types that may have occurred between the samples of MIG and conventionally managed farms. Matches by herd size (five categories) and Michigan Department of Agriculture geographical distribution (nine regions) were made.

Conventionally managed dairies were identified by a mailing to the 1,184 Grade-A dairies in the counties where MIG farms were located. The mailing included a letter asking for voluntary participation in the project and a self-addressed, stamped reply card on which producers could indicate their willingness to participate, as well as their herd size (one of five categories). Volunteers were matched to a MIG herd. If more than one potential match existed, a single match was randomly selected. Selected producers were telephoned to ensure they met the definition of a conventionally managed farm. Selected producers were telephoned to ensure they met the definition of a conventionally managed farm. A conventionally managed farm was defined as utilizing at least 95% of their whole herd forage requirement from mechanically harvested forages. In addition, MIG and conventionally managed farms were excluded if greater than 10% of their revenue came from sources other than milk or dairy-related livestock sales, if they were increasing their cow herd by greater than 10%, if they were purchasing greater than 60% of their forage, or if they were undergoing substantial structural or management change during 1994.

Data Collection

A financial data collection packet for the 1994 production year was mailed to producers prior to a farm visit. All participating farms were subsequently visited by one of two investigators who carried out data collection. After completion of the financial data collection at the farm visit, a questionnaire used to assess quality of life and management priorities was administered verbally by the investigator who recorded the producer responses. The data collected by this study represents producer attitudes during the period of farm visits that took place between October, 1995 and March, 1996.

Questionnaire

A questionnaire was modeled after that used by Bokemeier and colleagues (2). Bokemeier's study assessed the way in which individual Michigan dairy farmers reacted to changes within the dairy industry by measuring how they changed farming practices and their attitudes towards farming.

and

stat

invo

the

ma

Re

pro

fre

ve

Da

er

fa

10

m

Q

pe

m

de

The questionnaire's eight introductory questions explored demographics and included inquiries about age, educational level, ownership status, marital status, the spouse's managerial involvement, off-farm work, and community involvement. The responses to these questions were expected to help explain the level of producers' quality of life and their emphasis on particular management priorities.

Questions 9 through 12 were identical to those used in Bokemeier's work. Responses to these questions generated the outcomes utilized to assess producers' quality of life and management priorities. Question 9 investigated the frequency that producers consulted seven different professionals including their veterinarian, county Extension agent, state Extension specialist, feed broker, Dairy Herd Improvement Association representative, nutritionist, and agricultural engineer. Question 10 asked about the importance of 16 different economic, family, production, and cost related farm management goals. Questions 9 and 10 assessed the importance of particular management goals. Question 11 measured the importance of 12 different characteristics of farm life. Finally, Question 12 examined producers' satisfaction with career choice, farm financial performance, and the amount of time they and their family spent in labor and management duties on the farm through 11 separate sub-questions. By determining their enjoyment of farm life characteristics and level of satisfaction with the

Questio

C

Questio

Importa

"Very Sa

Appendi

Analysis

To

MIG or c

response

Questior

variation

Questior

to four c

average

the 1 thr

2 were c

"Dissatisf

with their career choice, financial performance, and time management flexibility, Questions 11 and 12 assessed producers' quality of life.

Questions 10, 11, and 12 utilized a 1 through 5 Likert scale. For Questions 10 and 11, 1 indicated "No Importance" and 5 indicated "Great Importance." For Question 12, 1 indicated "Very Dissatisfied" and 5 indicated "Very Satisfied." The full questionnaire used for this study can be found in Appendix 2.

Analysis

To begin, responses were summarized descriptively. The percentage of MIG or conventionally managing operators choosing each of the various responses was compiled. After examining the distribution of answers in Questions 9 through 12, it was determined that there was not enough response variation to use the full scale employed by the questionnaire. Responses to Question 9 were summarized from the seven available frequency choices to two to four choices, based logically on a priori expectations of the frequency that average dairy operators consulted professionals. For Questions 10, 11, and 12, the 1 through 5 scale was collapsed to three levels. Operators indicating a 1 or 2 were considered to view the question as having "Little Importance" or be "Dissatisfied." Those indicating 3 were considered to rate the issue of "Some

Importance" or be "Neutral" in regard to the issue. Producers choosing a 4 or 5 were considered to rank the issue "Important" or be "Satisfied."

After examination of descriptive results, univariate analysis was performed. The mean of principal operator age, the only continuous variable collected by the questionnaire, was calculated. Possible distribution differences between MIG and conventionally managing producers for this variable were tested with a Student's t-test. The remaining questions were examined using Chi square, goodness-of-fit tests or the Fisher exact test . The Fisher exact test was used to examine questions when the expected value for a cell was less than or equal to five. Results were considered significant if they produced $P < 0.05$.

Following univariate analysis, 11 indexes were created, consisting of pooled and averaged responses to portions of Questions 10 through 12 that were judged to measure similar attitudes. Indexes consisted of two to five questions. After creation, indexes were tested using Chronbach's α as a measure of internal reliability (1). Indexes having an $\alpha > 0.65$, indicating relatively high reliability, were examined using Chi square, goodness of fit tests.

As noted earlier, producers' perceived quality of life results from interactions between social, psychological, and economic characteristics of their existence. It is implausible to anticipate then, as univariate analysis does, that producer responses to the questionnaire relied only upon whether or not MIG was employed. To more accurately represent the relationships between producers' quality of life and management priorities and other demographic, labor use, and economic variables, multivariate analysis was performed. Specifically, ordered logistic regression analysis was carried out using maximum likelihood estimation in STATA 5.0 (11). Those responses from Questions 9 through 12 that produced a significant Chi square were used as dependent variables. Responses that did not yield significant Chi square results but were expected to differ between MIG and conventionally managing producers due to a priori knowledge or anecdotal reports, were also used as dependent variables. Indexes were also used as dependent variables in logistic regression if $\alpha > 0.65$.

The independent variable of interest in logistic regression analysis was *graze*, a binary dummy variable with a value of 1 for a MIG farm and a value of 0 for a conventionally managed farm. An additional four independent variables focused on demographics: education (*ed*), whether or not the spouse had an active role in farm management (*role*), whether or not the primary operator worked off the farm (*off*), and the natural logarithm transformation of age (*age*). Other independent variables used in each model were the natural logarithm transformation of: net farm income (*nfi*), hundredweight of milk sold per cow (*cwtpc*), primary operator labor (*oplb*), and the debt-to-asset ratio of the farm (*da*). Definitions of selected financial indicators used in analysis are as follows:

Revenue = Gross farm income from milk sales, cattle and crop sales, and government payments;

Expenses = Cash and non-cash farm costs including depreciation calculated for tax purposes;

nfi = ((revenue - expenses) + interest expense + inventory changes);

oplb = total labor hours of primary farm operator; and

da = average debt in 1994 ÷ average assets for 1994.

Regression equations were considered significant if the Chi square value resulting from the likelihood ratio test were found to have a $P < 0.05$. Parameter estimates were considered significant at $P < 0.05$.

RESULTS AND DISCUSSION

Descriptive and Univariate Analysis

Nine percent of the 1,184 Grade A dairies contacted by mail volunteered to participate in the study. Of these respondents, only 24 both matched a MIG farm and agreed to participate after a follow-up phone call. Subsequently, three MIG and six conventionally managed farms were excluded from the data set for not meeting stated definitions, leaving 35 MIG farms and 18 conventionally managed farms for analysis.

The percentage responses to each question, stratified by MIG and conventionally managing operators, are found in Tables 1 through 5. The mean age of the primary operator of MIG and conventionally managed farms can be found in Table 1. Most of the farms in this study appeared to be run as sole proprietorships with one main operator. Nearly 90% of the operators were married. Mean age of the primary operator is very similar by farm type. About 96% of these primary operators had completed at least high school and 45% had received post secondary training. The average operator in this study was slightly younger and more educated than found in other work. In a random sample of Michigan Grade A dairy farms taken in 1991, Harsh and colleagues (6) found the average age of principal dairy farm operators to be 50 years. Their study also found that 86% of the operators had completed high school and 39% had gone on to some type of post secondary training.

Examination of responses indicated that producers from both farm types seemed to have a high quality of life (Table 4). About 79% of all operators indicated they were "Satisfied" with their career choice as a dairy farm operator. Nearly 85% were "Neutral" or "Satisfied" with the financial performance of their dairy farm business and 85% were "Neutral" or "Satisfied" with the progress toward written or unwritten dairy farm goals. These results offer only minimal support for anecdotal reports about the quality of life advantages offered by MIG technology use on dairy farms.

After testing each question, only four significant results were found in univariate analysis. Chi square analysis indicated that the spouse of a grazier was significantly more likely to have an active role in farm management than the spouse of conventionally managing operator. About 40% of graziers' spouses worked off-farm, while nearly 60% of the spouses of conventionally managing farmers did so. This probably explains some of the difference in the percentage of spouses who took an active role in farm management (71% on MIG farms compared to only 39% on conventionally managed farms).

Graziers consulted state Extension specialists significantly more often than did conventionally managing operators. However, conventionally managing operators were significantly more likely to consult veterinarians and nutritionists more often. Because state Extension specialists assisted in identification of MIG dairies throughout the state but did not assist in finding conventionally managed herds, it was not surprising to find that graziers had consulted these professionals more often. Anecdotal reports indicate that graziers call veterinarians less often. This is claimed to be due in part to healthier cattle. In this study, a small number of graziers seasonally calved their herds. By consolidating pregnancy exams into one time of year, similar to the practice in beef herds, seasonal calving may reduce calls to the veterinarian. It is also expected that graziers would use the services of nutritionists less. This may be due to the low number of commercial nutritionists who had experience in supplementing grazing dairy herds.

Four of the 11 indexes constructed were found to have adequate internal reliability. However, Chi square analysis found no difference by farm type for any of the four. The questions used to create these indexes and their α scores are presented in Table 6.

Logistic Regression Analysis

Responses utilized as dependent variables in the ordered logistic regression equations are denoted with asterisks in Tables 2 through 5. Twenty-four separate regressions were examined. Four used those indexes found to have adequate internal reliability (Table 6). The results of only two regressions indicated tendencies toward a relationship between graze and the outcome variable. The results of these two regressions are shown in Table 7. Similar to univariate analysis, logistic regression also found a significant difference in the frequency with which state Extension specialists were consulted by the two types of operators.

Using ordered logistic regression, it was possible to predict the probability that MIG and conventionally managing operators would consult state Extension specialists at a particular frequency. Holding all explanatory variables constant at their means, the probabilities that a grazier or a conventionally managing operator would consult a state Extension specialist at various frequencies was, 3% and 0% more often than monthly, 17% and 3% quarterly, 58% and 30% less often than quarterly, and 23% and 67% would never consult, respectively. Graziers clearly use these professionals more often. However, it should again be noted that state Extension specialists helped select the sample of graziers and therefore it is not surprising that a difference was found in the frequency with which these professionals are consulted.

Results from the final regression indicated that conventionally managing operators tended to be more likely than their counterparts to be satisfied about the money they had available for family living. Again, it was possible to predict the probability that operators would be Dissatisfied, Neutral, or Satisfied with the money they had available for family living. Of MIG and conventionally managing operators, 37% and 20% were dissatisfied, 30% and 29% were neutral, and 33% and 51% were satisfied with the money available, respectively. It is possible that the extra income related to the higher number of spouses of conventionally managing operators working off the farm led to the higher probability that these producers were satisfied.

CONCLUSIONS

The results of univariate and logistic regression analyses lead to the conclusion that the quality of life of MIG and conventional dairy operators was very similar. This is evidenced by the high percentages of dairy farm operators that indicated satisfaction with their career choice (79%) and that were neutral or satisfied with the financial performance of their dairy farm business (85%). In addition, neither analytical method found that MIG producers placed more importance on cost lowering management tactics than did conventional producers. Chi square results indicated that the spouses of graziers were significantly more likely to have an active role in farm management than were the spouses of conventionally managing operators. Further univariate analysis also suggested that graziers were more likely to consult state Extension specialists more frequently, but were more likely to consult both veterinarians and nutritionists less frequently than conventionally managing operators. Logistic regression results also indicated that graziers tended to consult state Extension specialists more frequently. However, because these professionals had a hand in identification of the graziers included in the study, these results were not surprising. Regression results also indicated that graziers tended to be less satisfied with the money they had available for family living. This may have been due in part to the higher percentage of spouses of conventionally managing producers that worked off farm.

TABLE 1. **Demographics of MIG and conventionally managing (CM) operators in Michigan, 1995-1996.**

Demographics	Farm Type	Frequency Yes (%)		Frequency No(%)
Sole Operator	MIG	77		23
	CM	83		17
Married	MIG	91		9
	CM	89		11
Spouse has role in management	MIG	71		29
	CM	39		61
Written mission or goals	MIG	29		71
	CM	22		78
Manager works off farm	MIG	18		82
	CM	6		94
Spouse works off farm	MIG	39		61
	CM	56		44
Community involvement	MIG	69		31
	CM	50		50
		<HS[a] (%)	HS[a] (%)	>HS[a] (%)
Level of Education	MIG	3	46	51
	CM	6	61	33
			Mean	
Age (1)	MIG		44	
	CM		46	

[a] Responses to Level of Education are summarized by completion of: less than high school (<HS), high school (HS), or any post secondary education (>HS).

TABLE 2. Frequency at which dairy farm operators consulted professionals by farm type in Michigan, 1995-1996.

How often do you consult:	Farm Type	Frequency			
		≥ Mnthly (%)		< Mnthly(%)	
*Veterinarian	MIG	63		37	
	CM	89		11	
		≥ Mnthly (%)	Qtrly (%)	< Qtrly (%)	Never (%)
County Extension Agent	MIG	17	23	31	29
	CM	11	17	61	11
*State Extension Spec	MIG	3	17	60	20
	CM	0	0	39	61
Feed Broker	MIG	34	17	6	43
	CM	44	22	11	22
*Nutritionist	MIG	9	29	29	34
	CM	39	0	22	39
		≥ Mnthly (%)		< Mnthly (%)	Never (%)
DHIA rep	MIG	51		3	46
	CM	72		0	28
Engineer	MIG	0		17	83
	CM	0		17	83

* These responses were utilized as dependent variables in ordered logistic regression analyses.

TABLE 3. **The importance of various economic, family, production, and cost related farm management goals by diary farm type in Michigan, 1995-1996.**

How important is it for you to:	Farm Type	Frequency Little imp (%)	Some imp (%)	Very imp (%)
*Pay down debt	MIG	0	17	83
	CM	0	17	83
Avoid more debt	MIG	3	17	80
	CM	6	33	61
*Increase profit annually	MIG	0	17	83
	CM	0	28	72
Prepare for retirement	MIG	17	26	57
	CM	11	28	61
Have adequate family living	MIG	0	6	94
	CM	0	17	83
Save for children's future	MIG	53	18	29
	CM	35	35	29
Spend time with family	MIG	0	3	97
	CM	0	17	82
Take family vacations	MIG	20	23	57
	CM	35	24	41
Increase production per cow	MIG	31	26	43
	CM	11	44	44
Increase milk sold	MIG	14	34	51
	CM	11	44	44
*Increase herd size	MIG	51	31	17
	CM	50	33	17
*Improve herd health	MIG	6	14	80
	CM	0	0	100
*Reduce labor costs	MIG	32	24	44
	CM	39	22	39
Reduce family labor	MIG	11	29	60
	CM	22	33	44
*Reduce feed costs	MIG	0	6	94
	CM	6	17	78
Improve safety of farm	MIG	0	40	60
	CM	6	17	78

* These responses were utilized as dependent variables in ordered logistic regression analyses.

TABLE 4. The importance of particular characteristics of farming by dairy farm type, Michigan, 1995-1996.

		Frequency		
How important are the following characteristics of farming:	Farm Type	Little imp (%)	Some imp (%)	Very imp (%)
*Economic rewards	MIG	14	23	63
	CM	6	33	61
Opportunity to do things your own way	MIG	0	9	91
	CM	6	17	78
Good place to raise a family	MIG	0	3	97
	CM	6	11	83
Opportunity to work outdoors	MIG	0	6	94
	CM	0	22	78
Opportunity to work with animals	MIG	0	23	77
	CM	6	28	67
Do physical labor	MIG	9	29	63
	CM	6	50	44
*Challenge your management skills	MIG	11	9	80
	CM	6	0	94
Diversity of the work	MIG	3	11	86
	CM	0	22	78
*Work with family daily	MIG	9	17	74
	CM	17	33	50
Maintain family tradition	MIG	31	17	51
	CM	28	22	50
Keep farm in the family	MIG	37	29	34
	CM	44	22	33
Bring children into farm	MIG	41	18	41
	CM	29	29	41

* These responses were utilized as dependent variables in ordered logistic regression analyses.

TABLE 5. Attitudes toward life satisfaction by dairy farm type in Michigan, 1995-1996.

		Frequency		
How satisfied are you with:	Farm Type	Dissatisfied (%)	Neutral (%)	Satisfied (%)
*Your choice of becoming a dairy farm operator	MIG	3	23	74
	CM	11	22	67
*Money available for family living	MIG	40	31	29
	CM	22	28	50
*Financial performance of dairy	MIG	20	43	37
	CM	11	28	61
Options/alternatives to dairying	MIG	31	37	31
	CM	28	44	28
*Amount of time spent operating or managing your dairy	MIG	20	37	43
	CM	11	61	28
Amount of time in family labor	MIG	20	37	43
	CM	17	56	28
Time available to spend w/ family	MIG	26	40	34
	CM	33	28	39
*Time available for other pursuits besides dairying	MIG	37	31	31
	CM	61	22	17
*Flexibility in getting away from the farm when you need to	MIG	43	29	29
	CM	61	17	22
*Flexibility in getting away from the farm when you want to	MIG	63	11	26
	CM	61	17	22
*Progress towards dairy goals - written or unwritten	MIG	20	29	51
	CM	11	39	50

* These responses were utilized as dependent variables in ordered logistic regression analyses.

TABLE 6. Indexes used as dependent variables in logistic regression analysis.

Dependent variable	α Score	Responses Included
Milk Productivity Importance	0.68	Increase production per cow Increase milk sold
Farm-Family Interaction	0.77	Good place to raise a family Work with family daily Maintain family tradition Keep farm in the family Bring children into farm
Financial Status Satisfaction	0.65	Money available for family living Financial performance of dairy
Time Management Satisfaction	0.71	Amount of time spent operating or managing dairy Time available for other pursuits besides dairying Flexibility in getting away from the farm when you need to Flexibility in getting away from the farm when you want to

TABLE 7. Selected results of ordered logistic regression analysis.

Dependent Variable	Explanatory Variable	β	SE	p value	Regression Statistics	
State Extension specialist	*graze*	-2.669	0.810	<0.01	χ^2	16.31
	age	-2.012	1.668	0.23	Prob > χ^2	0.061
	ed	-0.068	0.905	0.91		
	role	-0.549	0.652	0.40		
	off	-1.445	0.997	0.15		
	nfi	-0.075	0.215	0.73		
	cwtpc	-1.090	1.169	0.35		
	oplb	0.335	0.684	0.63		
	da	-0.074	0.327	0.82		
Money available for family living	*graze*	-1.339	0.712	0.06	χ^2	17.78
	age	-1.620	1.748	0.35	Prob > χ^2	0.038
	ed	0.980	0.590	0.10		
	role	0.358	0.652	0.58		
	off	-1.544	1.092	0.16		
	nfi	0.179	0.242	0.46		
	cwtpc	1.565	1.032	0.13		
	oplb	-1.421	0.790	0.07		
	da	-0.664	0.337	0.05		

REFERENCES

1. Bohrnstedt, G. W., D. Knoke. 1988. Statistics for Social Data Analysis. 2nd. ed. F. E. Peacock Pub., Inc. Itasca, IL.

2. Bokemeier, J., E. Allensworth, A. Skidmore. 1995. Decisions for the future: Dairy farming in Michigan. Michigan State Univ. Ag. Exp. Station Research Report 540, Michigan State Univ., East Lansing, MI.

3. Fawson, C., C. R. Shumway. 1988. A nonparametric investigation of agricultural production behavior for U.S. subregions. Amer. J. Agr. Econ. 70:311-317.

4. Filson, G., M. McCoy. 1993. Farmers' quality of life: Sorting out the differences by class. Rural Sociologist. 13:15-37.

5. Ford, S., G. Hanson. 1994. Intensive rotational grazing for Pennsylvania dairy farms. Penn State Coop. Ext. Farm Economics. May/June issue. Pennsylvania State Univ., State College, PA.

6. Harsh, S., J. Lloyd, A. Wysocki, J. Rutherford, J. B. Kaneene, W. J. Moline, S. Nott , A. C. Rotz. 1996. Michigan dairy farm industry: Summary of the 1991 Michigan State University dairy farm survey. Michigan State Univ. Ag. Exp. Station Research Report 544, Michigan State Univ., East Lansing, MI.

7. Harsh, S. B., L. J. Connor, G. D. Schwab. 1981. Managing the Farm Business. Prentice-Hall, Inc., Englewood Cliffs, N.J.

8. Klemme, R. 1993. Profitability in Wisconsin dairying - reduced input costs: An economic comparison of grass-based and confinement dairying in Wisconsin. Page 77 *in* Proc. of the Wisconsin Forage Council's 18th Forage Production and Use Symposium. Madison, WI.

9. Mawapanga, M. N., D. L. Debertin. 1996. Choosing between alternative farming systems: An application of the analytic hierarchy process. Rev. Agric. Econ. 18:385-401.

10. Rust, J. W., C. C. Sheaffer, V. R. Eidman, R. D. Moon, R. D. Mathison. 1995. Intensive rotational grazing for dairy cattle feeding. Amer. J. Alt. Ag. 10:147-151.

11. StataCorp. 1997. Stata Statistical Software: Release 5.0. Stata Corporation, College Station, TX.

12. Stover, R. G., V. L. Clark, L. L. Jansser. 1991. Successful family farming: The intersection of economics and family life. Page 113 *in* Research in Rural Sociology and Development. Vol. 5, Household Strategies. JAI Press, Greenwich, CN.

13. Tauer, L. W. 1995. Do New York dairy farmers maximize profits or minimize costs? Amer. J. Agr. Econ. 77:421-429.

Chapter 5

Summary

PROBLEM STATEMENT AND HYPOTHESES

Widespread structural change has taken place within the dairy industry recently, as evidenced by increased herd sizes, increased milk production per cow, and shrinking numbers of dairy farms. Concurrently, financial indicators have suggested that some of the industry could be in a measure of financial difficulty. Alternative low input strategies, such as management-intensive grazing (MIG), are being explored as competitive dairy management alternatives. Management-intensive grazing is also being considered as a low-input alternative to expansion because of anecdotal reports of decreased requirements for labor and assets. In addition, some proponents of MIG claim that this combination of good financial performance and lowered input requirements leads to an increased quality of life on MIG dairies.

Many case studies, simulations, and descriptive studies have shown that moderately sized farms (80-100 cows) practicing MIG can generate similar or higher profit levels than conventionally managed farms. However, no research was found that utilized a stratified random sample of graziers matched to similar controls to compare the financial performance of these management systems. In addition, little work has gone beyond descriptive comparisons to statistical analysis to determine if the differences noted were due to chance or to the management system itself. If graziers do indeed capture increased profitability, no research was found that attempted to define efficiencies by which graziers were able to increase profit. Finally, no work was found that compared the quality of life or management priorities of MIG dairy operators with conventionally managing operators.

The goal of this project was to examine MIG as a low input alternative management strategy that will assist the average dairy farm in Michigan (85 cows) in developing a financially stable, competitive, sustainable farm business that contributes positively to the producer's quality of life. Specifically, this thesis examined the profitability, capital efficiency, operating efficiency, labor efficiency, quality of life, and management priorities of MIG and conventionally managed dairy farms matched on herd size and Michigan region. Specific hypotheses included:

H_1: Dairy producers implementing MIG had higher accounting net farm income per cow (aNFIpCOW) than conventional producers.

H_2: Dairy producers implementing MIG had higher economic net farm income per cow (eNFIpCOW) than conventional producers.

H_3: Dairy producers implementing MIG had a higher asset turnover (ATO) than conventional producers.

H_4: Dairy producers implementing MIG had a higher net farm income percent (NFI%) than conventional producers.

H_5: Dairy producers implementing MIG had a higher value of farm production per labor hour (VFPpLH) than conventional producers.

H_6: Dairy producers implementing MIG had a higher quality of life than conventional producers.

H_7: Dairy producers implementing MIG placed more importance on cost lowering management tactics than did conventional producers.

FINANCIAL PERFORMANCE

A retrospective cohort study was designed to determine differences in profitability, asset efficiency, operating efficiency and labor efficiency between Michigan dairy farms implementing MIG and conventionally managed dairy farms. Financial information and labor use data for the calendar year 1994 were collected with surveys and personal interviews from 35 MIG dairies and 18 conventionally managed dairies.

In univariate analysis, no difference was found in profitability or efficiency between Michigan MIG and conventionally managed dairy farms. However, multivariate regression results indicated that MIG farms tended to have higher economic profit and higher asset efficiency, and were significantly more operating and labor efficient. No difference was found between farm types in accounting profit. Specific relationships were found between labor efficiency and levels of acres, purchased feed cost and milk production. Increased levels of acres and purchased feed on both MIG and conventionally managed farms were related to decreased labor efficiency. Increased milk production per cow was related to increased labor efficiency on both farm types. However, on MIG dairies, increased milk production was related to smaller increases in labor efficiency. This indicated that methods necessary to increase milk production on MIG dairies may require more labor than on conventionally managed dairies.

Previous descriptive studies primarily used accounting measures of profit to compare MIG and conventionally managed dairies. While these earlier works generally found that MIG dairies had higher profit, measures were generally descriptive and differences were not tested for significance. This study found that there was no significant difference in accounting profit between farm types. Accounting measures are an important first step in assessing a firm's profitability and avoid the potential subjectivity associated with including opportunity costs in economic profit calculations. However, economic profit is probably a better measure of the sustainability of a dairy. Though a high accounting profit may make a business appear to be quite healthy in the short term, these returns may be generated with unacceptably high levels of contributed labor or assets.

It is notable, then, that this study found that MIG operations tended to have higher economic profit. Higher economic profits suggested that, given similar opportunity costs, graziers had lower capital investments and a lower labor contribution. These suggestions were supported by the finding that graziers tended to have higher asset efficiency and had significantly higher labor efficiency. In addition, MIG operations had significantly higher operating efficiency. Previous works often found lower costs of production on MIG dairies and it was hypothesized that cost control was the primary way in which graziers generated higher profits. However, no previous work calculated traditional efficiency measures or attempted to compare them statistically.

This study took important steps beyond previous works. It found that MIG and conventionally managed farms had similar accounting profits, but that MIG dairies had higher economic profit. This demonstrated that while the two farm types may have similar short term profitability, MIG dairies may be more sustainable over the long term. In addition, the significant differences in efficiencies established specific ways in which MIG operations captured these higher economic profits.

Because the geographic distribution of MIG and conventionally managed farms in this study did not include the main Michigan "dairy belt," extrapolation of these results to an average Michigan or Midwest dairy should be made with care. Within the areas represented, however, it is clear that MIG dairies have higher long term profitability and that they capture this profit by being more efficient in asset use, operating practices, and labor use. This work does suggest that MIG could provide a sustainable alternative management tool for portions of Michigan's dairy industry.

QUALITY OF LIFE AND MANAGEMENT PRIORITIES

The farm visit portion of the retrospective cohort study discussed above included a questionnaire that examined producers' perceptions about their quality of life and management priorities. Chi square results indicated that the spouses of graziers were significantly more likely to have an active role in farm management than were the spouses of conventionally managing producers. This was likely partially attributable to the fact that fewer spouses of MIG operators (about 40%) worked off the farm than did spouses of conventionally managing operators (nearly 60%). Univariate analysis also found that graziers were more likely to consult state Extension specialists more frequently, while conventionally managing producers were more likely to consult veterinarians and nutritionists more often.

Logistic regression results also found that graziers consulted state Extension specialists more frequently than did conventionally managing producers. Because state Extension specialists assisted in identification of MIG producers for this study, it is not surprising that graziers consulted these professionals more frequently. Regression also found that conventionally managing producers had a significantly higher probability of being satisfied with the money they had available for family living than did MIG operators. The fact that more spouses of conventionally managing operators worked off the farm may lead to their increased satisfaction with the money available for family living.

The few differences found through univariate analysis and logistic regression indicated that dairy producers' perception of their quality of life was very similar on MIG and conventionally managed dairies. In addition, graziers were not found to place more emphasis on cost lowering management tactics. Overall, both MIG and conventionally managing producers were quite satisfied with their quality of life.

FUTURE WORK

This study was designed quite well for decreasing unnecessary variability and allowing sound statistical comparison. Matching helped control for variation that may have been introduced by a dissimilar range of herd size or by large climate or soil type differences between the samples of MIG and conventionally managed farms. Collecting data in person and utilizing only two different people to do so increased the reliability of the sample data. Creating strict definitions for both MIG and conventionally managed herds and requiring farms to meet these definitions for two consecutive years also helped decrease variability in farm type. Finally, multivariate regression was an important step in modeling the complex relationships between inputs, outputs, profitability, and efficiencies.

However, matching farms necessitated that the geographic area represented by the study was confined to the areas in which graziers were located. Because areas where graziers were located were not within highly concentrated dairy areas of Michigan, these study results can be extrapolated to a limited portion of the population of dairy producers.

Because both MIG and conventionally managed dairies depend highly upon forages for feed requirements, it is expected that an extreme climactic year would have similar effects on either of these farm types. However, for this reason and to decrease the chance of Type II error, it would be advantageous to have information on one set of farms over multiple years.

Another important drawback in the implementation of this study's design was incomplete matching due to the small number of conventionally managed farms willing to participate. With complete matching and a larger sample size, more confidence could have been placed in extrapolation of these results to a broader portion of Michigan's dairy industry and more complete analysis of the relationships between inputs, outputs, profitability and efficiencies could have been explored.

Given the strengths and drawbacks of this study, future work should build upon the matched design with specific definitions for both cohorts. Data should be collected over several years through personal interviews. In addition, the advantages and disadvantages of a MIG system coupled with spring or fall seasonal calving could be compared to MIG and conventionally managed farms that calve year round. Economies of size should also be compared between management types. Do these economies exist for MIG dairies? If so, what is the optimum herd size for particular combinations of capital investments? Finally, there is ample current investigation into the environmental impacts of MIG. Financial performance could be combined with monitoring of environmental parameters to determine if environmentally "friendly" systems are also profitable, efficient and sustainable.

To more completely examine quality of life and management priorities, years of grazing experience should also be collected and used in multivariate modeling. In light of the result found in this study that the spouses of graziers were significantly more likely to have an active role in farm management than were the spouses of conventionally managing producers, future work might more extensively measure both the operator and spouse's perceptions about their quality of life. In addition, questions focusing on the operator's perceptions about the dairy industry's future and MIG's role in that future could provide additional clues to both quality of life and financial performance.

SUMMARY

This study built upon previous descriptive work comparing the profitability of MIG dairies to that of conventionally managed dairies. This work was much more rigorous in both study design and statistical analysis. This rigor generated somewhat different results than previous work. While no difference was found in accounting profit, the most frequently used profitability measure, this study did find that graziers tended to have higher economic profit and asset efficiency as well as significantly higher operating and labor efficiency than conventionally managed dairies. This is the first known work to compare the quality of life and management priorities of MIG and conventionally managing dairy producers. Finding little difference among the two farm types was most likely due to the perception by both groups of producers that they enjoyed a fairly high quality of life. Further work on the financial performance and quality of life of MIG dairies should focus on the potential advantages of seasonal calving and on the relationship between financial performance and the environmental impact of MIG technology.

Appendices

Appendix 1

Financial and Labor Use Data Collection Worksheet

Number_________

CATTLE INVENTORY

Your dairy herd as of **January 1, 1995**

	Number of Head	Market Value/Head
COWS		
HEIFER CALVES (less than one year)		
HEIFER CALVES (one year to fresh)		
FIRST CALF HEIFERS		
BULL CALVES		
BULLS		
OTHER CATTLE		

Was the number of cattle on **January 1, 1995** significantly different from the number on **January 1, 1994**? Yes__ No__ ****(significantly is ≥ 5%)****

If your answer was Yes, please be able to estimate the differences at the time of your interview.

Was the market value per head significantly different between **January 1, 1995** and **January 1, 1994.** Yes____ No____

If your answer was Yes, please be able to estimate the differences at the time of your interview.

INSTRUCTIONS

CATTLE INVENTORY

Use records or estimate what you had on **January 1, 1995**.

AVERAGE VALUE/HEAD	Record a fair market value. **Example:** What would they bring if you sold them?
COWS	Record the total number of mature cows (2nd lactation or older) that were both milking and dry at the beginning of 1995.
HEIFERS (less than one year)	Record the number of heifer calves less than 12 months old as of January 1, 1995.
HEIFERS (one year to fresh)	Record the number of heifers that were between 12 months old and ready to freshen as of January 1, 1995.
FIRST CALF HEIFERS	Record the number of cows in the herd that were in their first lactation as of January 1, 1995.
BULL CALVES	Record the number of bull calves under one year old on hand as of January 1, 1995.
BULLS	Record the number of mature bulls present as of January 1, 1995.
OTHER CATTLE	Record the number of any other type of cattle on hand as of January 1, 1995 (please note what type or age of cattle these are) **Example**: steers raised for beef, backgrounding cattle, etc

Number____

STORED FEED and BEDDING INVENTORY

Stored feed inventory on hand on **January 1, 1995.**

DRY HAY

Package	Avg Package Weight (lbs)	Number	Avg Mkt Value/Ton

SILAGE Use "as fed" weights and values, please estimate the % moisture if not known.

	Tons	Avg Mkt Value/Ton	Moisture %
HAYLAGE			
CORN SILAGE			
OTHER - specify			
OTHER - specify			

GRAINS AND SUPPLEMENTS List both purchased and home-grown grains and supplements.

	Tons **OR**	Bushels	Mkt Value/Ton **OR** /Bushel
CORN (high moisture or dry)			
COTTONSEED			
SOYBEAN MEAL			
PROTEIN SUPPLEMENT			
OTHER - specify			
OTHER -specify			

Number____

STORED FEED and BEDDING INVENTORY

BEDDING and OTHER FEEDS Sand, sawdust, shavings, straw, other bedding or feedstuffs not previously recorded.

Supply	Avg Package Weight (lbs)	Number	Mkt Avg Value/Ton

Was the amount of stored feed on **January 1, 1995** significantly different from what was stored on your farm on **January 1, 1994**? Yes__ No_

If your answer was Yes, please be able to estimate the differences at the time of your interview.

Was the market value of this stored feed significantly different between **January 1, 1995** and **January 1, 1994**? Yes_____ No______

If your answer was Yes, please be able to estimate the differences at the time of your interview.

INSTRUCTIONS

STORED FEED and BEDDING INVENTORY

DRY HAY

Package	Example: round, sm square, lg square, etc
Number	How many used for cattle feed
Avg Package Wt	Estimate or actual weight in pounds
Avg Mkt Value/Ton	Use a fair market value

SILAGE

Tons	Use wet or as fed weight
Avg Mkt Value/Ton	Market value per wet ton or as fed
% Moisture	List actual or estimated % moisture

GRAINS AND SUPPLEMENTS

Tons or Bushels	Amount on hand in tons or bushels
Mkt Value/Ton or /Bushel	Use fair market value

BEDDING AND OTHER FEEDS

List all other feed or bedding supplies on hand.

Supply	**Example**: sawdust, sand, straw, etc
Number	**Example**: Number of bales of straw, or number of tons of sawdust
Tons	Tons of supply on hand
Avg Mkt Value/Ton	Use fair market value

Number______

ASSETS FOR FARM PRODUCTION - INVENTORY

Inventory as of **January 1, 1995.**

Error! Bookmark not defined.LAND AND REAL ESTATE Owned and rented

	Owned Acres	Mkt Value/Acre	Rented Acres
HAY AND PASTURE LAND			
PASTURE LAND ONLY			
CROPPING LAND			
OTHER - specify			
or TOTAL LAND AND FACILITIES			

FEED AND CATTLE PRODUCTION EQUIPMENT

Equipment	Market Value
TRACTORS	
TRUCKS	
HAYING EQUIPMENT	
CROPPING EQUIPMENT	
MANURE HANDLING (example: spreaders, scrapers, etc., excluding tractors)	
MILKING EQUIPMENT	
FENCING EQUIPMENT	
WATERING SYSTEM EQUIPMENT	
LIVESTOCK FACILITIES	
OTHER-specify	
or **TOTAL EQUIPMENT**	

Number______

ASSETS FOR FARM PRODUCTION INVENTORY

SUPPLIES ON HAND

Item	Market Value
SEMEN	
ANTIBIOTICS	
TOWELS	
TEAT DIP	
OTHER - specify (i.e. bST, etc)	

Were the amounts of assets and supplies on **January 1, 1995** significantly different from the amount on your farm on **January 1, 1994**? Yes__ No__

If your answer was Yes, please be able to estimate the differences at the time of your interview.

Was the market value of assets for farm production significantly different between **January 1, 1995** and **January 1, 1994**? Yes____ No____

If your answer was Yes, please be able to estimate the differences at the time of your interview.

TOTAL DEBT

What was your total debt as of January 1, 1995? ______________
Did it increase or decrease in the year 1994? ______________
Approximately how much? ______________

Number______

INSTRUCTIONS

ASSETS FOR FARM PRODUCTION - INVENTORY

LAND AND REAL ESTATE	Record the number of acres and market value of land you use for hay, pasture or crops for the dairy herd.
LIVESTOCK FACILITIES	List the acres and market value per acre plus the market value of your facilities or just list acres that the facilities stand on and total market value of acreage and facilities. Livestock facilities include barns, silos, parlor, free stalls, heifer barns, etc. Exclude your house.
FEED AND CATTLE PRODUCTION EQUIPMENT	List machinery used in feed and cattle production and its market value.
SUPPLIES ON HAND	List significant supplies on hand and their market value.

Number____

INCOME

For the year **1994.**

FARM SALES

	Pounds	Total Value
MILK		
CATTLE	Number of Hd	Total Value
CULL CATTLE		
CALVES		
BREEDING CATTLE-heifers		
BREEDING CATTLE-bulls		
OTHER LIVESTOCK-specify (beef, show, etc.)		

OTHER FARM INCOME

Income	Total Value
GOVERNMENT PAYMENTS	
ASCS PAYMENTS	
PA116 TAX CREDIT	
HUNTING LEASES	
OTHER -specify	

INSTRUCTIONS

INCOME

SALES	Record all milk and cattle sales for the entire year of 1994.
Cull cows	Record all mature cows sold as culls in 1994.
Calves	Record all heifer and bull calves sold in 1994.
Replacement Cattle	Record all cattle sold for replacement stock in 1994.
Other Livestock	Record all other cattle sold in 1994.
OTHER INCOME	Record all other types of farm income for 1994. (**Example:** rent,crop sales, etc.)

Number____

EXPENSES

Use your 1994 IRS 1040F form.

LIVESTOCK

	TOTAL $$$
BREEDING FEES	
FREIGHT, TRUCKING, MKTING	
VET & MEDICINE	
OTHER	
FEED PRODUCTION	
PURCHASED FEED	
CHEMICALS	
SEED	
FERTILIZER/LIME	
GAS, FUEL, OIL	
REPAIRS/MAINTENANCE	
MACHINE HIRE	
CONSERVATION EXPENSE	
LAND & PASTURE RENT	
OTHER SUPPLIES	
OTHER	
TAXES	
INSURANCE	
UTILITIES	
LABOR	
EMPLOYEE BENEFITS, PENSIONS	
INTEREST	
DEPRECIATION	
OWNER DRAW	
OTHER	

Number_____

EXPENSES, CONTINUED

CATTLE PURCHASES

	No of Head	Total $
REPLACEMENT HEIFERS		
REPLACEMENT BULLS		
OTHER - specify		

Number_____

INSTRUCTIONS

EXPENSES

EXPENSES	List total expenses for the farm off your 1994 IRS 1040F form.
CATTLE PURCHASES	List all cattle purchased in 1994 for dairying use. **EXAMPLE**: bulls, heifers, mature cows

TOTAL FARM LABOR USE

		Hours/week				1994 Total hours
	NAME OF WORKER	Winter	Spring	Summer	Fall	▨
UNPAID LABOR						
PAID LABOR						

ALLOCATION OF FARM LABOR

Hours per day on this farm spent doing each job in each season

Daily and Seasonal Jobs	Winter	Spring	Summer	Fall
Milking				
Chores				
Manure management				
Fencing/Moving Cattle				
Feed Cropping				
Cash Cropping				
Farm management				
Repairs				
Other-specify				
TOTAL HOURS/DAY				

INSTRUCTIONS

TOTAL FARM LABOR USE

UNPAID LABOR Are those members of the main family or families that own and manage the farm. If more than one family operates the farm, please fill out separate family labor sheets for each family.

EXAMPLE: If your child works for you but only earns money out of what the family withdraws from the farm, he/she is considered unpaid. However, if the children draw a wage periodically, they are to be considered paid labor.

PAID LABOR Is any labor used on the farm that was compensated (including labor bartered or traded).

EXAMPLE: If the neighbor does chores on the weekends and gets paid every other weekend, then he/she is considered paid labor.

HOURS/WEEK

Spring, Summer, Fall, Winter **<u>These seasons can be defined as you like.</u>** This information should help you decide on how many total hours/week each working member contributes to the farms production in each season.

1994 TOTAL HOURS Please fill in the total number hours worked per year by each individual.

INSTRUCTIONS

ALLOCATION OF FARM LABOR

Milking	Include set-up of the milking facility, actual milking time, tear-down and clean-up of the milking facility.
Chores	Include feeding and watering all livestock including heifers and calves as well as heat detection.
Manure management	Include scraping the barn and/or lots, spreading manure and cleaning a pit or lagoon.
Fencing/Moving cattle	Includes set-up and moving fence and watering system, moving cattle between paddocks, moving cattle to and from the barn and clipping pastures.
Feed Cropping	Include green-chop, silage, dry hay, grains, and any other feed planted and harvested for the dairy herd.
Cash Cropping	Include any cropping done specifically for sale or not to be used as a feed.
Farm management	Include herd health visits, nutrition consulting, financial management, DHIA analysis or other computer analysis, pasture layout, conference or meeting attendance, and other time spent in farm management.
Repairs	Include time spent repairing cropping equipment, fences, milking equipment, etc.
Other	Include hours of time spent doing any other farm related activity.

Appendix 2

Quality of Life and Management Priorities Questionnaire

Quality of Life and Management Priorities
Michigan Dairy Grazing Study

1. ***What is your age?*** ______ years

2. ***What level of education have you obtained?***

Completed less than 8th grade	1
Completed 8th grade	2
Some high school (grades 9-12)	3
Completed high school or equivalent	4
Completed two year college degree	5
Completed four year college degree	6
Completed graduate of professional degree	7

3. ***Are you the sole operator/manager of the farm, or are there other co-owner/manager(s)?***

Sole owner/manager	1
Family partners	2
Other partners	3
Shareholders	4

4. ***Are you married or have you ever been married?***

Single, never married	1
Currently married	2
Separated or divorced	3
Widowed	4

5. ***If you are married, does your spouse have an active role in farm management?***

Yes	1
No	2

6. ***Do you have a written mission statement, goals, objectives?***

Yes	1
No	2

7. ***Do you and/or your spouse work off the farm?***

Yes____ No____ Full ____ Part ____

Yes____ No____ Full ____ Part ____

8. ***Are you involved in one or more of the following: ASCS board, schoolboard, scout leader, 4-H leader, church groups/leadership position?***

Yes	1
No	2

9. ***How often do you consult with each of the following types of professionals on your dairy operation?*** (weekly, monthly, 4X/year, 2X/year, annually, when I have a specific problem, never)

	wkly	mntly	4/yr	2/yr	1/yr	sp pb	never
County Veterinarian	1	2	3	4	5	6	7
Ag Extension Agent	1	2	3	4	5	6	7
State Extension Specialist	1	2	3	4	5	6	7
Feed Broker	1	2	3	4	5	6	7
DHIA rep	1	2	3	4	5	6	7
Nutritionist	1	2	3	4	5	6	7
Ag engineer	1	2	3	4	5	6	7

Questions 10 and 11 will use a scale of 1 through 5 with
1 = No importance, 3 = Some importance, 5 = Great importance.

10. ***How important is it for you to:***

ECONOMIC STATUS	no imp		some imp		great imp
a. Pay down your debts	1	2	3	4	5
b. Avoid more debt	1	2	3	4	5
c. Increase profit each year	1	2	3	4	5
d. Prepare for retirement	1	2	3	4	5
e. Have adequate family living	1	2	3	4	5
f. Save for children's future	1	2	3	4	5
FAMILY					
g. Spend time with family	1	2	3	4	5
h. Take family vacations	1	2	3	4	5
PRODUCTION					
i. Increase production per cow	1	2	3	4	5
j. Increase total milk sold	1	2	3	4	5
k. Increase herd size	1	2	3	4	5
l. Improve herd health	1	2	3	4	5
OVERHEAD					
m. Reduce labor costs	1	2	3	4	5

n. Reduce family labor	1	2	3	4	5
o. Reduce feed costs	1	2	3	4	5
p. Improve safety of farm operation	1	2	3	4	5

11. ***How important are each of the following characteristics of farming and farm life to you personally?***

	no imp		some imp		great imp
a. Economic rewards of farming	1	2	3	4	5
b. Opportunity to do things your own way	1	2	3	4	5
c. A good place to raise a family	1	2	3	4	5
d. Opportunity to work outdoors	1	2	3	4	5
e. Opportunity to work with animals	1	2	3	4	5
f. Do physical labor	1	2	3	4	5
g. Challenge your management skills	1	2	3	4	5
h. Diversity of the work	1	2	3	4	5
i. Working with family members daily	1	2	3	4	5
j. Chance to maintain a family tradition	1	2	3	4	5
k. Keeping the farm in the family	1	2	3	4	5
l. Chance to bring your children into the farm	1	2	3	4	5

Question 12 will use a scale of 1 through 5 with
1 = Very Dissatisfied, 3 = Neutral, 5 = Very Satisfied.

12. ***At this point in your life, how satisfied are you with:***

a. Your choice of becoming a dairy farm operator ___
b. The money you have available for family living ___
c. The financial performance of your dairy business ___
d. Your options or alternatives to dairy farming ___
e. The amount of time you spend operating/managing your dairy operation ___
f. The amount of time your family spends in labor on the dairy operation ___
g. The time you have available to spend with family ___
h. The time you have available to follow other pursuits besides dairy farming (hobbies like hunting, fishing, snowmobiling, traveling) ___
i. Your flexibility in getting away from the farm when you need to ___
j. Your flexibility in getting away from the farm when you want to ___
k. Your progress towards goals you may have set for your dairy operation ___