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1999 Mid-Atlantic Dairy Management Conference, February 24 and 25, 1999
Radisson Penn Harris Hotel and Convention Center, Camp Hill, PA

<u>Wednesday, February 24</u>

10:00 AM	**Registration and Trade Show**
1:00 PM	**Welcome and Setting the Stage** **(Session Chair – Randy Lyle, Purina Mills, Inc.)** Opening Remarks *Terry Etherton, Penn State University* Changes in Dairy Farming, 1949-1999 *Steve Larson, Hoard's Dairyman* The Final Permit – A Decision Case *Bill Heald, Penn State University*
2:20 PM	**Break**
2:40 PM	**Announcements**
2:45 PM	**Business Viability Session** **(Session Chair – Lisa Holden, Penn State University)** The Dairy Business as a Living Company *Dewayne Dill, Dairy Strategies, LLC* Growing the Dairy Business *Joe Conlin, University of Minnesota* Those People Who Care *Gary Snider, Farm Credit of WNY, ACA* Growth Requires Change *Tom Frey, Frey Dairy, Inc.*
4:45 PM	**Trade Show and Reception**
6:00 PM	**Dinner**
7:25 PM	**Announcements**
7:30 PM	**Specialization Session** **(Session Chair – Mike Westendorf, Rutgers University)** Managing Contract Heifers – A Western U.S. Perspective *Roger Cady, Washington State University* Contract Heifer Production in the Mid-Atlantic Region *Art Logan, Logan Acres Farm, OH* Custom Forage Harvesting and Sales *Keith Snoddy, Wasuka Farms, OH*

Thursday, February 25

6:30 AM	**Continental Breakfast and Trade Show**
7:55 AM	**Announcements**
8:00 AM	**Environmental Friendly Dairy Farming** **(Session Chair – Al Rotz, USDA Agricultural Research Service)** Dairy Production and Water Quality: Are They Compatible? *Andrew Sharpley, USDA Agricultural Research Service* Developing a Comprehensive Manure Management Plan *Doug Beegle, Penn State University* Feeding Management to Reduce Nutrient Loading *Katharine Knowlton, Virginia Tech.* Nutrient Management at Table Rock Farm *Williard De Golyer, Table Rock Farm, Inc., NY*
10:00 AM	**Break**
10:25 AM	**Announcements**
10:30 AM	**Information Management/Biosecurity Session** **(Session Chair – Mike Lormore, Monsanto Dairy Business)** Herd Information Management *Paul Rapnicki, University of Minnesota* Co-Mingling – A Herd Health Time Bomb? *David Tomsche – Veterinary Associates of Melrose/Alabany/Upsala, MN*
12:00 PM	**Lunch**
1:10 PM	**Announcements**
1:15 PM	**Decision Case Discussion** **(Session Chair – Bill Heald, Penn State University)** Breakout Discussions of Decision Case *Discussion Leaders: Doug Beegle, David Tomsche Joe Conlin, Paul Rapnicki, Gary Snider, Dewayne Dill* Brief Reports of Breakout Groups Producer Panel Discussion *Panel Members: Tom Frey, Williard De Golyer, Art Logan, Keith Snoddy*
3:15 PM	**Wrap-up and Words of Encouragement** *Charlie Stallings, Virginia Tech*

Table of Contents:

CHANGES IN DAIRY FARMING: 1949-1999

Author: Steven A. Larson, Managing Editor, Hoard's Dairyman

At the risk of being trite, let me recall two over-used figures of speech. "The only thing constant is change." "The more things change, the more they stay the same."

Now we come to looking at where we are today in this dairy industry, where we were 50 years ago, and where we will be going. Soon, we discover why these two tired, old sayings are still around, over-worked as they are . . . they sum up many situations all too well.

Here are titles of articles that have appeared in Hoard's Dairyman. Half of them appeared in recent months, half of them appeared 50 years ago. Which do you think appeared when?

1. Save labor by milking "California style"
2. Are big herds more efficient?
3. Cows like comfort, too
4. Help ensure a high quality of milk
5. Feeding fat for milk test
6. Don't go wild on feeding corn
7. How much does your silo hold?
8. Some bulls get more cows bred
9. How to produce quality milk
10. Cow milkers make a difference
11. Farm women can be business partners
12. Be careful when you buy cows
13. Raise or purchase replacements?
14. Manure: a storehouse of nutrients
15. Butter: a factor in milk prices
16. An animal's first attack should be its last
17. Milking before freshening
18. Don't cheat your alfalfa this September
19. Let's face inbreeding
20. Dirty equipment caused calf losses

All of the odd-numbered titles appeared about 50 years ago. All of the even-numbered titles appeared in recent months. Don't most of those 50-year-old titles sound as if they could be written today?

What things were like . . ?

Let's turn the clock back 50 years. Close your eyes and imagine how things might have looked and compare that to what we see today.

• The nation was still recovering from World War II. It was a boom time with a high inflation rate. Our current economy has been growing nicely for about four years.

• Then, as now, perjury was in the national news. Alger Hiss, a former State department employee, was indicted for passing secret documents to a Communist spy ring.

• Color TV was being introduced then. High-density television (HDTV) is being introduced now.

• The U.S. sent 35 military advisors to South Vietnam to provide military and economic aid to an anti-Communist government. And we all know to what that eventually lead. The U.S. recently bombed Iraq.

• There were 23 million farmers, compared to less than 1 million today. There were 152 million people in the country, compared to 265 million now. Fifty years ago, farmers were 15 percent of the population, compared to less than one half of one percent today.

• There were 2.5 million dairy farms in the nation 50 years ago, by USDA measure. Now there are about 120,000 by USDA count (operations with milk cows), but only 91,000 farms that have licenses or permits to sell milk, according to Ken Olsen’s American Farm Bureau Federation numbers.

• Back then, there were 23 million cows, about 9 per farm. Now there are just over 9 million cows, an average of about 100 per farm.

• National milk production in 1949 was about 116 billion pounds, compared to 1998’s expected total of about 157 billion. Fifty years ago, milk production per capita was 771 pounds. Now, it is about 580 pounds.

• Milk per cow now is well over 17,000 pounds. Fifty years ago, it was about 5,000 pounds.

• In 1950, cows on DHI test averaged 9,100 pounds of milk, compared to almost 19,000 in 1996. Fifty years ago, there were about 1 million cows on DHIA test in 40,000 herds. Now there are more than 4 million cows on test in about the same number of herds . . . just over 39,000.

• In Michigan during 1949, 18 farmers formed the 400 Club. They were the only dairymen in the state with herd averages higher than 400 pounds of butterfat. At present, there are 45 herds in Lancaster County, Pennsylvania, that have DHI averages above 25,000 pounds of milk. With 3.6 percent fat, they would average at least 900 pounds of fat.

• In 1949, there was a new national Holstein record set with a cow producing just over 900 pounds of fat and 21,000 pounds of milk. This winter, a Wisconsin Holstein finished a 365-day record with 70,612 M, 2,963 F, and 2,163 P.

• Milk prices 50 years ago were in the range of $3.50 to $4.00 per hundredweight. I don’t have to tell you where they are now.

• Fifty years ago, milk sold in stores for an average of 78 cents per gallon. A typical price now would be about $2.75 a gallon.

•In 1949, one hour's work for the average citizen would buy 5 gallons of milk at the store. Today, one hour's work will buy 10 gallons of milk.

• The first purchases under the dairy price support program were made in 1949. The price support level was $3.00 per hundredweight, but was based on a certain percentage of parity. It started out at 90 percent of parity. Ironically, the support program is scheduled to be eliminated at the end of 1999. The current support level is $9.95 per hundredweight.

• In 1949, people were investigating how dairy exports could improve the price of milk. Powdered milk was being shipped to Mexico City where it was being reconstituted in dairy plants and sold as bottled milk. Now, we have the U.S. Dairy Export Council with a $6 million budget, and milk is being concentrated on-farm in New Mexico from where it is shipped to Minnesota and Wisconsin for use in cheese making.

• Frozen semen was just being introduced 50 years ago. Now, cloning is in the news almost weekly.

• In 1949, we had an article about the alarming drop in the number of A.I. organizations. There were 69 bull studs at the time. Now there are six that could be considered major players.

• A 1949 Wisconsin study reported that dairy farm labor requirements ranged from 113 hours per cow on farms with two milking machines to 150 hours per cow with one milking machine to 182 hours per cow for people who milked by hand. Today, efficient farms are getting by with 40 to 50 hours of labor per cow.

• Brucellosis was the animal health scourge 50 years ago. Now, Bang's is just about eradicated, but Johne's disease is a growing threat.

• In 1949, people were inoculating the rumens of calves with cud to stimulate fermentation. Now, cutting-edge managers are keeping fistulated cows on hand so they can inoculate the rumens of fresh cows that go off feed.

• Fifty years ago, the dairy promotion check-off was voluntary and was done only during June Dairy Month. The level was 1 cent per pound of butterfat produced and about $1.2 million was generated. Now we kick in 15 cents per hundredweight the year around, which amounts to $225 million.

• Something called the National Dairy Products Corporation (made up of Kraft, Sealtest and Breyers), 50 years ago, bought a full page ad in Hoard's Dairyman encouraging dairy farmers to produce more milk in the Fall and Winter, as well as the Spring and Summer. Now the grazing segment of our industry is working toward seasonal calving.

Better or worse off ?

It is only natural to wonder whether dairy farm families were actually better or worse off 50 years ago. Were the Good Ol' Days good? Some figures from the Bureau of Labor Statistics and the USDA give us some insight.

The index of prices received for milk at the farm has gone up about 3 1/2 fold in the past 50 years. And that fits. The milk price was about $3.75 per hundredweight in 1949, and 3.5 times that price is just over $13 which is a typical, year in-year out price these days.

Prices paid for feed have gone up about three times during the last decade. This is believable when you consider what corn and soybean growers are getting paid these days.

By contrast, the index of prices paid for other production items has gone 4.5 fold during the past five decades.

On balance, I doubt that many of you who are milking cows today would want to trade places with your grandparents who may have been in their prime in 1949. Folks on farms then had their own set of problems and challenges. Certainly, the work they did was more demanding physically. (That new California-style of milking referred to earlier involved an innovation whereby milk went directly from cows to the milk tank. That article in the March 10, 1949 issue was the first mention of pipeline milking in the magazine.)

While I'm sure that many of you would like to have shorter work days and more time off, especially on weekends, you likely are much less tied down than the 1949 dairy farm families. I wonder what proportion of them would have had the time and money to get away from the farm for two or three days in a row to attend a meeting such as this.

But consumers have been the big winners. Using the Consumer Price Index as a guide, the cost of all items purchased by people has gone up 6.5 times since 1950. During the same time, the cost of dairy products has gone up only 3.9 times. That explains why the average employee only has to work half as long to buy a gallon of milk these days. And certainly, we as an industry are offering dairy products of higher quality and more variety.

So what of the future? Long-standing trends have pushed our industry into a new era of dairying. As we end the 20th Century and head into the new millennium, change will continue to be constant, but it will have a familiar look. Fewer farms, more milk per cow, more cows per person, and so on. Survival will depend on positive approaches to critical issues — some mundane . . . some part of the big picture. Just like for Peter and Mary Cary in the Decision Case, you will face nutrient management challenges and other environment issues. Animal welfare, milk quality, employee relations, and risk management will be other areas about which you must have a well-formulated plan.

We’re entering a Brave New World in our industry. Your presence at this conference is a sign that you’re willing to accept the challenge.

We wish you well.

THE FINAL PERMIT: Will Environmental Policy Crack the Retirement Nest Egg?

Authors: C. W. Heald, D. E. Dill, B. J. Conlin, Pennsylvania State University, Dairy Strategies, LLC, University of Minnesota.

Background

In 1992 Peter and Mary Cary were just making ends meet, working hard, long hours, and barely maintaining their equity. They felt their many hard, long hours should have bigger rewards. Their younger son Jim would be graduating from high school soon and was interested in continuing the farm tradition. Their older son had no interest in farming. Growing up on the farm convinced him that he didn't have the temperament to be a dairy farmer. He was attending the university about 60 miles away and rarely came home from school. He wanted more leisure time, less drudgery, and something that paid better than dairy farming.

Taking Control of Their Dairy Business

Peter, Mary and Jim solicited help from a dairy advisory team. By 1996 they had increased production of their 65 cows from about 16,000 in 1992 to over 21,000 lbs./year. Peter and Mary began to see tangible benefits to their improved management. In addition to increases in herd productivity:

- Their financial situation had greatly improved. Income available for family living had increased to about $22,000. They now met their financial obligations and had some money available for modest capital improvements to their old facilities.
- Reduction in the age at first calving by six months combined with a higher than usual number of heifer births the previous 24 months resulted in a surplus of springing heifers.
- Some persistent mastitis they had experienced was now behind them.
- They observed first-hand, milk production increases due to high quality forage in the silos. Peter was so convinced in the value of quality forages that he bought a new self-propelled mower to ensure timely forage harvesting.

Peter and Mary's attitudes also changed. They had gained a new level of confidence in what was possible and saw future opportunities with the dairy. They enjoyed an occasional leisure winter afternoon. Peter had more time to devote to management and on a cold winter day could be found pouring over records, developing cropping plans, or working at his computer. However, they were still tied to milking twice a day every day year around. They were ready now to have some free time away from the farm for an occasional weekend get-away and an annual vacation. They also began to examine their retirement plans and explore the possibility of helping Jim enter the farming operation. They concluded these plans were at risk if something wasn't done to increase income and ease up on the intensity of the hard physical work and the long hours.

Mary did most of the milking and had suffered from back pain that caused her to miss several days of work during the past year. Peter was experiencing knee problems and had difficulty getting down between cows in the stall barn. Mary feared additional debt and did not want to milk more cows in the current facilities. There were too many makeshift situations every time they milked a few extra cows. When the cows became crowded the drudgery increased and things went wrong. Some of the promising heifers would injure themselves in the makeshift stalls, come down with mastitis and eventually be sold. The root cause always seemed to come back to stress on people or cows. They had lost one son from farming and they didn't want to jeopardize another. Though interested in farming, Jim had not learned to like working with cows and much-preferred working in the fields.

Peter enjoyed working with machinery, particularly making do with various old tractors his Dad purchased long ago. He also liked fieldwork and compared the time in the combine to how others looked forward to hunting season. After getting a computer and attending classes in financial management and record keeping, he came to appreciate the power of farm records and strategic planning. He became an accomplished FINPACK user and enjoyed sharing his financial plans with his advisory team during their semi-annual meetings.

Peter, Mary and Jim shared the decision-making. If a decision was needed regarding milking cows or herd health, Mary made these, consulting Peter only if she needed another opinion. To foster their son's management skills, Jim was made responsible for preparing rations, ordering purchased feeds, taking feed samples for analysis and communicating with Tony, the feed supply rep. Jim liked the farm life and worked hard but when evening came his thoughts strayed from farming to friends he relaxed with in town. He was willing to come to work early and work hard all day. But he also made sure to leave in time to meet his friends after work several nights a week.

Making Plans for Their Dairy Future

Life for Peter, Mary and Jim had significantly improved during the 5 years from 1992 to 1996. Those nagging, management crises seemed to be less frequent, cash flow problems had eased, and their attitude and optimism were greatly improved. With taxes done for the year and crop plans for their 303 acres complete, Peter felt it was time to take stock of where they were and explore options. This took a lot of soul searching deciding what the family wanted their future to be. To realize Peter and Mary's vision, farm income needed to be increased to pay down debt faster, provide for retirement savings, improve family living draws, support a better life style, and make a business opportunity for Jim. Continuing the farm business as-is meant none of this vision would be realized. Putting all they had accomplished at risk by leaping into a large, modern dairy unit was not reasonable either.

Consensus was that the long-term future was in a modern dairy unit with free stall barns and a labor efficient elevated parlor. This led them to consider growing the dairy to 500 cows since fewer cows did not support the investment needed. Their debt to asset ratio was at 37% and stretching that beyond 60% was beyond their comfort zone. A plan to expand the dairy in several small, manageable steps was a compromise that made the most sense and was supported by their advisory team (Exhibits I-III). Mary was skeptical about borrowing more money (Exhibit IV) and milking more cows until Peter showed her what could happen to their projected assets and liabilities in ten years with his most recent plan (Exhibits I through X). Mary was surprised when she saw the $1.2M difference in assets and liabilities graph that Peter gave her one afternoon. She had never thought much of being a millionaire but the possibility was intriguing (Exhibit V). This was a turning point for Mary and she began to soften to the idea of more debt and more cows that Peter had been dreaming of.

With the help of the advisory team, Peter had devised a plan to grow herd size over time in steps. First step, grow herd size; second step, build equity; third step, expand facilities (Exhibit III). If conditions were favorable after each growth phase, they would grow again. They knew from experience that they had to master the management of a larger herd including moving animals, feeds, forages and manure in a timely fashion, getting experience with hired labor, keeping animals and people healthy, and paying down debt again while minimizing risk. The objective of their business plan was to pass on a viable healthy dairy business that Jim or someone else could purchase at an appreciated value and be financially secure in retirement within 15 years.

Peter had prepared several graphs as part of their business plan. These graphs summarized the projected change in net worth (Exhibit V), cost control measures (Exhibit VIII), profitability (Exhibit IX) and efficiency ratios (Exhibit X). Once Mary understood what these graphs were telling her, she became a believer in Peter's vision. She was as anxious as Peter to get started with the first step. So in February 1997 they built free stalls in a shed previously having only loose housing, built a 2X4 flat parlor, and added 70 additional milking animals.

Managing Risks of Environmental Regulations

Following expansion, Peter and Mary plan to own 178 acres and rent another 140 for a total of 318 acres, of which 293 are tillable. They plan to remove youngstock from the farm, keeping only baby calves and close-up springing heifers. Keeping 525 cows plus a limited number of youngstock on 293 acres will give them 765 animal units, more than 2 animal units per acre. They live in a county where permitting dairy farms is already more difficult than in many regions of the U.S. because of local public concern over agricultural pollution of ground waters and waterways. The new development within sight of the driveway is a reminder that neighbors may one day not understand modern farming practices, especially the odor on days when the manure storage is emptied.

Peter and Mary want to be good neighbors. They take pride in farming in a responsible and environmentally sustainable way. They have a personal environmental goal to add no more nitrogen or phosphorus to the fields than can be removed by the crops. However, many of their fields already test in the very high range for phosphorus (Exhibit XI). Increasing cow numbers will almost certainly force them to compromise their self-imposed environmental goal if they can't find new solutions to phosphorus accumulations on cropland. Peter asked his crop advisor, Harry, about the nutrient load from additional cows. Harry agreed to run a simulation model he had being working with called DAFOSYM. After getting these disturbing results Peter made a summary table of his planned expansions and the phosphorus utilization on their farm (Exhibit XV). He also included a scenario of milking fewer cows than the 525-cow scenario but maintaining the same total milk output by using BST. He presently does not use BST due to personal values but recognized he needed to evaluate alternatives. Nutrient build up was going to be a problem unless he changed his management practices or obtained manure disposal rights on additional land. Financing a land purchase was just too much burden this late in their business life. Being in a heavily concentrated dairy area, finding additional land where he could obtain an easement contract also posed a significant challenge. He would probably have to go about 12 miles to find manure easement land.

Over the winter Peter talked to many soils experts and read every article he could find relative to nutrient buildup in crop soils under intensive animal agriculture. He compiled an extensive list of all options he uncovered related to his dilemma:

- Lower feed phosphorus in diets of dairy cows
- Implement cropping plans that use more soil phosphorus
- Sell or spread manure on neighboring farms where crops are raised for export out of the region
- Use deep soil incorporation of manure phosphorus (12-18 inches) for a temporary solution
- Find alternative off-farm uses for manure solids
- Transport raw manure to phosphorus deficient farms in other counties
- Purchase or rent more land
- Use low phytic acid corn varieties anticipated in future years
- Install a sequencing batch reactor (a waste treatment system) that has the current attention of producers (Fad).
- Add a municipal type waste treatment facility to capture nutrients
- Use BST to increase milk production per acre while lowering nutrients returned to crop land
- Addition of iron chloride or aluminum sulfate to form geologically insoluble phosphate minerals in settling ponds

One afternoon, he and Mary sat down with their advisory team and rated each alternative on three criteria – How feasible was the alternative for their situation? How expensive was the alternative? And was the alternative consistent with their personal values? (Exhibit XVI). As they were reviewing the list, one of the advisors suggested they add a fourth criterion -- Is the alternative a short-term or permanent solution? This caused Peter to begin asking the question, will we be able to transfer this operation at retirement or will future environmental regulations make sale of our dairy operation untenable?

The Dilemma

Peter said it best when he explained his concerns to me:
"What's the right thing to do? All I know is this farm. Mary and I finally feel as though we are on top of our operation. I'm convinced we have a plan such that we can retire comfortably and provide Jim a business opportunity that we all can be proud of. The $1.2 M investment doesn't frighten me at all. But the uncertainty regarding new environmental regulations has me deeply concerned. I've read the papers. I'm aware of the pfiesteria outbreaks in our area and these things really trouble me. Mary and I care deeply about the environment. Shoot, I swam and fished in that river in the back of the farm when I was a kid. I'm the last one who wants to pollute it. But I admit the river does flood our fields on occasion. And we will be pushing the phosphorus levels higher. I've tried to find someone to provide me good answers but no one seems real convinced regarding what the future holds. My greatest concern is that phosphorus on soils will be like underground fuel tanks or asbestos in buildings. When we get ready to pass

this operation on to Jim, there might well be environmental regulations that are too costly for Jim to swing, rob us of our retirement investment or both. You tell me. What should we do?

Exhibit 1. Map of Farmstead in 1996.

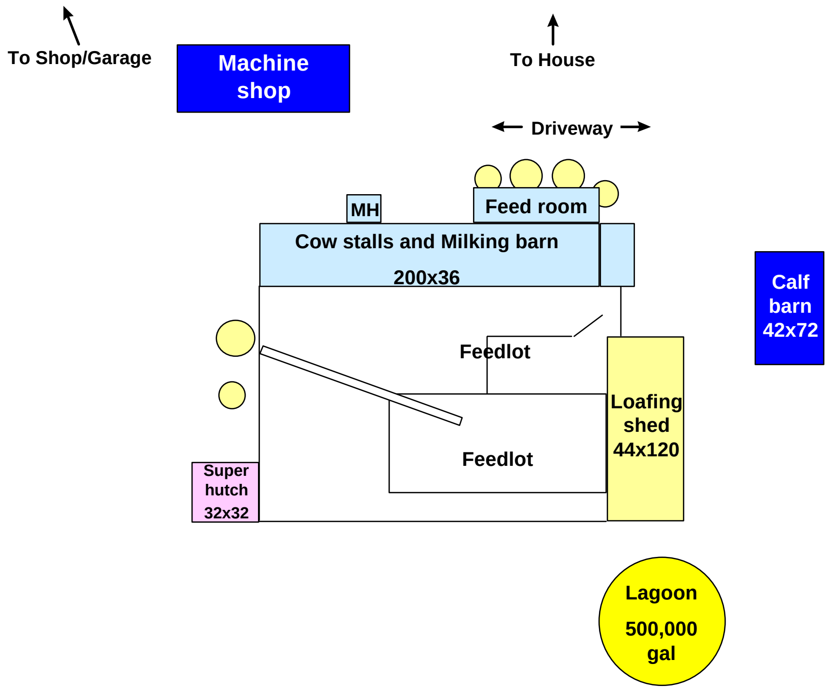

Exhibit 2. Map of Farmstead in 2008.

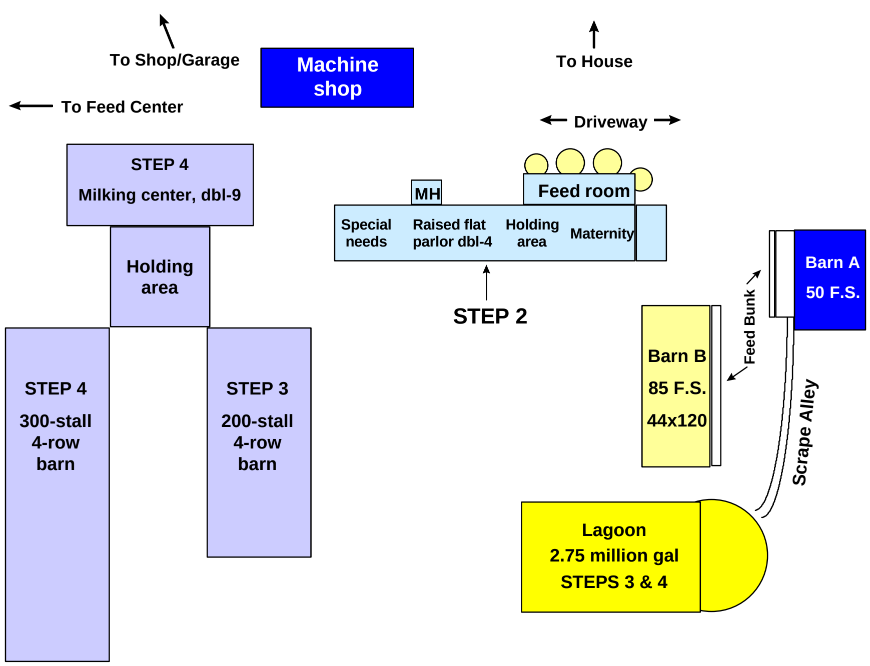

Exhibit III. Summary of 10-Year Growth Plan.

	Key farm business data						
Year	**Number of Cows**	**Crop Number of Acres**	**Net Worth**	**Assets / Cow**	**Debt / Cow**	**Family Living Draw**	**Goal**
1996	65	303	$574,657	$14,056	$5,228	$22,000	Improve production per cow and per worker
1997	135	303	$593,005	$9,377	$3,294	$22,000	Build flat parlor, renovate two barns for freestalls
2002	325	293	$754,748	$4,678	$2,355	$35,000	Build new 200 stall barn west of old facilities
2005	525	293	$984,156	$4,561	$2,686	$45,000	Build new double-9 milking center and 300 cow freestall barn
2007							Sell part of farm business to a partner and manage full time and/or retire

Exhibit IV. Step-wise Growth Plan Asset Purchases.

Asset	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
FACILITIES										
Renovate flat stalls		44200								
Flat parlor		25000								
Silage pad					15000					
Site preparation					20000					
Expand manure lagoon					45000					
Free stall barn						225000				
Commodity feed						30000				
New well							20000			
Site work							25000			
Expand manure lagoon							40000			
Milking center (double								200000		
Renovate for special								15000		
300-cow free stall barn								325000		
TOTAL		69200			80000	255000	85000	540000		
EQUIPMENT										
Machinery	16000									
Sell combine		-20000								
Skid Steer			25000							
Portable TMR mixer				28000						
Pay loader							25000			
Equipment update								25000		
Milking center								75000		
Machinery update										25000
TOTAL	16000	-20000	25000	28000			25000	100000		25000
LIVESTOCK										
Springing heifers		84000								
Springing heifers						190000				
Springing heifers								210000		
Springing heifers									30000	
TOTAL		84000				190000		210000	30000	
GRAND TOTAL	16000	133200	25000	28000	80000	445000	110000	850000	30000	25000

Exhibit V. 10-Year Asset, Liability, and Net Worth Projection.

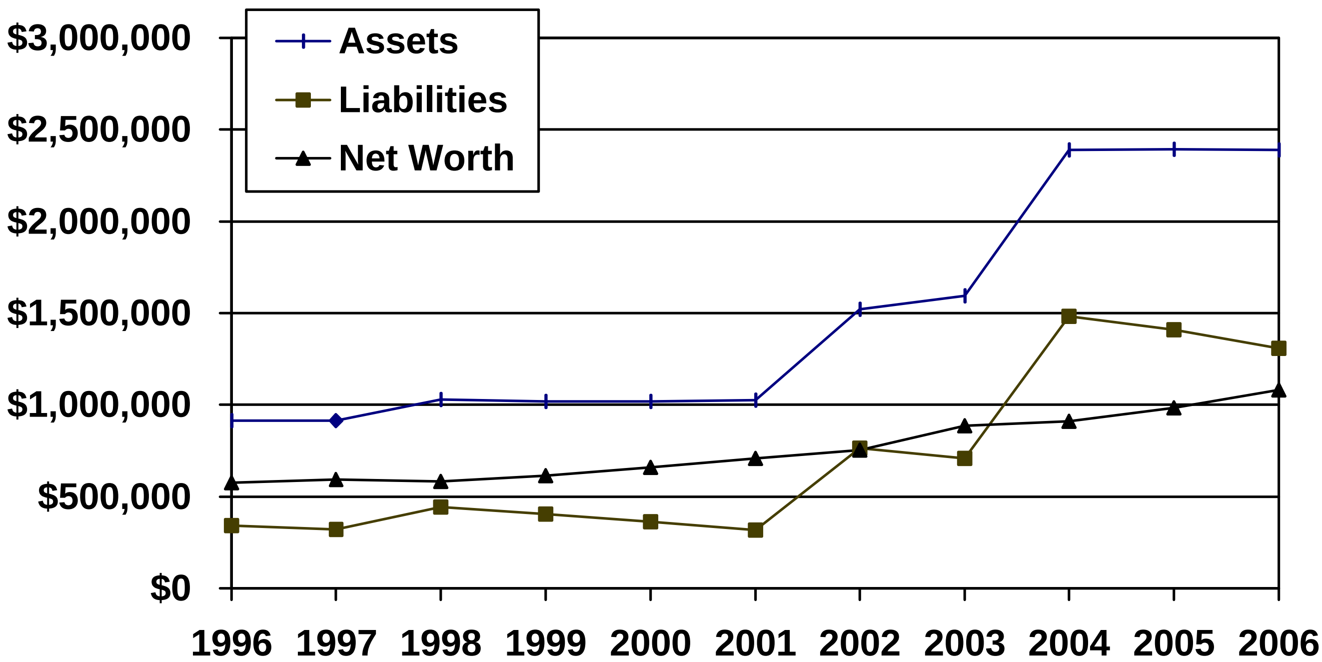

Exhibit VI. 10-Year Term Debt Coverage and Debt/Asset Ratio Projection.

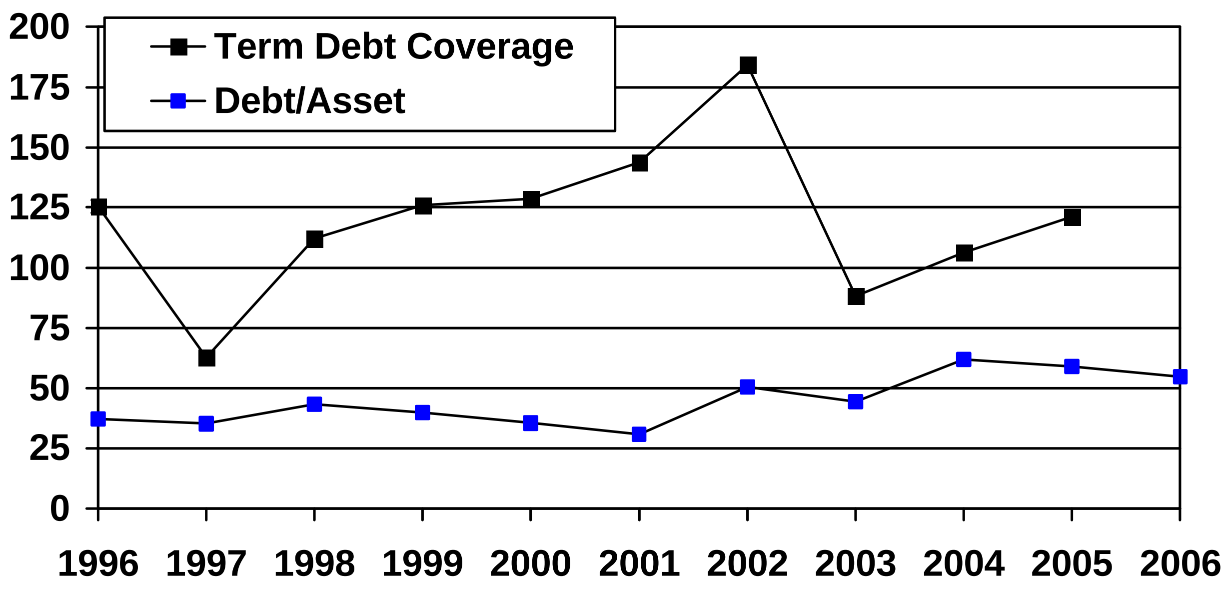

Exhibit VII. 10-Year Net Worth Change and Cash Surplus (Deficit).

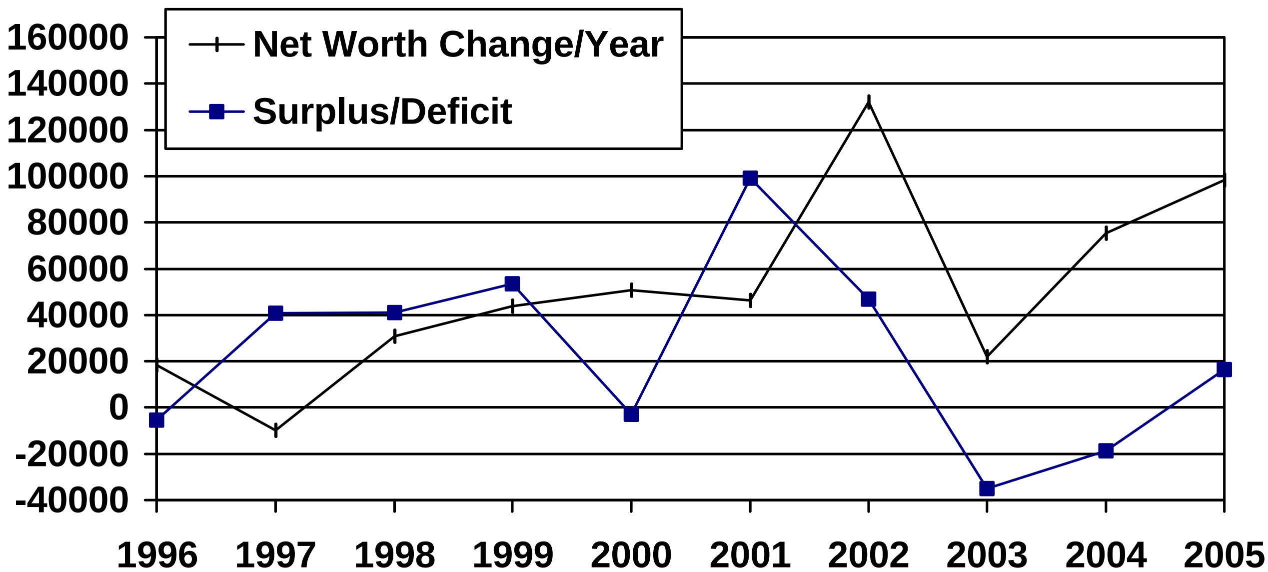

Exhibit VIII. 10-Year Breakeven Cost/Cwt. and Assets/cwt.

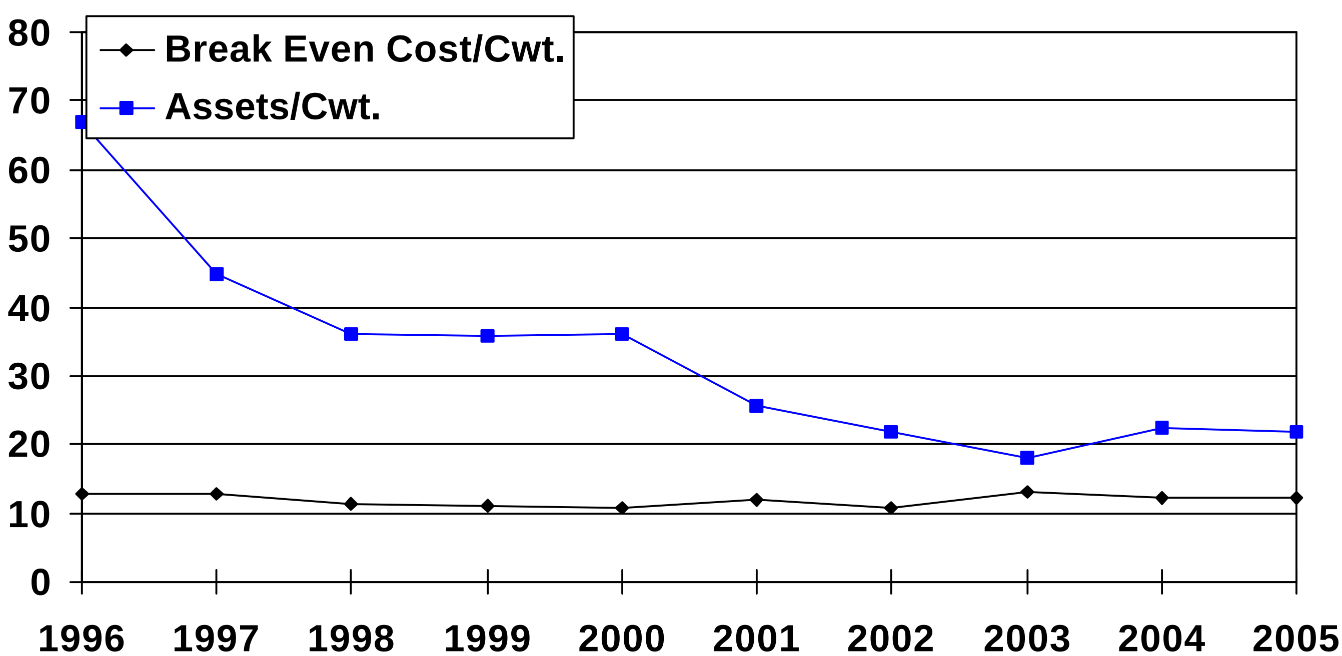

Exhibit IX. 10-Year Profitability Projection.

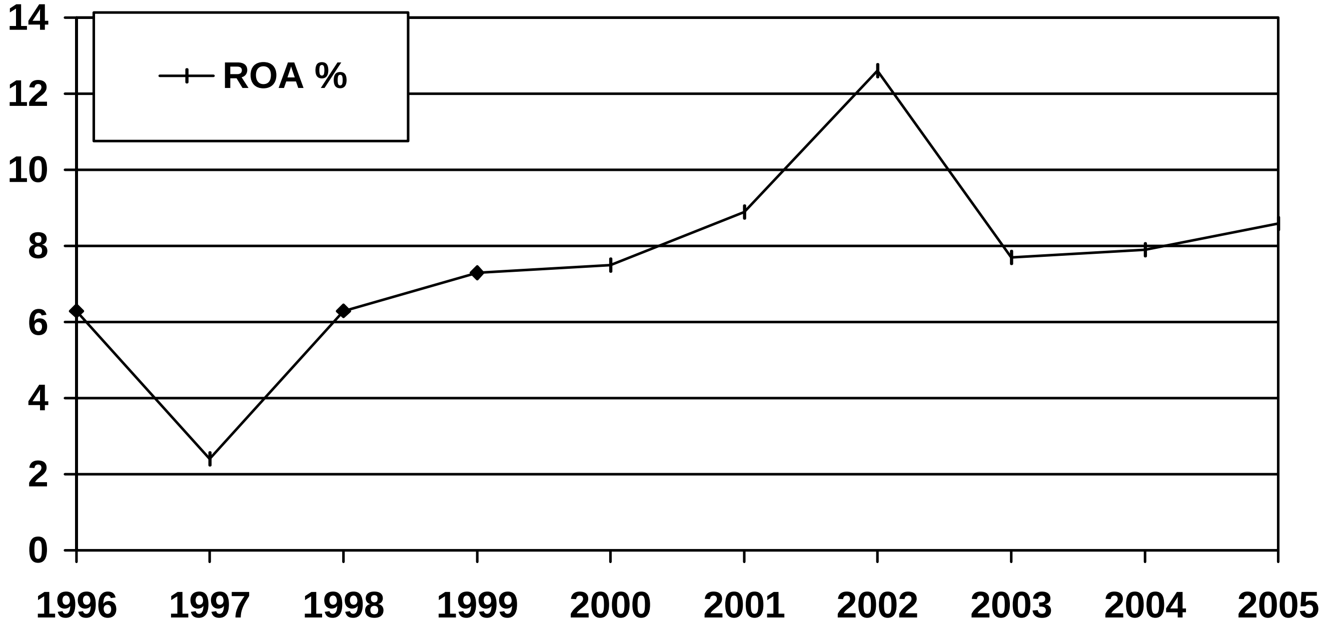

Exhibit X. 10-Year Efficiency Ratio Projection.

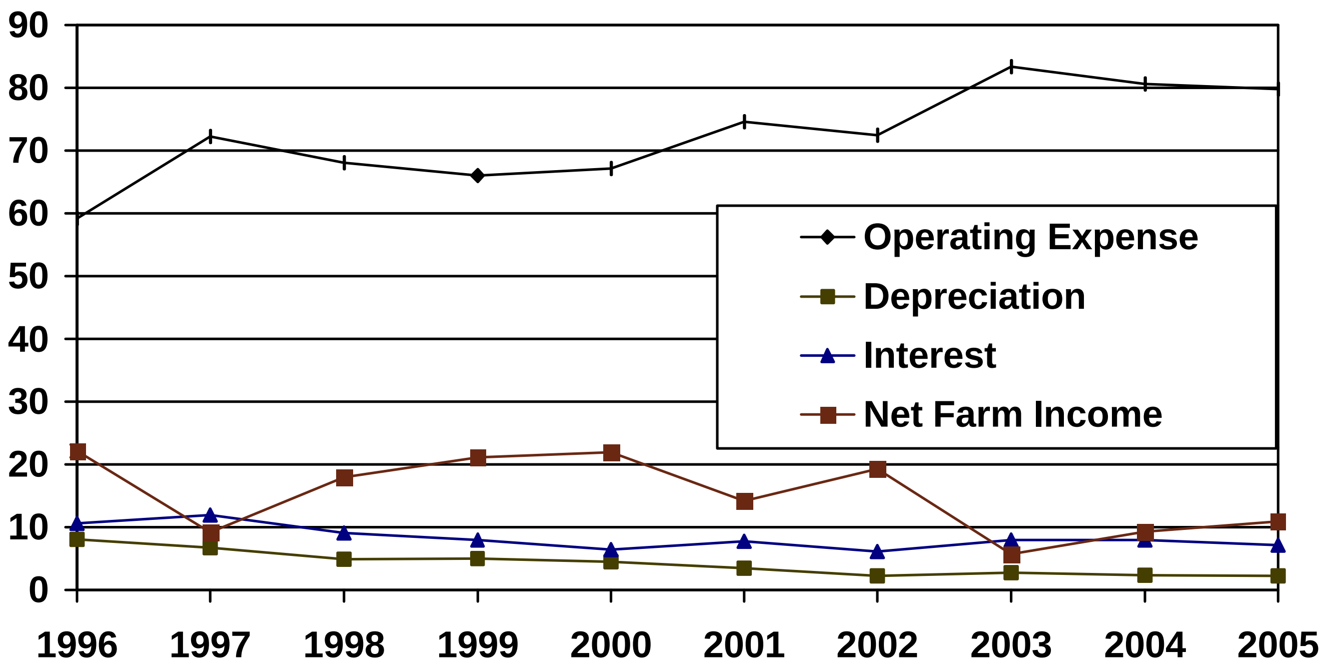

Exhibit XI. Summary of Soil Fertility Levels.

Farm	Field Number	1996 Crop	Acreage	Phosphorus	Potassium
Meyer	MI-1 & MI-2	Corn	16	Low	Medium
Home	H-1	Corn	19	Very High	Very High
	H-2	Alfalfa	24.5	Very High	Very High
	H-3A	New Seeding Alfalfa	30	Very High	Very High
	H-3	Corn	22	Very High	Very High
	H-4	Corn	14	Very High	Very High
	H-6	Corn	4	Very High	Very High
Riddle	R-1	Corn	7	Very High	High
	R-2	Alfalfa	8	Very High	Very High
	R-3	Alfalfa	8	Very High	High
	R-4	Corn	5	Very High	High
Opperman	OP-1	Corn	10	Very Low	High
	OP-2	Alfalfa	30	Medium	High
Griffith	G-1	Corn	18	Very High	High
	G-1A	Alfalfa	7	Very High	High
	G-2	Corn	14	Very High	Very High
	G-3	Bean	18	Very High	Low
	G-4	Alfalfa	10	Medium	Very High
	G-5	Corn	18	Medium	Medium
	G-6	Corn	20	Low	Medium

Exhibit XIV. Summary of Phosphorus Utilization by Growth Phase.

	Stage of Growth (Represented by number of cows)						
	65 (base)	**135**	**325**	**525**	**500** (BST)	**Difference** (525 - base)	**Difference** (BST – base)
Number of replacements	65	14	32	50	50	65	65
Crops (acres)							
Alfalfa	118	195	151	64	64	-54	-54
Corn	167	108	142	229	229	62	62
Soybeans	18	0	0	0	0	-18	-18
Total crop acres	303	303	293	293	293	0	0
Milk per cow, lb. (20yr simulated avg.)	21500	21500	21500	21500	22575	0	1075
Manure N over crop requirement, %	26	33	78	162	158	136	132
Manure P over crop requirement, %	55	88	191	318	312	263	257
Manure K over crop requirement, %	59	58	136	341	330	282	271
Soil phosphorus build-up, lb./acre	0.6	7.2	29.6	56.9	55.5	54.9	56.3
Phosphorus exported in milk and meat, lb.	1751	3194	7683	12405	12355	10654	10604
Phosphorus from manure and fertilizer, lb.	6440	8822	16164	23899	23480	17459	17040
Phosphorus removed in crops lb.	6244	6631	7488	7218	7218	974	974

Exhibit XV. Comparison of Phosphorus Mitigation Alternatives.

Mitigation Alternative	Success Score	Cost Score	Personal Values Score
Reduce phosphorus in ration	✯✯	$	☺☺☺☺☺
Modify cropping plans to use more soil phosphorus	✯✯✯	$	☺☺☺☺☺
Spread manure on neighboring farms	✯✯✯✯✯	$$	☺☺
Incorporate manure phosphorus deeper into soil (12-18 inches)	✯	$	☺
Find alternative off-farm uses for manure solids	✯	$ - $$$	☺☺☺
Transport raw manure to phosphorus deficient farms in other counties	✯✯✯✯✯	$$	☺☺
Purchase or rent more land	✯✯✯✯✯	$$$$$	☺
The sequencing batch reactor is one of several waste treatment systems and has the current attention of producers (Fad).	✯✯✯✯✯	$$$$$	☺☺☺☺☺
Addition of iron chloride or aluminum sulfate to form geologically insoluble phosphate minerals in settling ponds	✯✯✯✯✯	$$	☺☺
Install a sequencing batch reactor or similar municipal type waste treatment facility to control odors and process nutrients	✯✯✯	$$$$$	☺☺
Use BST to increase milk production per acre while lowering nutrients returned to crop land	✯✯	$$	☺☺

Exhibit XVI. Manure Application and Hauling Cost for Easement Land, 10-Mile Haul.

Herd Size	Hauling & Application	Fertilizer Value of Manure	Net Cost	Net Cost Per Cow
325 Cows	$12,525	$6,240	$6,285	$19.40
525 Cows	$25,683	$12,699	$12,984	$24.73

Exhibit XVII. Manure Volume and Phosphorus Estimates – DAFOSYM & MAP Comparison.

	Manure Volume (Tons/Year)		**Manure Volume** (Lbs./AU[*]/Day)		**Total Phosphorus** (Tons/Year)		**Total Phosphorus** (Lbs./AU[*]/Day)	
Stage	**DAFOS YM**	**MAP**	**DAFOS YM**	**MAP**	**DAFOS YM**	**MAP**	**DAFOS YM**	**MAP**
Base (65 cows)	2556		108		1.7		0.07	
135 cows	3774		105		2.9		0.08	
325 cows	9946	8648	115	100	7.2	6.9	0.08	0.08
525 cows	15342	13992	110	100	11.5	11.2	0.08	0.08
BST (500 cows)	15070		113		11.3		0.08	

[*] AU – Animal Units; Lactating Cows – 1.4 AU, Replacements < 1 year – 0.4 AU, Replacements > 1 year – 0.8 AU; Base – 130 AU, 135 – 197 AU, 325 – 474 AU, 525 – 765 AU, BST – 730 AU.

THE DAIRY BUSINESS AS A LIVING COMPANY

Author: Dewayne E. Dill, Ph.D., Senior Consultant, Dairy Strategies, LLC

The topic of dairy business viability has taken many different forms and has been presented with many different faces over the years. One popular aspect is that of succession planning, which deals primarily with taxation issues related to multi-generation business transfers. Another face of business viability is what has become popularly labeled as the sustainability paradigm. This issue addresses the need for the farming practices applied to a particular agricultural unit to be compatible with that unit's local environment. Another aspect of business viability has been largely a topic reserved for discussion by farm groups, academicians and politicians (3). It deals with the industrialization of agriculture and the related structural changes within the industry. At the heart of this issue is the role of public policy in driving the agricultural production unit towards vertical integration, market alignment, business consolidation and larger production units. While at the industry level this is often a topic of heated debate (4), at the farm level it has intensified the need for heightened business competitiveness. All of these issues are commonly understood and have been widely discussed.

Use of the words competitive and viable in the previous paragraph gives indication to the nature of the emerging dairy business environment. The word ***competitive*** implies presence of rivals where there are winners and losers. The word ***viability*** raises the bar even higher. A viable business is one that survives – an inviable one does not. A dairy farmer who chooses to remain in business must accept the fact that a successful business (7) future is not assured but rests in the business' ability to remain viable and competitive. As Sun Tzu wrote in his brilliant text (6), *The Art of War,* more than 20 centuries ago:

> *"If you know the enemy and yourself, you need not fear the result of a hundred battles. If you know yourself but not the enemy, for every victory gained you will also suffer a defeat. If you know neither the enemy nor yourself, you will succumb in every battle".*

This article is about knowing the dairy as a business and the characteristics that make the business viable. It is also about understanding the issues that will threaten the dairy's ability to compete.

The Living Company

Webster's New World Dictionary of the American Language, 2nd College Edition (1) defines viability as, "able to live; specifically, able to take root and grow". The reality of the notion of a business that is able to live, to take root, and to grow is not readily apparent. Its not until you look at the example of living companies that you come to understand what is meant. Riemon Soga founded Japan's Sumitomo in 1590 as a copper-casting shop. The Swedish company Stora began as a copper mine more than 700 years ago. Examples such as these provide evidence that a business can exist for hundreds of years, can survive the death of its founder, can endure many business cycles and can live through changing political regimes, depressions, wars, natural disasters, and new technologies and can continuously adapt to an ever changing business environment.

In his book, *The Living Company,* Arie de Geus (2) provides an analysis of the characteristics common to living companies. Though clearly not a prescription for success, these four "shared personality traits" could explain the longevity of these highly successful businesses.

1. **Conservatism in Financing.** Money in the kitty allows the business to govern their growth and evolution without needing to convince third-party financiers of the attractiveness of opportunities they wanted to pursue.

2. **Sensitivity to the World Around Them.** The business is good at learning and adapting. It manages for change.

3. **Awareness of Their Identity.** There is a sense of community shared by all employees of the business. There is a feeling of belonging and identifying with the organization's achievements. And everyone understands what are the family jewels and are fiercely protective of these.

4. **Tolerance of New Ideas.** A dairy business that survives more than a century, by definition, exists in a world it cannot hope to control. The company must be willing to change in order to succeed.

These shared personality traits of 27 of the longest-lived corporations in human history are not uniquely different from those of successful farm businesses. In fact, financial conservatism, awareness, community involvement, and innovation have long-been personal traits common to many involved in agriculture. It is in the application of these basic personal values to the dairy business where success most likely will be found.

Trait 1 – Conservatism in Your Financial Management

In the context of this discussion, financial conservatism is defined as retaining sufficient cash reserves to control one's growth and evolution. This begins with one's attitude regarding financial matters. However, it also includes an understanding of financial management and requires certain financial management practices.

Assets and profits are like oxygen: necessary for life but not the purpose of life. Understanding the relationship between assets, costs, and profits are key to understanding financial management. Return on Equity (ROE) is a key measure of how well management is maximizing the value of the business. Figure 1 illustrates how ROE can be used to both measure and manage financial performance. Return on Equity can be calculated by dividing Net Income by Equity. However, for the sake of financial management, it can also be calculated by multiplying together Asset Turnover, Net Profit Margin, and Leverage. By separating Return on Equity into its three components, the manager can directly manage the finances of the business.

Table 1 provides an example of this relationship for the decision case farm. It compares the ROE calculation for 1997 with the projected calculation for 2005. The ROE for this farm improves from a meager (though similar to average performance of agricultural businesses) 4% in 1997 to a more acceptable 15% projected for 2005. This improvement results mostly from improved asset turnover, which increases from 0.28 to 0.63. In practical terms, this means the assets used in the business are more productive in 2005 than in 1997. For example, more cows are being milked through the milking parlor. More cows are being fed with the same commodity feed center. And use of land in the form of manure disposal rights and feed purchases are being contracted rather than purchased. Thus, no additional land assets are being added.

Part of the ROE is also due to increased use of debt. This shows up as a change in leverage from 1.76 to 2.21. Increasing debt will increase ROE but at the price of increased risk. Net Profit Margin or changes in expense management are the least important to the proposed success of the decision case farm. As is often the case in well managed dairies where the costs of production are closely monitored, improvements in the financial performance of the operation following an expansion or business restructuring result more from improved use of assets than from significant changes in production costs.

Trait 2 – Awareness of Your Business World

The importance of using information to manage a dairy business has never been more critical. A living company knows the factors critical for success and is constantly monitoring and learning to identify trends that might threaten the success of the business. While there are many types of information that could and should be monitored, a few warrant special mention.

- Futures and Options. As milk pricing moves closer to a free market, increased priced volatility will result. Whether or not a dairyman chooses to participate in milk or feed contracts is not as critical to this discussion as simply being aware of expected movements in the market.

- New Technologies. We live in a time of unprecedented change. While this causes some reason for alarm, it also provides for significant opportunities. Some technologies will present a short-term competitive advantage. Whether the greatest rewards are to the earliest adopters or to the early imitators will depend on the technology. What’s important is that the managers of the business are constantly alert to new technologies and are eager to evaluate their potential to strengthen or threaten the viability of their business.

- New Markets. Biotechnology has just begun to open up new markets for some agricultural products. Most of these currently are in the agronomic side of agriculture. However, milk based products are currently being researched with some promise for the near future.

- Issues and Threats. Awareness of factors that could cause catastrophic business failure is perhaps the most critical issue to business viability. Topping my list of examples is bio-security. Johne’s disease is feared by some to be a potentially deathblow to the industry. Another example that is perhaps less contemporary but important nonetheless is Bovine Spongiform Encephalopathy (BSE).

In earlier times, business alertness required an emphasis on acquiring reliable information. Today, the information is readily available. The emphasis instead must be turned to filtering unnecessary or unreliable information from the vast quantity of information received. A three-step strategy is suggested.

1. Frequently browse a variety of information sources. This might include an Internet discussion group, some dairy publications, a Cooperative Extension Newsletter, and some supplier literature.

2. Assemble a management team that includes employees as well as various product and service suppliers. A qualified business consultant, independent of any product, can also be an extremely valuable source of information and counsel. Deliberately include in your expectation of each team member, an assessment of relevant issues of which you should be made aware. If necessary, make assignments that topics be researched and reports presented.

3. Actively participate in a peer-group. This is a group of fellow dairy-farmers assembled for the purpose of sharing and learning. Generally, product or service suppliers are included by invitation only.

Trait 3 – Employees as Your Human Community

Perhaps the most significant challenge to any growing dairy business is the transition from managing the dairy herd, to managing the employees and agri-service providers who care for the herd. The extent to which employees are cared for will largely determine how successful the dairy business will be. However, the manager of a living company has a responsibility to carefully assess the decision to add people to the business. While the business cannot promise a contract of employment for life, the business must recognize that people are to be valued above all else. A decision to hire one person is a decision to accept responsibility for the basic welfare of that person and his or her dependents.

Two practices are particularly relevant to shaping your human community. The first is organizing for learning. If your expectation is for a warm body to show up and do what you tell them to do, you will attract only someone so motivated. To attract someone with ambition and desire requires a willingness, even an expectation that the employee regularly experiments, tries new ideas, learns new skills, and has an opportunity for personal and professional growth. The rewards in such an employee are in a lightened managerial load and a source of new ideas.

The entire human relationship is built on trust. Where mutual trust exists between employer and employee, the employee will lighten the managerial load by risking to make decisions. Where trust does not exist, managing the performance of the employee becomes yet another responsibility the overworked employer must now accept.

The second practice is to share the rewards of the business to the entire community. If employees are treated as outsiders, their contract with the organization is to trade their time and expertise for money. People under such a contract generally do not give their all or feel much loyalty to the business. Many dairy operations yet today rely on family labor. These principles still apply. If the business is perceived to produce wealth for an inner circle, whether that's mom and dad, or dad and one son, or some other individual or group, to the exclusion of others, the ability of the organization to outlive its founders is seriously impaired.

Trait 4 – Change as your Growth Strategy

Many dairy operations today are assessing their business viability and evaluating strategies to regain competitiveness. These operations were quite successful 10 or 15 years ago but lost ground as the rules of the game changed on them and they continued as long as they could to ignore these changes. Some dairies that make a significant reinvestment into their business do so only to plateau again. As the remaining dairy businesses consolidate and grow, opportunities for a dairy to fall behind then to leap ahead by re-energizing the business by a fresh infusion of investment are quite slim. A dairy that hopes to remain viable must adopt a continuous growth strategy.

Most business planning today relies on static cash flows. However, in financial terms, a business strategy is much more like a series of options than it is like a series of static cash flows (5). At any one time, a business should have a variety of independent projects that represent opportunities for future growth. Some of these are dependent on considerable changes; others require few if any changes. Each project can also be evaluated by a value to cost metric. Figure 2 illustrates some hypothetical projects the Decision Case Farm could consider.

Treating these various projects as options allows you to assess which projects should be put forward for further evaluation. The real option methodology provides a means of evaluating the relative value of each project. However, the most important message is not the methodology for evaluation but the attitude to consider independent projects for continuous change and improvement as a necessary business strategy for long-term viability.

Its important to note that having projects under evaluation does not always mean change is necessary or appropriate. While living companies constantly test their environment and themselves to see if making changes is appropriate, they also know when it is appropriate to change very little and just continue doing what they do.

Conclusions

The dairy industry is undergoing significant structural change. Many dairy operations are evaluating business transitions that will reposition them to again become competitive. Business techniques characteristic of companies that have survived for several hundred years offer these dairies a reasonable opportunity to be viable for many generations.

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Figure 1. Measuring Financial Management using Return on Equity.

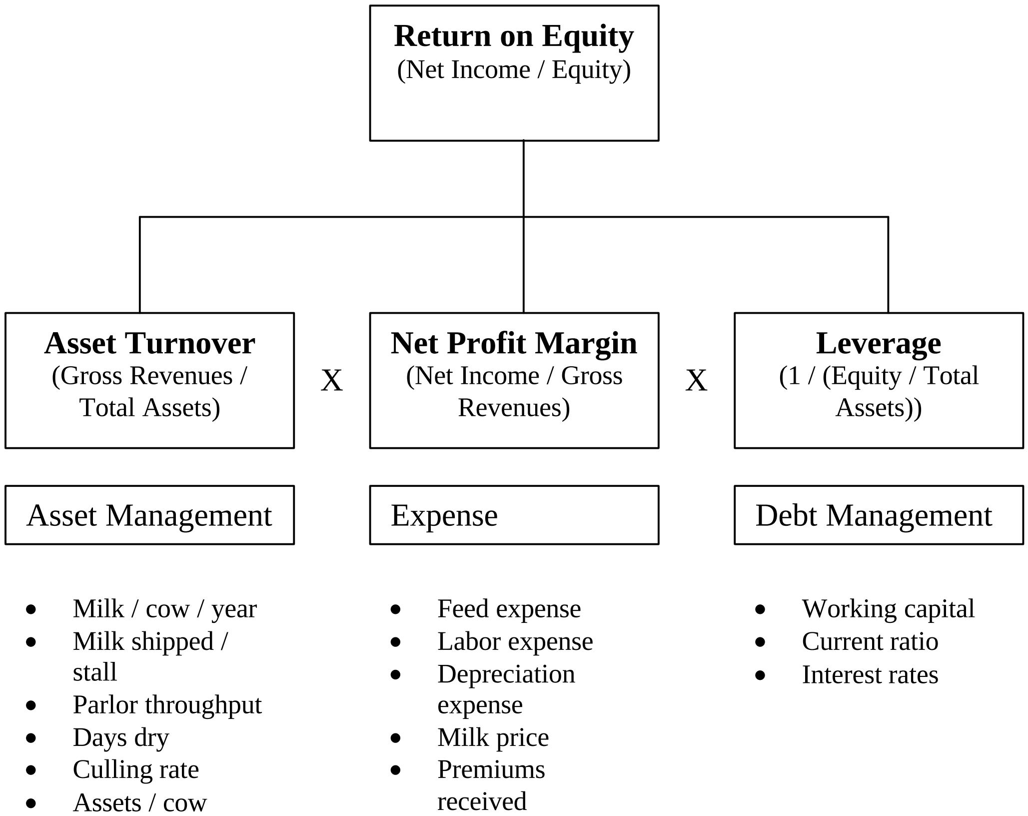
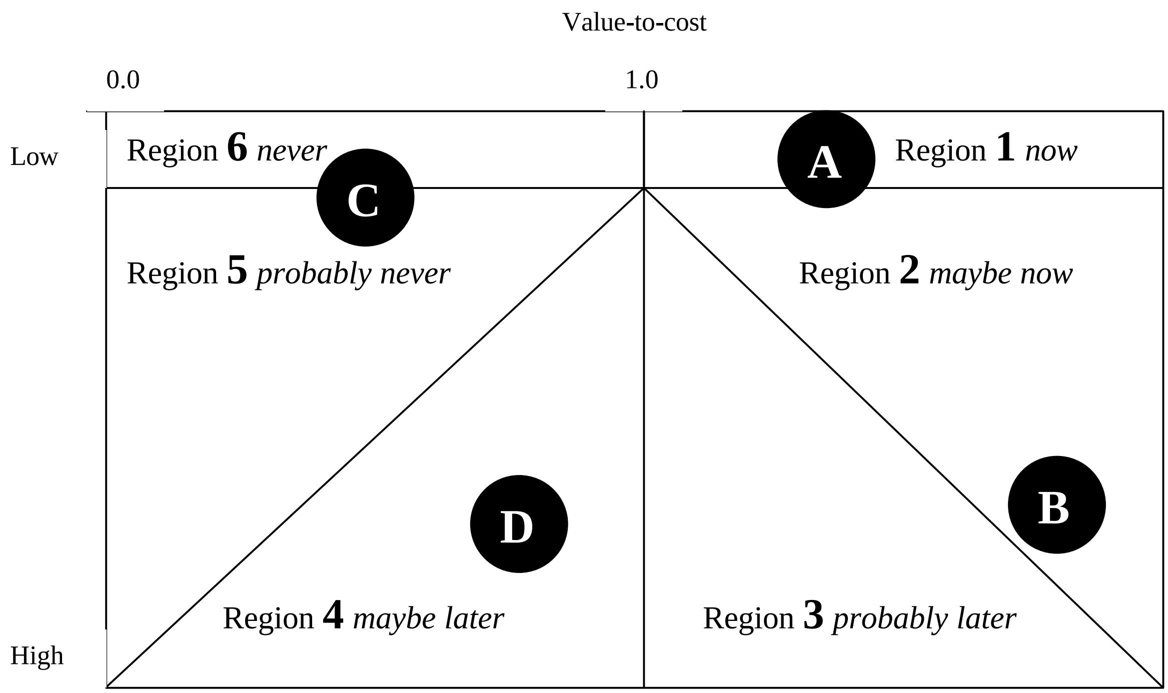


Table 1. Example of financial management measures for Decision Case Farm.

Financial Measure	1997	2005
Return on Equity	4%	15%
Asset Turnover	0.28	0.63
Net Profit Margin	8%	11%
Leverage	1.76	2.21
Gross Revenues	$284,800	$1,498,050
Net Income	$22,940	$162,740
Total Assets	$1,027,555	$2,390,927
Equity	$583,147	$1,082,482

Figure 2. Hypothetical investment projects for Decision Case Farm



Project	Project Description
A	Expand the manure lagoon. This decision must be made immediately and it has a positive value-to-cost analysis. Expanding the lagoon results in greater storage allowing less frequent manure hauling. These efficiencies have an immediate payback. This project is in Region 1, invest now.
B	Reduce phosphorus in ration. Improved feed efficiency and nutrient utilization while also reducing phosphorus load on the soil has a low cost investment and a high potential for return. Thus the value-to-cost evaluation is high. However, the time before this type of feeding regimen would be available is quite high. Nonetheless, based on its value-to-cost, this would be a project to explore further.
C	Purchase more land. Neighboring farmland is available for immediate purchase. The remaining time to make a decision is very low (the decision must be made immediately). The value-to-cost analysis shows this to be a poor decision. This project is in Region 6, invest never.
D	Switch to Jersey cows. This investment decision presently has a value-to-cost of less than 1.0. The time available to make a decision is quite long. It is possible this decision might become a profitable decision but there is value in waiting. This project is in Region 4, maybe later.

GROWING THE DAIRY BUSINESS[1]

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Decisions that worked in the past may not work any more. The dairy industry is in the midst of unprecedented change. The forces of change range from government policies, interest rates, and world trade agreements to consumer preferences, new technology, and social and economic needs of dairy families. Management is challenged to control those things that can be controlled and manage around those that cannot be controlled, and to know the difference.

Family economics and lifestyle needs and hopes are critical on-farm forces of change. Dairy profit margins have become slimmer while family living costs have risen. Opportunities for quality family time and for breaks in day-to-day routines to get away are growing more important to many families. There is no single recipe for success, but there are some key ingredients: planning, profit and a satisfying lifestyle. Success will ultimately be measured by the personal fulfillment and satisfaction of those having a vested interest in the business, but it will not survive long term without being profitable.

Dairy cows are the ultimate generators of profit in a dairy business. They are the primary income source for most farms producing milk. Modern genetics has made them capable of producing 20,000 to 30,000 lb of milk, some even over 60,000 lb annually. These are highly tuned converters of feed inedible to humans into highly appealing and nutritious food products. They are highly responsive to the right mix of inputs, feed, care and comfort. The business of producing milk is highly dependent on the efficiency of this conversion process. The wrong mix or an out of balance mix can have a devastating affect on performance, efficiency and profitability.

Many dairy businesses in the Northeast, Midwest and Mid-Atlantic, are highly profitable when compared to their competitors in the West, East, South, and elsewhere in the world. Many others have the opportunity to be more competitive by increasing efficiency of cow and herd productivity, increasing the efficient use of capital, tightening their control of costs, and marketing more milk per worker.

POSITIONING FOR THE FUTURE

A business not growing is destined to fail. Growth must ultimately be measured by the personal fulfillment and satisfaction of those having a vested interest in the business. Profitability of a business is a survival defining criteria. An unprofitable business will eventually die. Business growth requires a road map or plan, and proactive management with purpose and goals to work toward. Reactive management maintains the status quo by managing with a crisis/ fix-it

[1] Prepared for Systematic Approach to Dairying and the Next Millennium, 1999 Mid-Atlantic Dairy Management Conference, February 24-25, 1999, Camp Hill, PA.

management approach – this is a "don't fit it unless it's broken" approach where management waits until something breaks before they fix it.

Total Quality Management (TQM) is proactive, seeking for continuous improvement by: 1) determining what must be done, planning, seeking goals and taking action; 2) achieving, controlling and monitoring results; and 3) utilizing the efforts of oneself and others, implying importance of people and their role in plans and controls. A TQM approach focuses on getting results as opposed to just getting the job done. Dairy TQM must address the critical areas or profit centers for managing production, finances and people.

SIGNS OF A HEALTHY BUSINESS

Profitability: Returns on assets should be at least 6% but are healthier when 1.5 to 2% above prime interest rates. New investments need a greater return on assets than lending interest rates. Returns on equity (value of owned assets) should be greater than a CD or Treasury bill considering the risk of farming (6 to 10%). Profit is simply the difference between earnings and the expenses associated with generating the income.

Liquidity: Bills are paid on time and current assets are at least 1.25 times current liabilities. Working capital (Current assets – Current liabilities) is more than 25% of the value of farm production.

Solvency: Equity to asset ratio (Owned assets / Total assets) is greater than 60%. Ratios less than 40% are considered risky especially for a business with marginal profitability.

Financial performance/ efficiency measures: How well do the business assets generate revenue and how efficient is the production system?

- Asset turnover ratio (Value of production / Total farm assets) greater than 35%.
- Operating expense ratio (Total operating expense / Value of production) less than 65%; tells how much of each dollar is going to expenses.
- Depreciation expense ratio (Depreciation expense / Value of production) less than 12%. If 5% or less, you may not be investing enough in your business to be competitive long term.
- Interest expense ratio (Interest expense / Value of production) less than 12%.
- Net farm income from operation ratio (Net farm income / Value of production) greater than 20%; tells how much of each dollar is available for family living, to build equity (growth) and service debt.

Key Differences Between High and Low Profit Dairies

There are wide farm-to-farm differences in the economic and production performance of producing milk. A detailed comparison of high and low profit Minnesota dairies (Exhibit A, Tables 1-4, Minnesota Dairy Farms, 1996) reveals some important differences comparing the 20%

high profit dairies with the 20% low profit group. The profit groups are based on net farm income. This summary is based on more than 800 Minnesota dairy farms in 1996 from the Farm Management Education Program, Minnesota State Colleges and Universities. Some key differences highlighted from Exhibit A, Tables 1-4 include:

Profitability. Return on assets was 11.9% for high profit dairy farms while the low profit group had a return of .4%. This resulted in a higher net return of $3.43 compared to $-2.10 per cwt of milk. The high profit dairy farms had an Operating Profit Margin of 30.5% compared to 1.4% for the low 20% profit group. The net worth growth from 1995 to 1996 was $-4,331 compared to $78,002 for the low and high profit groups.

Production performance. High profit dairies marketed about 5,200 more lb of milk per cow and had larger herds (73 vs 54 cows per herd). Minnesota studies showed that with good cost control and balanced management, returns to labor and management increased by $0.30 to $0.50 per cwt of milk for each additional 1,000 lb of milk produced per cow. Milk and feed prices will affect this return. Dairy farms when compared to all farms had crop performance per acre yields of: corn grain, 113 vs 125 bu; soybeans, 37 vs 38 bu; corn silage, 14 vs 15 ton; alfalfa 3.2 vs 2.8 tons. Land rent paid was $56 per acre for dairy farms compared to $72 for all farms.

Price income performance. High profit dairies had an income advantage of $1.06 per cwt of milk marketed. High profit dairies received almost $0.43 more per cwt for their milk largely due to premiums for quality and other. Sales of cows and calves and animal inventory changes added $0.63 per cwt to the advantage of the high profit group.

Cost control. High profit dairies had a lower operating expense ratio – spending $0.66 to generate $1.00 of income compared to $0.83 for the low profit group. Total cash cost of production was $13.15 compared to $17.62 per cwt for the low profit group. High profit dairies had lower feed costs by $2.22 per cwt ($5.66 vs $7.88) for milking cows, lower other variable costs ($2.17 vs $3.10), and slightly lower overhead costs ($2.29 vs $2.45). Herd replacement costs were $2.08 vs $2.71 per cwt of milk in favor of the high profit group.

Family living and unpaid labor. The high profit group enjoyed an advantage of $7,299 more family living and non-farm investment. The average labor management charge per cwt milk for the high profit group was $.95 compared to $1.48 for the low profit group. The low profit group had $16,573 of non-farm income compared to $7,246 for the high profit group.

Capital use. High profit dairies had a lower debt asset ratio (34% vs 57%), with higher total assets and liabilities. The high profit group had higher investment per cow and about equal investment per cwt of milk. Debt per cwt of milk was $20 vs $31 to the advantage of the high profit group. High profit dairies also had a substantial advantage in the depreciation and interest expense ratios and years to turn over assets. Machinery and equipment investment on dairy farms was $344 per crop acre compared to $237 on all farms.

Herd Size and Production Costs

Are larger herds more profitable than small herds? The summary of all herds by profit level suggest large herds produce milk at lower cost and have a higher return than small herds. A breakdown of high and low profit groups within 6 herd size classes do not confirm this. This summary shows wide differences in the cost and returns in all the size classes from herds less than 30 cows to those over 200 cows. The summaries are based on costs and return per cwt of milk.

The highest average cost was for herds less than 30 cows ($19.30 per cwt) by a big margin and lowest for the largest herd group ($14.32) by a small margin compared to the other size groups above 30 cows. The spread between the low and high profit groups was greatest in the herds less than 30 cows, ($14.92 vs $19.30 per cwt) and this spread between profit groups tended to be smaller among the larger herds. Feed cost per cwt of milk ranged from $5.41 for the most profitable herds with over 200 cows to $9.42 for the low profit herds with less than 30 cows.

There was also much variability in the gross income per cwt, ranging from $12.61 per cwt for the least profitable herds with less than 30 cows to more than $17.50 for the most profitable larger herds. Milk price was only a part of this variability; just as important were the sale of culls and other animals, and changes in animal inventory from one year to the next.

The difference in returns per cwt between high profit large and small farms were relatively small compared to the larger differences between high and low profit farms within the size classes. Returns per cwt were negative for the low profit herds in all size classes except the largest. Low productivity, feed costs and change in animal inventory are major contributing factors to lower returns in all size classes. The profitability margins per cwt were similar for the high profit groups for all size classes except those with less than 30 cows.

The most significant issue is to market enough milk to generate the desired level of family income. Unprofitable farms have significant opportunity to enhance their profit level through improved management control and increasing productivity. Adding cows to an unprofitable dairy is seldom an effective strategy. The more profitable dairies are the best candidates for increasing family living through increases in cow numbers.

First Things First

Start with the end and most important. How much will you need to take from the business to support family needs, and life quality and living style aspirations: $30,000, $40,000, $50,000 or more? How much milk will you need to market to meet your goal? Begin by estimating the number of cows needed.

No. of cows = (Family living $ goal / Family living per cwt) / Production (cwt) per cow

As you plan your dairy future, start with budgeting the family living amount for each 100 lb of milk. Remember that you are setting performance standards for production per cow and controlling production costs to ensure that the budgeted family living margin will be available for each 100 lb of milk produced (Table 1). This helps to establish an initial target that may need fine-tuning in the planning process. Change the Midwest practice of taking what's left for family living by starting with it. The amount that Midwest farms draw for family living typically ranges from about $3.00 per cwt to nothing. Depreciation supports family living on many farms. Plan your growth with your end in mind. Many Midwest farms have unrealistic expectations of the income possible from the amount of milk marketed.

Table 1. Family living goals per cwt needed.

Total annual milk lb produced	Family living goal, $ per year $30,000	$40,000	$50,000
	----------------------- $ per cwt of milk -----------------------		
500,000	$6.00	$8.00	$10.00
800,000	$3.75	$5.00	$6.25
1,100,000	$2.72	$3.64	$4.54
1,400,000	$2.12	$2.86	$3.57
2,000,000	$1.50	$2.00	$2.50

CRITICAL SUCCESS FACTORS DRIVEN BY CRITICAL CONTROL POINTS

The critical success factors on a dairy farm are those areas that must go right for the business to flourish as a healthy business and achieve its goals. The critical control points are the management handles for controlling the critical success factors. Some examples include: management control points for controlling days open are days to first breeding, heat detection, and conception rate; for control of profitability the management handles are price, cost, and productivity. The critical control points are the handles which management can act upon to drive the success of the business. Successful managers have mastered the art and science of doing it right at the right time to control the most important processes efficiently and profitably. Figure 1 illustrates this system as managing a mix of biological, human, and financial inputs through standard operating procedures or management protocols.

The management protocols are written descriptions of the actions to be taken, when, and how; and the goal and minimum acceptable levels of performance. This is an approach to management borrowed from other industries being adopted successfully by many larger dairies. They are written in an operations manual, like a football playbook, that all the workers are expected to know. They provide the road map for training how things will be done to achieve greater consistency, from milking procedures to processing dry cows or new born calves. The priority protocols are those critical control points that effect the out come of the critical success factors.

"You can't manage it if you don't measure it, therefore measuring and monitoring the critical success factors and control points is an absolute must for executing management control. Performance measures provide signals for corrective action when compared to the standards and goals established.

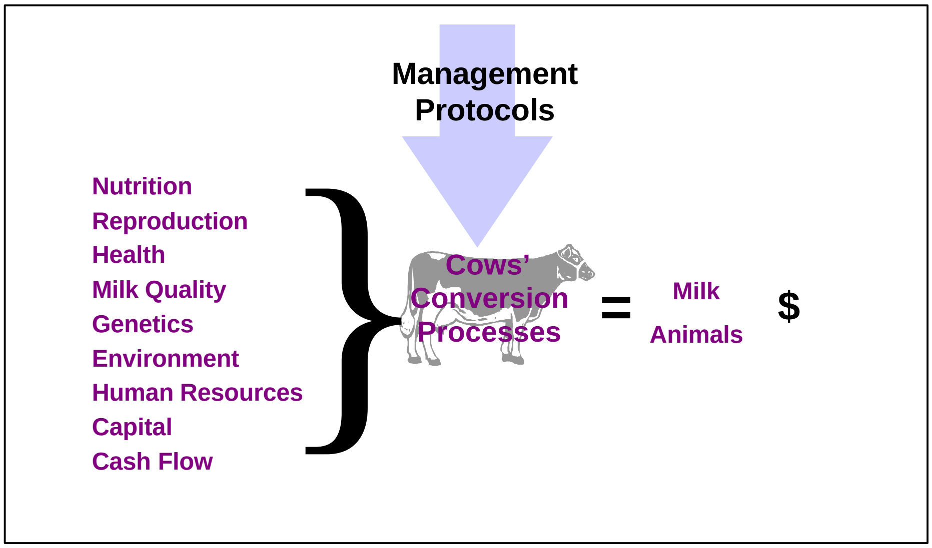

Figure 1. Management Protocols

STRATEGIES TO GROW THE DAIRY BUSINESS

What are the profit control levers of your business, how do you measure and monitor them, and how do you control them? The dairy profit equation is basic and quite simple:

Profit = (Price – Cost) x Volume

The three primary control levers to increase profit are 1) increase price; 2) reduce cost; 3) increase volume. The management challenge is to find the best balance. A change in price, cost or volume may affect one or both of the other profit components. Use the dairy profit equation to estimate the benefits and/or consequences of dairy decisions. Knowing your costs and returns and how they compare to similar businesses can be a powerful tool for continuous and competitive improvement. This is called comparative analysis or benchmarking. Knowing your strengths and weaknesses helps focus on the management factors that will make the biggest difference. Exhibits A and B provide profit benchmarks and insight into why some dairies are more profitable than others.

STRATEGY I: INCREASE GROSS INCOME PER CWT OF MILK MARKETED

Milk is a perishable product in a highly competitive national market and is highly sensitive to short range changes in the supply demand balance. The roller coaster ups and downs of milk prices have added a new dimension to management since the mid 1980's. This volatility has been very frustrating to many dairies while some have thrived on it. Federal government support price for milk is equivalent to $10.05 per cwt in 1998, and scheduled to move lower in the future. The support price is intended to serve as a price safety net. As the support price moved well below the average production cost, the market price has become highly volatile. This has led to some price stabilizing tools, futures and options markets, and milk processor contracts that set a price floor. Dairy lenders often encourage their use to stabilize income flows for meeting loan obligations.

Producers can control only 10 to 12% of the price they receive for their milk compared to their neighbors. Quality milk premiums can often make a dollar or more difference in the milk price. Milk is priced on a solids basis (protein, fat and other solids); therefore, high solids milk brings a better price per cwt. Producers need to balance quantity with percent milk component solids to maximize total returns. Some lucky producers have found ways to negotiate additional premiums/benefits such as hauling charges, volume premiums, etc.

Profit centers for income per cwt. High Profit dairies have higher gross income per cwt of milk marketed. They receive a higher milk price because of premiums for quality, etc. Greater income from animal sales and changes in inventory are important contributors to a higher gross income per cwt. About 40% of the difference in gross income per cwt was due to milk price; the rest was due to non-milk income sources (Exhibit A, Table 1).

STRATEGY II: COST CONTROL

The cost of producing milk on many Midwest dairy farms is out of control for both the variable and capital costs. Cost control starts with knowing your cost structure of producing 100 lb of milk. Tackle the cost components that are most out of line when compared (benchmarked) with other farms and to make the largest difference in your profit equation. Lowering the cost of production is a major opportunity for many Midwest farms to maximize profit.

Variable costs. High profit dairies send less to generate each dollar of income; \$.66 verses \$.83. Their total cash cost of production was almost \$4.50 less per cwt. High profit dairies had lower feed costs by \$2.22 per cwt (\$5.66 vs \$7.88) for milking cows, over other variable costs (\$2.17 vs \$3.10), breeding fees, health care, supplies, repairs, etc. Herd replacement costs were \$2.08 vs \$2.71 per cwt of milk in favor of the high profit group.

Capital Costs: High capital costs relative to the income generated are major deterrents to competitiveness for many dairies. Many diversified dairy farms typically have \$7,500 to \$10,000 invested per cow while milk represents their major source of income. Many farms have an opportunity to redirect their capital investments to leverage a greater return on their investment.

Efforts have been made at the University of Minnesota and elsewhere to estimate how some production management practices and corresponding measures of performance affect profitability. Table 2 shows comparative estimates of returns over cash expenses for a 75-cow herd producing 18,000 lb milk for five factors. The first five factors in the table show single factor effects on economic efficiency independent of changes in production. Most of the gains in economic efficiency are due to shorter calving intervals and lower mastitis infection levels. The mastitis infection level also represents a \$.30 per cwt loss in milk quality premium. The single factor values can help establish the relative importance with the feed and milk prices used. The relationships will change with changing prices. The combined effect of the five factors and the impact productivity has on returns is also shown.

Increased productivity from 18,000 to 22,000 lb per cow under average management lowered economic cost by \$1.87 per cwt (Table 2). The bonus for the same increase under excellent management was an extra $0.62 per cwt to lower cost by $2.49 per cwt. Table 2 shows the rewards of increasing productivity and excellent efficient production management combined to yield the largest rewards.

Table 2. Economics of management performance (*Example base herd: 75 cows; 18,000 lb/cow).

Management factor	From	To	$/herd/year	Ret. over cash cost, $/cwt	Economic cost/cwt, $
Mastitis (SCC)	400,000	100,000	+6,566	+.38	-.59
Age at 1st calving	27	24	+7,823	+.58	-.60
Replacement ratio, %	40	27	+4,006	+.29	-.63
Calving interval, mo.	13.5	12.5	+10,084	+.61	-.55
Calf mortality, %	20	5	+285	+.02	-.55
Combined change of above five factors			+18,260	+1.09	-1.49
<u>PRODUCTION</u>					
Average management	18,000	22,000	+20,789	+.97	-1.87
Excellent management	18,000	22,000	+26,842	+1.33	-2.49

* Base inputs: Milk $11.50/cwt; Corn $3.25/bu; SBM $240/ton; Hay $75-$90/ton; Cull cows $400/hd; Veal calves $25/calf; Investment/cow $5,000; Debt/cow $1,800; Equity 64%.

Feed cost typically makes up 45 to 55% of the cost of production, so it is one of the first places to look for cost control opportunities. Feed price is only one component of controlling feed cost, the others are also critically important. Good management control of the biological process of efficiently converting feed inputs into milk can impact feed cost greatly. Many herd management factors affect this conversion: production level, reproductive performance, length of dry periods, mastitis and animal health, age at first calving, and number of herd replacements; this is just a partial list. Other non-price factors that often contribute to high feed cost include feed spoilage wastage, unbalanced rations, and poor feed quality that limit intake production potential. The goal should not be to have the lowest feed cost but to maximize the return above feed cost. Quality forage is the basis for maximizing these returns.

Fitting Technology to the Production Level

Dairy technologies do not work the same for everyone. Many of today's technologies need to be used as part of a package of practices to be cost effective. Figure 2 illustrates this principle. Care needs to be used in choosing the combinations of technology that will yield the best payoffs.

Several management practices and some new technologies will be most cost effective when used to achieve higher levels of productivity from already high levels and be less cost effective for lower producing herds. Examples might include, milking three times per day, bypass protein, added fat, feeding three or more times per day, and use of BST. Use of DHI records, forage testing, balanced rations, mastitis control practices, and milking procedures must precede the use of many high technologies. Increased productivity is a major profit enhancing opportunity on a majority of upper Midwest dairy farms. Overcoming this profit constraint is a necessary first step to be positioned to make additional investments in the dairy farm business.

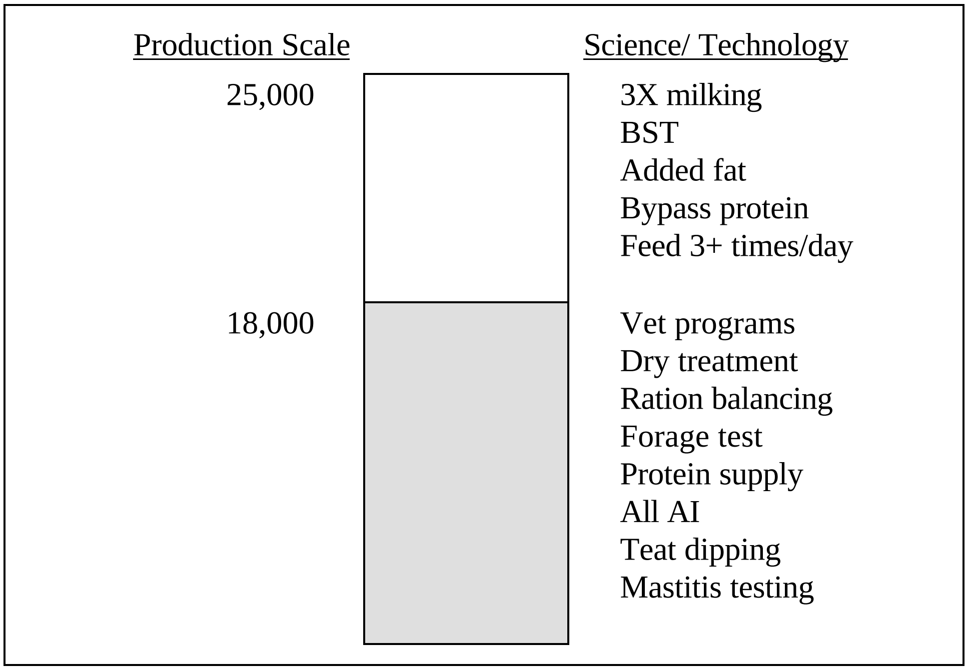

Figure 2. Fitting technology to production level.

Higher productivity is also a cost control strategy. More milk means more total revenue over which many of the costs can be spread and support family income. More milk per cow, per person, and per pound of feed indicates more volume of milk per unit of input, and are indicators of efficiency. Increased volume with no or small increases in input costs is an effective way of diluting costs per unit over more units to take advantage of scale efficiencies.

Summary: Critical Control Points for Controlling Costs Offer Major Profit Opportunities

Variable costs:

- "Be sure you know your costs."
- Make wise price buys of inputs and buy only what is needed.
- Establish a close cost monitoring policy especially for feed costs.
- Control the biological processes through high standards for animal health, reproductive performance, and a balanced mix of appropriate inputs.
- Use technology appropriately and be sure you are realizing its benefits.
- Control replacement costs with separate enterprising, moderate replacement rates, and calve at 25 months or less.

Capital costs:

- "Invest in assets having the largest return to capital and divest of lazy assets."

- Focus capital resources to yield high returns.
- Manage debt and risk wisely; avoid becoming overextended.
- Keep investments and debt levels in balance with income and cash flow.

STRATEGY III: INCREASE VOLUME OF MILK MARKETED

Marketing more milk means either increasing production per cow or increasing cow numbers. More milk means more total revenue over which many of the costs and family income can be spread. More milk per cow, per person, and per pound of feed indicates more volume of milk per unit of input and are indicators of efficiency. Increased volume with no or small increases in input costs is an effective way of diluting costs per unit over more units to take advantage of scale efficiencies. Gains from high production per cow are usually the best first offense because they can usually be made with relatively small additional costs. More milk per cow and cost of production are closely linked but not perfectly.

Production performance. Productivity is a major profit limitation in many dairies. Minnesota studies showed that with good cost control and balanced management, returns to labor and management increased by $0.30 to $0.50 per cwt of milk for each additional 1,000 lb of milk produced per cow. Milk and feed prices will affect this return. Increasing productivity will usually dilute the costs over more pounds of milk.

Cows are the sole generators of income and profit in a dairy business. Facilities, equipment, land, feed, labor, and all other resources are costs to support the cow's role of producing milk. Typically, upper Midwest dairies are overcapitalized having $7,000 to $8,500 assets per cow invested in cows, facilities, land and equipment while their dairy herd is their primary source of income. Increasing cow numbers with limited investments dilutes the investment assets over more cows and pounds of milk.

Dilemma of Growing Cow Numbers

Most Minnesota and Pennsylvania dairy herds are relatively small and in stall barns that have reached obsolescence. They are too small to be sustainable through the next generation. Finding a way to move out of the stall barn is a challenge for many wanting a long term, healthy and profitable future in dairying that will enable a quality life style. Modern freestall barns coupled with milking centers are more labor efficient, kinder and gentler on the backs and knees of milkers, are well ventilated, provide a healthier and more comfortable animal environment, are easier to adopt new technologies, have major scale efficiencies in investment per cow, and are more flexible for growth options in the future.

The dilemma many face is the lack of adequate capital to quickly modernize to freestalls and pit parlors to support a profitable size at tolerable levels of risk. Few have had experience or training in the skills required to manage these modern dairy systems. Moving out of the stall barn changes the way cows are housed, fed and milked. The move also affects routine work, purchasing feed, handling manure, using consultants, managing people, establishing control systems, and budgeting and forward planning. The skills of managing finances, production and people can be learned with commitment, study, experience and training.

Typically, dairies in our regions highly diversified, raising forage and grain crops for feed for the dairy. Dairy income is the primary income source while the invested capital, labor and management talents are diluted over several enterprises. Many farms can benefit from evaluating which enterprises are contributing most to their profitability and then reallocating their resources to those that contribute most.

Many of the already profitable dairies will need to increase herd size to maintain a competitive and viable dairy farm business. Increasing cow numbers in an unprofitable or marginally profitable dairy business has a poor chance for success. The profitability problems should be solved first.

Alternative Ways to Dairy

Many upper Midwest, Northeast and Mid Atlantic dairy farms are at a crossroads in trying to find better ways to reach their goals. The typical upper Midwest dairy farm is highly diversified in demands for capital, labor and management know-how. All of these resources are stretched so thinly that it is often difficult to compete. Farm families are looking for ways to work smarter, not harder and longer.

Options under consideration include grazing, expansion, use of consultants, net-working with other farmers, specialization, contracting, exiting the dairy business, surviving to retirement, etc. In 1994, a University of Minnesota study explored three alternative dairy production systems:

1. Purchasing all feed on minimum land base.
2. Raising forages and purchasing grains and concentrates.
3. Raising forages and grains to feed the herd.

The analysis was based on a new start-up dairy with the land and field machinery investment determined by the cropping plan. The systems were analyzed over a range of herd sizes from 138 to 828 cows. The dairy facilities, parlor, manure system, feed storage and housing were designed to meet herd sizes. Summary results are shown in Table 3.

Table 3. Economic performance comparison of three dairy farming systems.

	Herd size (stalls/cows)					
	100/138	200/276	300/414	400/552	500/690	600/828
Total assets, $/cow						
Purchase all	3,361	3,152	2,997	2,883	2,845	2,859
Raise forages only	5,393	4,831	4,590	4,447	4,402	4,410
Raise forages & grains	6,594	5,863	5,603	5,391	5,334	5,300
Return on assets, %						
Purchase all	2.5	9.9	12.8	15.6	16.8	17.5
Raise forages only	5.8	11.5	14.2	16.1	16.8	17.2
Raise forages & grains	4.7	10.0	12.4	14.3	15.2	15.5

University of Minnesota, 1994.

These estimates would be most representative of a new start-up dairy and may not be applicable to an individual farm or an existing dairy operation that is planning to expand. The results suggest some key points:

1. Dairying is capital intensive and there are substantial capital efficiencies gained up to 300 to 400 cows for all three systems. Gains are still realized beyond 400 cows but at a slower pace. These capital efficiencies are largely due to dilution of two large fixed cost items, the milking center and waste management systems. These costs are not increased greatly by increasing cow numbers.
2. Cropping machinery and the land base required to produce the herd feed supply add greatly to the capital requirements. Capital investment requirements are reduced by 15 to 20% for the option of raising forages and buying grains compared to raising all the forages and grains. The capital investment was further reduced by 40 to 45% for purchasing all feed.
3. Increasing returns on assets (profitability) demonstrates substantial scale efficiency. Returns on assets increased most up to 300 to 400 cows, then more slowly up to 800 cows. This was true for all three systems.
4. Profitability levels (return on assets) favored the two more highly specialized systems: purchasing all feed, and raising forages only. The more diversified the system of raising all feeds was, the least favorable relative to returns on assets but still acceptable at larger herd sizes.

Making the leap to a large full-fledged modern system is not feasible for many of our current dairy farm businesses. The availability of the investment capital needed to move out of the stall barn to a modern freestall system with pit parlor milking in one step requires a major investment of new capital and additional management competencies. These units have to be large enough to dilute a large capital cost with enough cows to be profitable. Milking centers with pit parlors and manure systems are typically the largest fixed cost items in these new systems. A 1994 Minnesota study showed 400 to 500 cows were needed to achieve an acceptable level of return on assets of at least 12%. Typically, the capital requirements for developing complete new units from the ground up are $1.5 to $2.0 million or $3,000 to near $4,000 per cow. This level of investment may be beyond the available loan capital and or the tolerance for financial risk for many dairy farm families. The Minnesota study illustrates the impact on the investment per cow if all crops and only forage crops are raised compared to purchasing all the feed.

Phasing the Growth Path

Growing a step at a time will make the most sense for many. The key to phased growth is to start with the end in mind. What will it be like in 5, 10 and 15 years? Make each step count — a building block toward your bigger plan. Plan carefully to avoid needing to discard new investments along the way. Leverage the use of existing resources where possible, but don't make the old and obsolete the center of your future. Site selection comes right behind planning for family, income and life style needs. Location of current facilities may limit the use of existing facilities. Site location may limit how existing facilities can be used in growth steps. Sometimes machine sheds or other non-livestock facilities can be converted for use. Growing the herd size in steps over time offers several advantages:

1. Provides a way for profitable dairy businesses with limited capital to grow and be more profitable.
2. Reduces risk.
3. Provides for growth and development of people to gain management competencies and confidence.
4. Reduces overall investment costs by paying a larger portion from cash flow as opposed to loan capital.
5. Less stressful on the owners and stakeholders.
6. Often provides a quicker pathway to reach owner and family goals of financial security and life quality.
7. Commitments and investments can be changed, redirected, postponed or terminated at any step with out losing the benefits of the previous step.
8. Allows for a greater portion of the increase in herd size to be generated from internal growth rather than purchased cows.

A Phased Growth Example

Peter and Mary Cary were just making ends meet, working hard and long hours, and barely maintaining their equity. They felt their hard work should have bigger rewards. Their son Jim just graduated from high school and was interested in farming. They had increased the production of their 65 cows from about 16,000 in 1992 to over 21,000 in 1995 with help from a dairy diagnostic team. They recognized they would be worse off if it wasn't for the increase in milk production. They gained a new level of confidence in what was possible and saw future opportunities with the dairy. Income available for family living had improved to about $22,000. This met their financial obligations, but they recognized that their savings for retirement and farm net worth were not growing to meet their retirement hope and support Jim's potential entry into the business. They would like to have some free time now and then. Their retirement dreams and keeping Jim on the farm were at risk if something wasn't done to increase income and ease up on the intensity of the work and the long hours. It was time to take stock of where they were and explore options. This took a lot of soul searching about what they wanted their future to be. Some key conclusions:

1. They valued farm life, liked cows, and hope to spend their retirement on the farm with Jim taking over if he chooses. Farm income needs to be increased to pay down debt faster, provide for retirement savings, increase amount available for family living to support a better life style, and make an opportunity for Jim if that is his long term wish. The target is $40,000 per year.

2. The long hours, intensity of the work, and lack of opportunity to get away now and then was getting old. Reducing the intensity of the physical labor, having more flexibility in getting more family time, and being able to get away now and then (at least two weekend milkings per month) are priorities.

3. The risk of not doing anything put their hope in jeopardy, but they were not about to put all they had accomplished at risk. Their debt to asset ratio was at 52%. They did not want to stretch that beyond 60% if they could help it. See key financial summary (Exhibit C).

4. They liked the cows and most of their income (95%) has been from the dairy. Besides, there wasn't any more land available to rent than the 140 they were now renting. Expanding the dairy made the most sense. They felt the long term future was in a modern dairy unit with freestall barns and a pit parlor for milking. This led them to setting their sights on growing into a dairy of about 500 cows someday.

They began exploring options that would help them reach their goals and be within their means and comfort zone. They developed a plan for growing the herd size over time in steps with the help of their County Extension Educator and Farm Business Management Instructor. The plan started with the end in 15 years, debt-free retirement, and a viable healthy dairy business that Jim or someone else could purchase at an appreciated value. The plan called for new investments to be supported with improved profits and minimal duplication of the investments in future steps, and the plan was flexible for keeping future growth steps optional. Exhibit B has a detailed summary of the financial profile of each step planned. A farmstead map of existing buildings is shown in Exhibit B, Figure 1. The planning horizon was 10 to 15 years (see Exhibit B, Figure 2). They had already accomplished Step 1, which began in 1992 at a time when they didn't realize there might be more steps to their future. In 1992, shorter term goals for improving their income situation were more immediate and pressing.

Step 1: 65 cows; focus on improving profit by making many management changes

The first step actually began in 1992. In 1991, they had a bad year. Family living was really sparse on the $10,967 from their farming efforts. The herd was averaging 16,000 lb per cow, they were making major family sacrifices to keep their loans current, and they lost equity. With help from the Extension Service, a Farm Business Management Instructor, and a Dairy Diagnostic Team they identified several short range opportunities for improving production and controlling costs.

Some of the major changes included regular forage testing, ration balancing, TMR rations, a mastitis control program, lowering age at first calving, dropping the dairy steer enterprise, and improving both the production and financial records. By 1996 production increased to almost 22,000 lb per cow, bills were paid, family living improved, and they had a new confidence about possibilities for the future.

Financial Snapshot 1996 (Before Step 2)

Farm Net worth $429,727; Debt to asset ratio 44.2%; Return on assets 2.4%; Repayment capacity 125%; Family living $22,000; Assets/cow $11829; Debt/cow $5,228 Cost per cwt $15.25 (see Exhibit C).

Step 2 (1997): 135 cows; flat parlor; convert two Quonset barns to freestalls

They recognized they needed to reduce their assets and debt per cow either by selling assets or by diluting the assets with more cows and more milk. The size of new capital investment needed for more cows was limited by their potential ability to borrow more capital and stay within 60% debt asset level. It was estimated that they could borrow an additional $255,000 for new investment. Can this new investment be used as leverage to make the whole business more profitable and contribute to their goals? Making this step work is crucial in making future steps to reach their goals.

The feasibility of five basic options was explored estimating the new investment cost and projecting the potential financial performance of each. Projections are based on 21,000 lb per cow and $12.50 milk price. Purchased feeds: corn, $2.75/bu; corn silage, $25/ton; hay, $85/ton; and soybean meal, $240/ton. The financial performance of each option was compared to the other options and with their current operation. All the options involved a double-4 walk-through flat parlor in the existing stall barn, with a holding area and special needs area. The parlor was to be raised to minimize bending and squatting. One person could milk 40 to 50 cows per hour in this parlor. The basic options explored included:

1. 80 cows; convert Quonset Barn A (see Exhibit B, Figure 1) to 50 freestalls and keep 30 in stall barn converting tie stalls to freestalls; continue raising replacements. Estimated investment: $62,000.

2. 100 cows; convert Quonset Barn B (see Exhibit B, Figure 1) to 80 freestalls and keep 20 cows in stall converting tie stalls to freestalls; continue raising replacements. Estimated investment: $91,000.

3. 135 cows; convert both Quonset barn to freestalls; use stall barn for maternity and special needs; sell calves and repurchase replacements. Estimated investment: $153,000.

4. 150 cows; build a new 150-cow freestall Some variations of these options were explored relative to continuing to rent the 140 acres now being rented.

The option that best met their goals was Option 3. Remodel the two Quonset barns to hold 135 cows, sell and purchase back the herd replacements, continue renting the 140 acres (318 acres total crops) but hiring the corn combined and selling the combine. The plan ranked highest on profitability indicators: return on assets, return on equity, operating profit margin, and return on the added investment. The plan met liquidity or cash flow requirements, increased family living, had a cash surplus after payments, and also met the 60% debt asset guideline with the highest estimated annual growth in net worth.

1998 Projected Financial Snapshot (Year After Step 2)

Net worth $435,304; Debt to asset ratio 49.4%; Return on assets 3.5%; Repayment capacity 112%; Annual family living $22,000; Annual net worth change $30,918; Cost per cwt $12.56; Assets per cow $6,516; Debt per cow $3292 (see Exhibit C).

Step 2 (1997) Investment Plan: $153,200; Sell Combine For $20,000

$24,000	Convert Barn A to 50 freestalls with curtain, outside feed bunk and manure scrape channel.
$20,200	Convert Barn B to 85 freestalls with curtain and drive by feeding.
$25,000	Convert stall barn to double-4 walk-through flat parlor, holding area and special needs area.
$84,000	Purchase 70 cows.

<u>*Operational plan:*</u>

- Heifer calves will be sold and repurchased prior to calving. The budget has provided for a 35% replacement rate with $55,000 provided annually for purchasing replacements.
- Additional hired labor is budgeted ($16,000).
- Existing manure lagoon will handle added manure but may have to be emptied more often.
- The stationary existing TMR mixer will be used.
- Continue with 318 acres of crops and renting the 140 acres; shift the crops to priority on corn silage and alfalfa to meet the needs of the dairy and the balance in corn grain.

Projected time to Step 3 is 5 years to pay down new and existing debt.

2000 Projected Financial Snapshot (Year Before Step 3)
Net worth $506,969; Debt to asset ratio 41.7%; Return on assets 5.8%; Repayment capacity 128.5%; Annual family living $22,000; Annual net worth change $50,648; Cost per cwt $11.88; Assets per cow $6432; Debt per cow $2677 (see Exhibit C).

Step 3 (Expected Time Line: 2001 to 2003): 325 cows; new freestall barn (200 stalls); estimated additional investment, $612,000

This step will require more capital. Options are fewer because new barn construction will be needed to further expand cow numbers. The site for the new barn and site for future expansion is on the high ground south of the existing stall barn. The site will be close enough to continue milking cows in the flat parlor, can be tied to the existing manure lagoon (expanded), is at least 1 mile from neighbors down wind, can be easily accessed by roads, and has space for further growth (additional barns, milking center, and feed center).

The estimated added investment for Step 2 is $612,000.

$225,000	New freestall barn constructed south of the current stall barn, 200 stalls.
$20,000	Site work preparation for new facility.
$30,000	Commodity and feed storage.
$13,000	Silage pad for storing bags, 4,000 sq. ft.
$45,000	Expand manure lagoon and connect to new barn.
$20,000	New skid steer.
$25,000	Purchase used payloader.
$25,000	New portable TMR wagon.
$209,000	Purchase 190 cows.

Loans: 50% intermediate and 50% long term.

The plan calls for 325 cows; up to 230 in the new barn, and 85 in Barn B. Barn A will be used for dry cows, transition animals and other special needs. The stall barn will handle maternity. Replacements will continue to be sold and repurchased. All corn silage and a portion of the hay forage to be raised. All grains will be purchased.

2002 Projected Financial Snapshot (First Year Of Step 3 and Year before Step 4)
Net worth $500,901; Debt to asset ratio 56.0%; Return on assets 9.7%; Repayment capacity 184.3%; Annual family living $35,000; Annual net worth change $131,951; Cost per cwt $11.67; Assets per cow $4,204; Debt per cow $2355 *(see Exhibit C).*

Step 4 (2003): New freestall barn (300 cows) and double 9 milking center

This step will take the herd to 500 cows with a new milking center with a double-9 milking parlor. Total added investment is expected to be $895,000, most will be long term loans.

$325,000	New freestall barn, 300 stalls.
$275,000	Milking center double-9 parlor.
$15,000	New well and water system.
$25,000	Additional site work.
$35,000	Expand manure system.
$10,000	Renovate existing barns for special needs.
$210,000	Purchase 175 cows.

2004 Projected Financial Snapshot (First Year After Step 4)

Net worth $825,649; Debt to asset ratio 66.3%; Return on assets 3.4%; Repayment capacity 106.3%; Annual family living $40,000; Annual net worth change $75,373; Cost per cwt $12.91; Repayment Capacity 106.3%; Assets per cow $4,412; Debt per cow $2,927, Cost per cwt $12.91(see Exhibit C).

2005 Projected Financial Snapshot (Second Year After Step 4)

Net worth $922,389; net worth change per year $98,326; Debt to asset ratio 63.1%; Return on assets 4.4%; Repayment capacity 121%; Annual family living $45,000; Cost per cwt $12.70; Assets per cow $4,259; Debt per cow $2,686 (see Exhibit C).

Projected Performance Timeline Through Growth

Exhibit C tracks the projected performance over the ten year period. The tightest cash flow years are the year after each step of new investment. These periods can be planned for with the expectation they are likely to occur. Good planning and communication with your lender will go a long way for finding a way through these periods of cash flow crunch.

A 2% annual depreciation has been factored into these projections of asset value, plus a discounted value of the new investments was carried on the balance sheet. The net worth is expected to match the asset value in the year 2012, meaning the loan obligations have been served.

<u>Summary of key principles:</u>

1. Each case needs to be tailored to fit the values and goals of the stakeholders of the business, and the human, capital and physical resources available.
2. Increasing herd size in steps is a powerful option for increasing dairy profitability, family living and management skills in the transition to modern facilities.
3. Planning the steps long range so each step is a building block to the next is key to avoid duplication of investment over time and plan each step with the next one in mind.
4. It is crucial that the early steps focus leveraging new investment dollars to generate as much cash flow and profit as possible.
5. The first step is the most difficult, it needs to be big enough to make a difference and within the owner's tolerance for risk. This step also usually requires adapting one's management to the new system.

6. Growing in steps is a risk-adverse strategy that can provide many profitable Upper Midwest dairies a way to modernize and grow in size and profit and fulfill life quality goals.
7. Plan with the end in mind.

Thriving in the future will require greater attention to detail than has been typical of many managers of the past. Careful scrutiny of all investments and vigilant cost control will go a long way in increasing the chances of success today and in the years ahead. Set your priorities on your Critical Success Factors and manage their Control Points. Know your strengths and weaknesses; leverage your strengths and minimize your weaknesses. Keep the end in mind on what you want from the business. Use the power of planning to chart your course and monitor progress. Your mission and goals will guide you in setting priorities and help you focus on targets along the way. These will be exciting times for those welcoming the opportunities and challenges facing them as they go about meeting their family and business goals.

PROFIT GROWTH GUIDELINES

1. *Know your critical success factors and their control points with your strengths and weaknesses of each*. Focus on what is most important and minimize your weaknesses and leverage your strengths.
2. *Focus on growing profits.* Herd size is just one of many factors affecting profitability. Many Midwest dairies need to position themselves first by correcting existing weaknesses and leveraging their opportunities. Many farms have major opportunities to strengthen their profitability with improved cost control, increased productivity, and eliminating or redirecting lazy assets or low returning enterprises.
3. *Invest in assets that generate the greatest returns.* Cows are an appreciating asset and the one that generates income in the dairy business from milk sales. Machinery and equipment require repair and maintenance, and depreciate rapidly – 12 to 18% per year. Buildings depreciate 5 to 7% per year. Land is a speculative investment that will probably appreciate with the rate of inflation.
4. *Investments made from cash flow as opposed to borrowed capital are much less costly.* An added $1,000 borrowed per cow at 20,000 lb milk will increase cost of producing milk by $.30 to $.40 per cwt.
5. *See the future as an opportunity.* Plan for success. Carry a positive attitude, an open mind, and a thirst for learning new things and taking on new challenges. Thinking, planning, communicating, negotiating, and leadership will be crucial to your success.
6. *Smell the roses and enjoy what you are doing.* Take time to cultivate the things that are really important to you and your family.

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EXHIBIT A

Minnesota Dairy Farms 1996

Table 1. Income, costs and returns for high and low profit dairies.

	Low 20%	Average	High 20%
No. of farms	161	804	161
Herd size (cows)	54	64	73
Production per cow, lb	14,639	17,428	19,812
Income			
Milk price	$ 14.56	$ 14.81	$ 14.99
Sale culls/caves/other	$ 1.03	$ 0.87	$ 0.86
Inventory change	$ (0.07)	$ 0.39	$ 0.73
Gross income per cwt	$ 15.52	$ 16.07	$ 16.58
Expenses			
Herd replacements	$ 2.71	$ 2.28	$ 2.08
Feed cost	$ 7.88	$ 6.54	$ 5.66
Other variable cost	$ 3.10	$ 2.50	$ 2.17
Overhead cost	$ 2.45	$ 2.28	$ 2.29
Labor mgmt charge	$ 1.48	$ 1.11	$ 0.95
Total Cost	$ 17.62	$ 14.71	$ 13.15
Net Return to Capital	$ (2.10)	$ 1.36	$ 3.43
Dairy enterprise return to capital	$ (16,601)	$ 15,169	$ 49,607
Percent income from dairy	77%	75%	68%
Net Farm Income	$ (8,105)	$ 38,502	$ 102,608

Table 2. Minnesota dairy farm balance sheet, 1996.

Farm Assets	Low	Average	High
No. of farms	147	705	104
Current	$ 47,630	$ 65,857	$ 135,567
Intermediate	$ 177,631	$ 297,944	$ 327,076
Long term	$ 202,282	$ 217,283	$ 319,909
Total Assets	$ 430,543	$ 491,084	$ 782,555
Farm Liabilities			
Current	$ 51,115	$ 42,271	$ 63,719
Intermediate	$ 82,848	$ 72,077	$ 96,892
Long term	$ 107,269	$ 100,061	$ 123,163
Total Liabilities	$ 241,332	$ 214,409	$ 283,774
Net Worth	$ 219,710	$ 315,903	$ 571,836
Net Worth Change 95-96	$ (4,331)	$ 23,623	$ 78,002

Source: Farm Business Management Report 1996, Minnesota State Colleges and Universities.

Table 3. Business performance measures, 1996.

Profitability	**Low**	**Average**	**High**
Return on farm assets	0.40%	7.40%	11.90%
Labor & management earnings	$ (12,051)	$ 26,666	$ 76,243
Operating profit margin	1.40%	22.10%	30.50%
Liquidity			
Current ratio	0.93	1.7	2.51
Working capital	$ (3,766)	$ 32,759	$ 82,903
Solvency			
Farm debt to asset ratio	57%	44%	34%
Farm equity to asset ratio	43%	56%	66%
Repayment Capacity			
Term debt coverage ratio	46%	140%	224%
Capital replacement margin	$ (16,187)	$ 11,321	$ 109,142
Efficiency			
Years to turn over assets	3.8	3.0	2.6
Operating expense ratio	82.50%	69.70%	65.90%
Depreciation expense ratio	10.30%	6.00%	3.70%
Interest expense ratio	11.80%	7.50%	5.20%
Net farm income ratio	-4.50%	16.80%	25.20%

Table 4. Dairy farm characteristics.

	Low Profit	**Average**	**High Profit**
Crop acres	284	329	537
Percent income from dairy	77	76	68
Acres per cow	5.26	5.14	7.36
Assets per cow	$ 7,973	$ 7,673	$ 10,710
Assets per cwt milk produced	$ 55	$ 44	$ 54
Debt per cwt milk produced	$ 31	$ 19	$ 20
Assets per acre	$ 1,516	$ 1,493	$ 1,457
No. of sole proprietors	59	309	48
Average family size	3.0	3.7	4.9
Total family living expense investments & non-farm purchases	$ 25,538	$ 26,851	$ 33,837
No. of farms	165	826	165
Average no. of operators	1.1	1.2	1.7
Average age of operators	42.4	41.6	39.6
Non-farm income	$ 16,573	$ 9,960	$ 7,246

Dairy Farms Compared to All Farms

	Dairy	**All Farms**
Machinery/equip assets per acre	$ 344	$ 237
Corn yield, bu per acre	113	125
Corn silage tons per acre	14	15
Alfalfa, tons per acre	3.2	2.8
Soybeans, bu per acre	37	38
Land rent per acre	$ 56	$ 72

EXHIBIT C

Example: Phased Growth Projected Performance Summary

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Herd Size, No. Cows	**65**	**97**	**135**	**135**	**135**	**192**	**325**	**423**	**506**	**525**
Family Income	**$22,000**	**$22,000**	**$22,000**	**$22,000**	**$22,000**	**$22,000**	**$35,000**	**$35,000**	**$40,000**	**$45,000**
Farm Assets/Cow	**$11,829**	**$7,875**	**$6,516**	**$6,440**	**$6,432**	**$4,554**	**$4,204**	**$3,405**	**$4,412**	**$4,259**
Farm Debt/Cow	**$5,228**	**$3,295**	**$3,292**	**$2,998**	**$2,677**	**$1,653**	**$2,355**	**$1,676**	**$2,927**	**$2,686**
Debt Asset Ratio %	**44.2**	**41.8**	**49.4**	**46.6**	**41.7**	**46.4**	**56**	**49.3**	**66.3**	**63.1**
Capital Invest	**$16,000**	**$153,200**	**$25,000**	**$28,000**	**$80,000**	**$445,000**	**$110,000**	**$850,000**	**$30,000**	**$25,000**
New Borrowings		**$153,200**				**$490,000**		**$800,000**		
Operating Loan Balance	**$5,413**				**$2,967**			**$49,263**	**$73,221**	**$62,344**
Return on Assets %	**2.4**	**-1.3**	**3.5**	**5**	**5.8**	**5.3**	**9.7**	**1.5**	**3.4**	**4.4**
Net Worth Change	**$18,347**	**$(9,859)**	**$30,918**	**$43,718**	**$50,648**	**$46,317**	**$131,951**	**$22,084**	**$75,373**	**$98,326**
Net Farm Income	**$51,160**	**$22,940**	**$63,702**	**$76,487**	**$83,401**	**$79,056**	**$181,412**	**$73,530**	**$134,804**	**$162,740**
Term Debt Coverage %	**125.4**	**62.6**	**112**	**125.8**	**128.5**	**143.8**	**184.3**	**88.4**	**106.3**	**121**
Surplus/Deficit	**$(5,382)**	**$40,828**	**$41,025**	**$53,495**	**$(2,851)**	**$99,068**	**$46,793**	**$(34,979)**	**$(18,746)**	**$16,331**
Capital Replacement Margin	**$12,527**	**$(17,770)**	**$8,633**	**$18,538**	**$20,475**	**$27,225**	**$96,045**	**$(18,808)**	**$12,815**	**$40,291**
Operating Expense %	**59.2**	**72.3**	**68.1**	**66.0**	**67.2**	**76.6**	**72.5**	**83.4**	**80.6**	**79.8**
Depreciation Expense %	**8.1**	**6.7**	**4.9**	**5.0**	**4.5**	**3.5**	**2.2**	**2.8**	**2.3**	**2.2**
Interest Expense %	**10.6**	**11.9**	**9.1**	**7.9**	**6.4**	**7.7**	**6.1**	**8.0**	**7.9**	**7.1**
Net Farm Income	**22.1**	**9.2**	**17.9**	**21.1**	**21.9**	**14.2**	**19.3**	**5.7**	**9.3**	**10.9**
Breakeven Cost/cwt Milk	**$15.25**	**$14.41**	**$12.56**	**$12.13**	**$11.88**	**$12.92**	**$11.67**	**$13.53**	**$12.91**	**$12.70**

Breakeven cost/cwt. includes all operating expenses, family living, taxes interest, and depreciation and adjusted for changes in inventory

LEADERSHIP AND THE ABILITY TO DIRECT THOSE PEOPLE WHO CARE ABOUT YOUR BUSINESS.

Author: Gary P. Snider, AAC, Farm Business Consultant, Farm Credit of Western New York, ACA

Preface:

Peter, Mary and Jim are highly motivated individuals. They have worked hard, struggled and pulled themselves up by the bootstraps and have tasted some impressive business success. When they start out the day, they do whatever it takes to "get the job done" with a high degree of accuracy. They will need to be able to accomplish the same degree of accomplishment through the management of others.

Perhaps their biggest challenge will be to reverse their roles from spending 80% as a laborer and 20% manager, to an 80% manager and a 20% laborer. One common theme folks who have expanded their businesses tell us; they wished they had put together their management team before their expansion instead of after. One well-known dairy farm manager in Western New York tells those expanding that they will have to give up the activities they enjoy most and start managing people instead of cows

I believe our friends will be able to measure their success and money available at retirement time by what degree they have taken on a leadership role.

We will attempt here to briefly outline procedures Peter, Mary and Jim should follow to build leadership skills and motivate a highly self-directed staff.

Quotation from *Citizen Soldiers*:

"In its search to the difficulties of hedgerow combat, the American army encouraged the free flow of ideas and the entrepreneurial spirit. Coming from a wide variety of sources, ideas generally flowed upward from the men actually engaged in battle." "It was the NCO, junior officers and the soldier in the foxhole, which made the difference. While these people were self-directed, senior German officers made no decisions awaiting Hitler's direction, everyone was afraid to awaken him on June 6, 1944 – The Fuhrer slept until 11:00 am." Stephen E. Ambrose, *Citizen Soldiers*.

Characteristics Needed by a Successful Large Farm Leader:

Peter, Mary and Jim will have to learn to delegate daily activities.

They will have to attract or train people who will be accountable for specific jobs or functions.

They can not afford to get bogged down with routine tasks, but they also need to be involved and visible in all daily functions.

I'm glad to see Peter is learning the numbers. Very quickly Jim will need to do the same.

We should expect them to rattle off the daily milk production, calving interval, and last month's cost per hundredweight. It must become routine for them to calculate the payback of every capital decision.

They should incorporate the use of helping devices to monitor the business to keep themselves and their employees up-to-date on production, efficiencies, and costs.

Peter, Mary and Jim will have to develop their organizational instinct. They need to practice organization like a religion. They should always be organized and demand others to be the same. Everyone in the organization will know what his or her next project is.

They should surround themselves with trusted professionals, those who get around and have a reputation for integrity.

They need charisma. This is hard work and they must work at it. They want their business to be the one the neighbor's employees visit on their day off. They'll know they have reached that level when they hear things like: "I'd like to be working on that team. I'd be able to do the jobs I can do best at that farm and be recognized for my abilities too".

Some Management Skill Qualities:

Peter, Mary and Jim will hopefully discover that delegation is a powerful management tool. It multiplies the manager's effectiveness. They will need to ask themselves, "Could and should this job be delegated to one of my employees?" If the answer is no, why is it? "I don't trust him." "It takes longer to explain what I want than it does to do it myself." "It feels good to do this job, I've always enjoyed ……" "It's not worth the hassle."

Whatever the reason for keeping jobs to ourselves and trying desperately to get them done alone, none seem to hold water when you watch a skilled manager in action who is skillful in delegating work. In fact, their efforts are multiplied by letting other people assume some of the responsibility. Others have become empowered. Delegate with style and grace. Be pleasant in your dealings. You spend more time with them than with your family! Work at making working relationships as pleasant as possible.

Empowerment guidelines:

- Be clear about assignments.
- Provide enough time.
- Provide sufficient resources.
- Monitor job underway. Be friendly and helpful. Communicate that you believe the employee will do his best once the assignment is understood.
- Provide feedback to let employee know whether or not they are on track. Stress the need for the work to be done correctly and precisely. Recognize the importance of following procedures and setting protocols for the business.
- Enlist key employees input when establishing protocols.
- Be generous with praise and be sure credit is given when credit is deserved. Use your monitoring tools to give feedback of success of employee's efforts.

Everyone needs a management team:

What is a management team?

Two or more that assumes major responsibilities in your business.

Why is it important?

No one is good enough to do it all themselves.

Few can afford the time to learn all the technology.

The margins will continue to get thinner over time as businesses further their competitiveness.

We all are getting older and need to accomplish more through others.

What expanding businesses have taught us:

Again, a common comment from our businesses that grew have told us they wished they had first developed a better management team before the new barns went up.

What it takes to make an effective management team:

Wise leadership. Responsible, motivated team members.

Another Quotation from *Citizen Soldiers*:

Speaking of the Ardennes, Stephen Ambrose writes: "Eisenhower's decisiveness and Patton's boldness were electrifying. Their mood quickly spread through the system. Dispirited men were energized."

Some Specifics on Motivating Employees:

As leaders, Peter, Mary and Jim will recognize that effective employee motivation will be their most powerful management tool.

Here are a few thoughts about motivation:

It does take practice. Sound funny? It's not!

Employees expect direction. Remember earlier we said that you need to be organized and expect others to be too? You've got to be out front to lead. Directions must be clear and workload distribution fair. You need a plan everyday and know what to do next.

The leader must be decisive and act like they know what they are doing. Peter, Mary and Jim will need to keep their knowledge base upgraded; yet the best employees will know more about some jobs than you do.

Attention must be given to the way you are dressed. Clean clothes and clean shaven face speaks volumes. Maybe extra clothing should be taken to work.

A wise leader will use people to help solve problems. You should be asking for input, praise input, and reserve the final decision. If you don't take their suggestions have a good reason and tell your people why.

Become a good listener. Questions and suggestions should always be taken seriously. Follow-up, use a daily business planner. Give plenty of feedback.

Never ignore non-performance, yet never throw tantrums or scream.

The Final Product:

The best-managed businesses have put together a team. That team will be a group of people with shared authority. There will be leaders of course, but the truly effective team will have people who really care. The leaders and the workers will have mutual satisfaction.

Characteristics of Effective Teams:

Peter, Mary and Jim's people will be attracted to their team. They will be loyal to other team members and to their leaders.
Both the members and our farm family will have a high degree of trust and confidence in each other.
The values and goals will be important to everyone. Everyone wins when common goal is achieved.
The team is eager to help new members develop their full potential.
There is strong motivation to communicate fully and frankly all the information that is relevant and valuable to the team.
The members of the team will feel secure in making decisions that seem appropriate to them.

Final Ambrose Quote:

"The American soldier won the battle." Says Ambrose about the Battle of the Bulge. "If victory was less than complete, the fault lay mainly in generalship's failure to seize fully the opportunities created by the valor of the men."

Suggested Reading:

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GROWTH REQUIRES CHANGE

Author: Tom Frey, Frey Dairy Farms, Inc.

History

In the 1930's Armor Frey, my grandfather, milked a small herd of cows and began marketing milk. In 1959 he formed two corporations and divided responsibility for ownership and management among his children. The milk processing and marketing business was known as Turkey Hill Dairy while his dairy farm was named Frey Dairy Farms.

In the mid-60's Jay Frey, my father, who had no involvement in Turkey Hill Dairy, initiated the building of new dairy herd facilities. The arch-beamed barn for 400 cows and double-18 herringbone parlor moved the herd to freestall housing. In following years additional barns were constructed to replace outdated barns and numerical growth of the herd continued.

In 1985 my father bought all shares owned by his 5 siblings to become the sole owner of Frey Dairy Farms, Inc. Two years later, in October of 1987, he died of cancer at the age of 54. Rather suddenly my younger brother and I were in the dairy business!

My Perspective

As I was growing up, my involvement in Frey Dairy Farms was very limited. The business employed numerous full-time employees and sizeable machinery. There were few jobs suitable for kids. When I graduated from high school I had no interest whatsoever in working on the farm or more schooling. Five years later, after I was married, I took a job working for my father.

Working for my father meant working with other employees. I learned as much, or more perhaps, about the hands-on aspects of operating a dairy farm from the older men that I worked with as I did from my father. The more difficult part was earning the respect of the men I worked with. At one point one of these older men told me that if I was ever the boss they would all quit!

While I enjoyed the work and got along well with my father, I grew discontented with the fact that there were so many family members involved in ownership. What's more, I questioned whether I could handle the responsibility of supervising other men. I decided self-employment would be better for me.

In 1981, after nearly 6 years on the farm, I pursued self-employment. For 2 years I worked successfully as a professional hoof trimmer. Then a series of circumstances led me to respond to the need, in our local church, for a full-time director of Christian education. During this period of off-farm employment, I began to realize the limitations I faced as I avoided working with other people. What's more, I began to discover I had potential and the desire to organize and lead.

Meanwhile my father was given the opportunity of full ownership of the dairy farm operation and invited me to return. I gladly returned -- but had no idea what lay ahead!

Under New Management

As the sole owner of Frey Dairy Farms, my father ventured somewhat unprepared into unknown territory. Bookkeeping and payroll, which had always been managed by his older brothers (who owned and operated Turkey Hill Dairy), then became our responsibility. While my father, brother and I knew we would be taking on more responsibility and authority, we had not planned how to divide this responsibility and authority among us. During this period of uncertainty my father discovered he was dealing with cancer.

At this point we could have taken several courses of action. What prevailed was our desire to continue to operate Frey Dairy Farms as a growing business. The need for stabilizing change was urgent.

Why Grow? Why Change?

When we talk about growth on a dairy farm most of us think first of an increase in the number of cows in the milking string. And, obviously, that is one kind of growth. But there are many other kinds of growth. Growth can mean improvement in any one of many areas of dairy management. Milk production, herd health, financial and business management, forage quality, soil conservation, nutrient management, labor management, and quality of life are just some of the many areas for growth on the typical dairy farm. If there is no growth on a dairy farm, it will soon be dying.

Change can be good. Change can be bad. How it's accomplished can be as important as the results that are brought about. Change for the sake of change, or with no resulting improvement, is a waste of effort and resources. If you do the same things, you'll get the same results. If you don't like the results of what you're now doing, change is the only alternative. Change can be difficult. But not changing can be more difficult.

Change In Mind Set

The task of getting our business organized and moving fell to me. Because I felt so inadequate I began looking for help. That was probably what saved me from being overwhelmed in my early days of exercising leadership. I started with a management consultant that taught me the basics of structuring ourselves and our employees, the value of clarifying job descriptions, and helped me implement the plan we developed. Now, with some years of experience behind me, I've gotten a better grip on the role I must fill to keep our business growing. I've found there are three major areas on which I must stay focused if Frey Dairy Farms is to continue growing.

A. I must be growing in my ability to give leadership
B. I must build and maintain a capable and loyal team of employees
C. I must find and use good information

Without a doubt it is more fun, and more rewarding in the short run, to go out and get involved in the physical work. I do some of it. But to keep our business on track I must discipline myself to give attention to these critical needs.

Moving On

Fortunately my father had adequate time to plan a smooth transfer of Frey Dairy Farms to the next generation. And now, looking back, the years immediately following my father's death progressed fairly smoothly, were relatively uneventful, and remained profitable.

Some of the most significant changes during those years were:

1. Hired a management consultant to guide us in:
   a. Structuring our staff
   b. Developing job descriptions
   c. Establishing our compensation plan
   d. Writing a Buy and Sell agreement
2. Change of accounting firms
3. Bought our first computer for accounting and payroll
4. Hired a crops consultant
5. Developed written procedures, policies, employee handbook
6. Developed a plan to build a new milking parlor and new barns to house the milking herd

In 1992 my brother made the decision to leave employment and triggered the implementation of our buy and sell agreement. At the same time we were constructing a new, 600 cow freestall barn. These two events in the same year forced more significant changes. Not only was there the impact of increased debt but the exit of my brother left our crops men without a leader.

Some of the most significant changes since 1992 were/are:

1. Increased the milking herd from 750 to 1000+, went from 3X to 2X
2. Sold peripheral real estate
3. Refinanced
4. Cropping
   a. Quit raising alfalfa, started corn silage based rations for milking cows
   b. Hired custom operators to do all tillage, planting, mowing, drilling, etc.
   c. Hired custom harvester
5. Heifer calves sent to a contracted grower and returned at 5 months old
6. Manure management
   a. All slurry spread by contracted hauler
   b. Flush cleaning, separating, and recycling water in buildings built since 1991
   c. Using pulse irrigation to apply waste water at a slow rate

7. Hired two top-notch middle managers
8. Milking is done by Spanish-speaking men
9. Upright silos removed, primary storage is a blacktop pad
10. Currently constructing another 600+ cow freestall barn and a new milking parlor for use beginning early Spring, 1999

MANAGING CONTRACT HEIFERS – A WESTERN U.S. PERSPECTIVE

Author: Roger A. Cady, Extension Dairy Specialist, Washington State University

Transition and specialization are two by-words that characterize the U.S. dairy industry. Dr. Michael Boehlje, Center for Agricultural Business, Purdue University, no longer uses the word "*farmer*" to describe those people actively involved in producing undifferentiated food (i.e. wheat, milk, apples, etc.). Instead he uses the term "*grower*". The reason is that the word "farmer" carries a specific connotation and creates a distinct picture in the mind's eye of a particular type of activity. As we look forward to the future of agriculture, that picture (paradigm) is no longer sufficient to portray the needs and skills that will be required of successful managers in the future food production system in the U.S.

Instead of trying to lecture and convince everyone of his statement, Dr. Boehlje challenged participants at the recent National Conference for Management Educators of Agricultural Audiences[1] to identify the farmer in the following true scenario:

Sam the Potato Grower

Sam is a potato grower who last year sold $2.3 million dollars of potatoes to Simplest. Simplest advance contracts potato purchases from growers who agree to meet specific standards for quantity, uniformity, size, blemish score, texture, and other quality issues, prior to potato seed ever being planted. Sam does not own the land on which his potatoes are grown. Sam does not live within 500 miles of where his potatoes are grown. Sam does not own any machinery except the plane he pilots to his potato fields once a week. Sam does not do any of the manual labor, nor does he have any employees except the receptionist at his office in the West Coast City where he lives. Sam leases the land, hires contract labor, hires custom planters, custom fertilizer applicators, and custom harvesters. The only resources Sam "owns" are his knowledge of how to grow potatoes, a $3 million line of credit, and a $2.3 million contract to sell potatoes, and his ability to manage and control resources for the purpose of growing potatoes.

Who is the farmer in this scenario? Is Sam the farmer? Is the landowner the farmer? Is he one of the various custom machine operators? What really exists in this scenario is a food production system without a farmer, as we have traditionally defined a farmer. A farmer is thought of as a person who owns all the resources and provides all the labor required growing undifferentiated food commodities. In the manufacturing world, this is the equivalent of a craftsman who builds watches from scratch, by purchasing raw product, designing the products, machining parts, assembling, and marketing the product, while also doing the bookkeeping, and taking orders, as a single self-employed individual. While there is a niche market for this type of manufacturing, it is no longer a sustainable method for marketing large quantities of a product.

They key paradigm shift in moving from being a farmer to being a grower is to become a manager of resources, instead of an owner and provider of resources. Because farming has always been looked upon as a way of life, attracting some, driving others away, agriculture has not moved to this form of management to the degree that manufacturing, merchandising, and service industries have. However, the reality of regulations, economic demands, and societal pressures, is transforming agriculture, however reluctantly, into a food production system with specialists all along the way. The success of the system will depend on how the specialty service and resource providers learn to interact with each other, with each focused on the overall goal, while contributing their value-added portion of the system.

What Do Potatoes have to do with Producing Milk and Heifers?

What does this have to do with dairy you may ask? Everything is the answer, because the dairy industry has been moving toward the "*Sam the Potato Grower*" production model ever since the close of World War II. World War II is a landmark event for agriculture because it provided at least two massive contributions toward moving all of agriculture toward specialization. The first was the development of plant capacity and deep-pit-mine nutrient sources to produce inorganic fertilizer. The demand for this capacity came from the need for gunpowder. Fertilizer manufacturing is what filled the empty gunpowder production capacity when the war ended. The second contribution was rural electrification. The demand for power came from the need to process aluminum ore for use in airplane manufacture. Once demand for aluminum diminished and federal funds were freed from the war effort, rural electrification moved forward rapidly. Thus inventions like refrigeration and mechanical milking machines, which had languished, unadopted for decades, became ubiquitous hallmarks of an emerging dairy industry.

The effect of this transition on the U.S. dairy industry has been dramatic. The first step toward specialization was to separate crop farming from animal farming. Dairy farms are defined as those farms, which derive over 50% of their gross farm income from the sale of milk. While there were hundreds of thousands of farms in the U.S. that had dairy cows during the Great Depression, there were few dairy farms per se. The first significant count of dairy farms was in the early 1950's and even then, only about 20% of the nation's dairy cow population were on dairy farms. This is an indication of how diversified farming was as little as 50 years ago. Today, virtually all dairy cows reside on dairy farms or at least specialized dairy enterprises within in very large diversified farm corporations.

Thus, the result of this first step toward dairy specialization was to have crop farmers grow grain, which was in turn purchased by the dairy farmer. Today the progression toward further specialization is being driven by the need to take advantage of scale and size and has expanded to the point that many dairy producers no longer do much more than feed and milk cows. In fact, that is a misnomer, because often the owner/manager never sets foot in the milking parlor. The list of services that a dairy producer can contract out includes:

- Grain production
- Forage production
- Manure disposal
- Health services
- Heat detection and AI breeding services
- Unionized milking parlor labor
- Ration balancing services
- Animal purchasing

- **HEIFER GROWING**

Today, it is possible to find milk production units in which the only resource owned by the dairy producer is the milking parlor and a couple of tractors, and perhaps the ground on which the cows reside and the milking parlor is built. Milking parlors are viewed as the harvesting mechanism for milk, and thus the only income generating resource besides the milk manufacturing plant (cow). Thus, to maximize income, parlor utilization must be maximized. Parlors are now built and sized to operate 24 hours around and expected to last 10 years, at which time they will be fully depreciated and worn out and need replacing. Everything else is organized to feed that milking parlor in an efficient manner. If a contractor can do support tasks better, or cheaper, or more efficiently, than the dairy producer, than those functions are often contracted out to free up resources to be devoted to the cows and milk production capacity of the production plant.

Heifer raisers have been around for years. Historically they have been people who owned a few heifers as a side venture to make a few extra bucks from vacant buildings or idle pastures. Now though, as market policies, economics, technology, and regulations continue to pressure the dairy industry toward larger more specialized farms, heifer growing is becoming a specialty within the industry, just as feed grain cropping and forage cropping has before it.

A USDA NAHMS study in 1991, published in 1994, by Jud Heinrichs of Penn State estimated there were less than 2% of heifers in the U.S. grown by custom growers. Today, unofficial estimates range between 10% and 20% of heifers are grown by custom growers nationwide; with some states having up to 30% of heifers grown off-farm. While the greatest number of custom grown heifers and growers are in the upper Midwest, the western states tend to have a higher percentage of heifers grown under contract. However, the fastest growth area is the upper Midwest.

There are several pressures causing the growth of the heifer industry. One is the expansion of dairy farms. Because heifers are viewed as an expense, and not an investment, bankers are loath to loan money for heifer facilities to new dairy expansion projects. Also, as farms specialize in milking cows, owners and managers are recognizing that in some cases someone else may be able to a better job raising their heifers. Capacity for the heifer grower industry has been created because of the vacated dairy farms and feedlots. There are many semi-retired dairy farmers and feedlot owners looking for an opportunity to make use of their skills and facilities. Another factor contributing to the growth of the heifer industry is environmental protection. As states and the federal government enact more rigid environmental protection laws, there is advantage to reducing animal density on a fixed land base. Moving heifers off-site allows greater income per unit of land owned by the dairy producer and reduces nutrient loading on the soil and exposure to pollution liability.

In order to survive as a sub-industry to the dairy industry, contract heifer growers need to establish various norms and standards and come to a common understanding of what service they are providing. Furthermore, these standards and the purpose of the heifer grower need to be understood by the client, the dairy producer. For this to be accomplished, many business management practices well known to the manufacturing sector of our economy need to be incorporated into the emerging dairy industry. A basic necessity to for success is an established grower-client-animal relationship which includes communication, a feedback loop, and a mutual understanding and acceptance of both the milk producers and the heifer growers goals and purpose.

Networking

There are two situations, which exist that inhibit the development of a healthy dairy heifer industry. One is that because the heifer-rearing specialty is a new field, there are few visible examples to copy and learn from. At the 1997 heifer growers meeting in Atlanta, there were numerous people from non-traditional dairy areas stating that they thought they were the only people who had started this type of enterprise. They were developing their business in a trial and error fashion. Thus, there are many people reinventing the same wheel and repeating the same mistakes. An association gives growers the opportunity to learn from each other.

Conversely, there are established heifer growers loath to share information because they view other growers as the competition. By sharing their successful "trade secrets" they are afraid of losing hard won business. However, this isolationist policy tends to divide the industry and makes it difficult for interested third parties to provide support and assistance to the industry as a whole. There are some issues, such as policy development and standards that are common and of benefit to the whole industry without sacrificing an individual competitive advantage. Furthermore, it does the industry more harm than good to have a naïve person underestimate what it cost and the management required to raise a quality heifer. The existence of a naïve grower who is undercharging gives the impression that other growers are price gouging, and when an inferior product is delivered, it is too often assumed to be representative of the whole industry's ability.

Education

Heifers have occupied the lowest status on the typical dairy farm's list of things to take care of. When resources, be it time, facilities, labor, or money are short, heifers usually are the ones left to fend for themselves. Educational programs are often reflective of the priorities on the farm. Thus, there has been a paucity of quality educational programs and material dealing with heifer management. With the emergence of the heifer grower industry, there is real opportunity to present high quality educational programs for a highly interested and motivated audience. I cannot count how many times I have heard a grower express thanks for a program devoted to heifer management because they are tired of paying full price to attend a dairy cattle educational program to see that one paper devoted to heifers in amongst the dozen others on milking routine, dry cow nutrition, etc.

Marketing

As with any new venture, the dairy heifer industry is ripe with opportunity but also fraught with risk. Opportunity always draws the quick buck artist and the uninformed. Marketing is often cited by growers as their biggest challenge. There are several issues at the core of this concern. One relates to who is the competition? For a grower to view another grower as the competition means that they are competing over at most 20% of the heifers in the U.S. With all the people entering the business, this means a shrinking piece of the pie for everyone. Market share growth will only come from tapping into the other 80% of the heifers still grown on the dairy farm. Therefore, the real competition for this young immature industry is the dairy farmer. To sell their services to the dairy farmer though will require some education and an improvement of the image of the heifer grower. Unfortunately, the heifer enterprise is typically the one on the dairy farm with the least amount and poorest quality management and financial information. Thus there are many misconceptions held by dairy farmers that cause them to tend to underestimate the cost of their enterprise and value of their heifers. It is going to be up to the diary heifer grower industry as a whole to dispel some of these notions.

Benchmarks

Because heifers have received low priority on most farms, they also tend to have the least known about them. Information systems dealing with heifers have typically only consisted of identification data for inventory purposes and perhaps some breeding dates. Thus most of the industry benchmarks currently in use are based on research at universities and covers only growth rates and age at first calving recommendations. There is very little on-farm data regarding growth performance, reproductive performance, virtually no data on how heifer management may affect herd life or lifetime production. There is no data on the advantages of contracting a specialist to raise heifers vs. raising them on the farm. There is little good financial data for heifers. Without an information system and the information it can generate, it is difficult to market services or set good goals to strive for.

Standards

Many heifer growers talk about an “added value” product or guaranteed product. However these terms have no real meaning because everyone’s idea may be different. To a dairy farmer who’s concept of a heifer grower is a cattle jockey or someone who did a poor job raising his heifers, added value has no meaning what-so-ever. It is solely the responsibility of all reputable heifer growers to develop the industry norms that they want their industry to be known for. These standards include business ethics, financial accountability, adequate record keeping, and providing a product superior to what the dairy farmer could produce at a reasonable price.

Research

As with education, research priorities are often reflective of on-farm priorities. Like educational programs, there is a relative lack of information and research on heifers. A good example is the poor recommendations made for calves and heifers in the NRC Nutritional Guide. This guide is being revised, but there are still many unknowns. Biosecurity is the new buzzword in the industry. The logistics of contract heifer raising opens up the risk of exposing cattle to harmful diseases. The ones of greatest concern right now are Johne's, BVD, Leukosis, and hairy foot wart. There is tremendous potential for research into the extent, prevention, and eradication of these diseases. Then there is the industry itself. Little is known about how many heifer growers there are, where they are, how they conduct business, what cattle movement is etc. Without a voice like the Professional Dairy Heifer Growers Association, there is no one to bring pressure to bear to focus research on many when policy is developed.

Policy Development

Federal and state governments are making policy and regulations on food safety, waste management, animal disease, land use, milk pricing, and a myriad of other issues that affect the livelihood of all heifer growers. Yet, as far as the government is concerned, they are not even aware of the issues or the impact of their decisions on the heifer grower industry because they do not know it exists. There are examples of legislative programs from which diary farmers, feedlot owners, and other well recognized cattle owners and handlers have benefited financially, but from which heifer growers are excluded, simply because the legislative body did not write the legislation in such a way to include growers because they did know there was such a entity. The only way to impact policy development is to have an organization to represent the industry in these issues.

I have been asked many times if the growth of the dairy heifer grower industry is for real and the wave of the future, or is it just a fad. A person considering entering the business usually asks this question. What they are really asking is do they have a chance and making a buck and succeeding? That is a very complex question. When taken in context of the other changes affecting the dairy industry, contracting out heifers is just one more example of specialization. Waste management concerns and heavy expansion of farms all contribute to the impression that contract heifer growing will continue as the wave of the future. However, will a particular individual make money and succeed is a totally different issue. That will depend on how well they push a pencil and understand their true costs. It depends on their ability to market their services. It depends on whether the dairy farmers in the area understand what is really at stake and what their impression of a "heifer grower" is. It will depend on how well they can address biosecurity issues. If they expect to get rich, this is probably not the business to get in. While there is lots of opportunity that also means there is lots of risk. Right now the business is attracting con artists and naive people in addition to legitimate and responsible growers. Until the industry is more mature, there will be a shake out of the inferior growers. It is an exciting time to be associated with the dairy heifer grower industry, but it is also a time fraught with risk. While I believe the industry will grow and flourish, there will be many individual casualties along the way.

Transportation Not a Limiting Factor

This talk runs contrary to the values and traditions of many that will hear or read it. It is not meant to advocate for what is happening, only to report of what is happening. Change by necessity requires that old ways of doing things be abandoned. You may shoot the messenger, but that will not make the message go away.

Changes are occurring because long held values with regard to land ownership are evaporating. This is reflective of the changing values of society, but is even more driven by demands for low cost food with lots of choice by an affluent society no longer with most people no longer tied to growing their own food for sustenance. Society through public policy is pushing farmers off land that has been farmed by a family for generations, sometimes for over 300 years. We have come to a time where people are forced to make a choice between giving up the farm in order to continue to live in a community or give up the community and move to a more food production friendly area in order to keep farming. These changes are lamentable, especially for those of us that associate farming with family, community, and a way of life. Unfortunately, those of us that choose to stay in farming will be forced over time to give up some of which we hold near and dear if we are to be producers and growers in the food production system. Furthermore, we need to understand what our role will be in that food production system and how to prepare for it, whether it is as the grower, a processor, or the contract service provider, or a consumer.

Reference

Boehlje, Michael. 1998. Management challenges in a changing agriculture. Proceedings of the National Conference for Management Educators of Agricultural Audiences. June 25-26. The Ohio State University. Columbus. Pp. 1-11.

CONTRACT HEIFER PRODUCTION

Author: Art Logan, Logan Acres Farm

Contract Heifer Production is allowing dairy farmers in Northeast Ohio to reduce their cost of raising replacements and improve their profit margins. The two most obvious methods to increase profits for the dairy farmer are either by using their current dairy facilities more hours per day (using labor previously used to raise heifers now to do 3 times a day milking) or add more cows to the current milking herd (renovate barns for cows which previously housed heifers). Other owner benefits of sending heifers to a custom heifer raiser could be the reduced demand for feed, labor, facilities and/or manure management.

At Logan Acres Farm, heifers are always our #1 priority. Our crop plans, time schedules and harvest plans are all geared to our heifers. Our goals are simple – return well grown heifers in the correct body condition, in good health, pregnant and ready to milk in a reasonable number of days.

We developed a contract to outline some specifics concerning our custom heifer raising operation. Examples of the areas covered include the following:

1. Age and condition of the calf when delivered to the contractor
2. Care of heifer while at contractor's farm
3. Sire selection and matings
4. Slow or non-breeders
5. Transportation to and from
6. Payment schedule/costs included
7. Time of return of heifer to owner
8. Health/vaccinations
9. Death loses

Two of the dairy farmers that I raise heifers for had some heifer barns close to their milking facilities. After they moved their heifers out, these barns were renovated to allow space for more milking cows. One of the other dairy farmers did not have the facilities, feed, or labor to properly care for heifers after his expansion from a 45 head stanchion barn to a 120 head freestall/parlor set up. The fourth dairy farmer, (I have only part of their heifers) finally realized that trying to raise heifers at several locations and not always having adequate forages was costing much more than paying a contract heifer raiser.

I like to emphasize that as a custom heifer raiser where my (your) heifers are my #1 priority, the daily care, heat detection, pregnancy checks, vaccinations, feed supplies, manure management, and facilities all become my responsibility. This permits the dairy farmer to use their time and their facilities to get maximum production and profit from their milking herd.

CUSTOM FORAGE PRODUCTION

Author: Keith Snoddy, Wasuka Farms

Background

Wasuka Farms has been run by the Snoddy family for three generations. I was born and raised on the Wayne Co. Ohio dairy. I also graduated from Youngstown State University in 1980 with a Bachelor of Science degree in Business Administration. I returned to work on my father's farm in 1982 and eventually took over management responsibilities in 1990. We continually expanded until we were milking 200 cows, raising all of our replacement heifers, and feeding out 150 head of bull calves as well as farming 700 acres of corn and alfalfa. Currently we milk 150 cows, raise all of our replacement heifers but have stopped feeding bull calves. We are currently researching the possibility of eliminating the dairy herd and expanding in custom heifer raising as well as custom harvesting.

Custom Harvesting

We began doing silage bagging as a custom business in 1982 when we purchased our first bagging machine. Since that time the business has grown to the point now where we do not only bag silage but also chop and deliver to the silo either bunker, bag , or upright. We use trucks to haul whenever possible to speed up the process. We can harvest haylage, corn silage, or high moisture ear corn. We chop with a John Deere 5830 self-propelled harvester with a kernel processor built in. This 300 hp. Unit has a 10' hay pickup, 4-row corn head , and a six-row snapper head. All our custom work is done on our hourly basis. We charge currently, $120 per hour for the John Deere harvester and $50 per hour for each truck and driver. Forage wagons are charged at $60 per day and tractors are rented for $30 an hour. The reason we charge by the hour, opposed to by the ton , is due to the wide differences in crop yield, field layout and hauling distance. We have the capacity to chop up to 80 ton per hour if all conditions are good. We averaged 50-60 ton per hour last season. Also in charging by the hour the customer has a little more interest in placing us in the best fields with the highest yields because it will be more cost effective for them.

Forage Sales

In 1990 we began to market forages as a cash business. This idea came from reading about it being done in New York State. Most of the sales there have been done right out of the field and stored on the purchaser's farm. We felt that there was a need for fermented feed in a ready to feed form. So with our use of silage bags as a storage system, we decided to sell silage right out of the bags. With this system we are able to test the quality of our forages and match the needs of our customers as well as have a consistent feed for our own cows. Customers handle our deliveries in various ways, some just have us dump it in a pile and feed it while others want their silos refilled so they can feed through their feeding system. We price all of our feed on a dry matter basis and each load is tested and the price adjusted accordingly. A base price of $50 per ton is currently charged for haylage that tests 40% dry matter and 18% crude protein. The price would then be adjusted according to the actual test of that load of feed. Dry matter adjustment is approximately $1.25 per point while crude protein adjustment is $.75 per point. The current corn silage base is $32 per ton for unprocessed silage at 35% dry matter, and $35 per ton for processed silage at 35% dry matter. The adjustment at $35 per ton would be $1.00 per point while at $32 per ton it would be $.92 per point. These adjustments are made either up or down from the base figures. All the prices include delivery of full loads. Many different types of farmers have bought silage from us in the last 7 years. These would include beef farmers as well as dairy farmers with conventional feeding systems and dairy farmers that us the intensive grazing system. The main advantages for an intensive grazer is that he can contract all his forage needs for the winter with me and never have to worry about making or storing feed for his cattle for the winter. By contacting us in late summer he can have a set amount of feed held for him to use through the winter. The main advantages for the confinement farmer is that he can now refill that silo during late winter and have enough feed to carry him through the summer without having to change rations. He can also have fermented feed to use during the time that he is filling his own silo in the fall. As you can see there are a lot of different reasons why people buy forages from us and if you look at the cost of production, cost of equipment, and ease of handling you can see why it does fit well in many situations.

Overview

As you can see specialization is playing an exceedingly critical role on our farm. We not only have stopped feeding steers, but are looking seriously at concentrating on only heifer raising and custom forage harvesting and sales. We feel the time has come in agriculture to try to be exceptionally good at a few things, as opposed to being adequate at a lot of things.

Decision Case Adaptation

In looking at the case study I would want to look closely at the cost of ownership of forage harvesting equipment for harvesting 3900 tons of forage.

Self-propelled Harvester	$200,000—$250,000
Dump trucks (2 used)	$30,000—$40,000
Dump Wagon	$11,000—$16,000
Packing tractor or loader	$20,000—$25,000
TOTAL INVESTMENT	$261,000—$331,000
ANNUAL PAYMENT (8%, 7yr)	$48,800—$61,900

That same forage could be done by a custom harvester for $4.00—$6.00/ton or $15,600 to $23,400. That also eliminates the need for additional labor to operate all of the equipment. The cost of ownership could be reduced by the purchase of used equipment, but by doing that you are compromising the ability to harvest the crop at the optimum quality and are going to spend extra dollars on repair costs. I would think the extra money saved in this case could be used better in transporting the unneeded manure to distant farms where it can be utilized.

WASUKA FARMS FORAGE SERVICE
1999 PRICE LIST

FORAGE SALES:

Corn Silage....... Base Price $35.00/ton @ 35% Dry Matter—Processed
Haylage............ Base Price $50.00/ton @ 40% DM 18%CP

These prices include delivery of full loads within 25 miles of the farm.

FORAGE HARVESTING:

J.D. 5830 Chopper W/ Roller Mill & Metal Alert .... $120/hr Cap=50-80 ton/hr

New Idea Uni-System... $80/hr Cap=20-40 ton/hr

Ford 9000 Live Bottom truck $50/hr
Int. 18' Dump truck $50/hr
Chevy 1 ton w/ 16' Dump Trailer............................. $50/hr
Tractors.. $30/hr
Windrow Merger.. $3/acre w/o operator
Forage Wagons... $60/day
Tank Truck 5000 gal-manure hauling $50/hr
Payloader $50/hr
All these items are with an operator included.
Tact Hrs. used on choppers, clock Hrs. used on all others.

SILO BAG FILLING

SILOPRESS 8' X 150' BAG FILLED..................... $750......$5/foot..110 ton
VERSA ID891 BAGGER 9' X 150' FILLED.......... $900.....$6/foot..150 ton
VERSA ID910 DUMP BAGGER 10' X 150'........... $1050...$7/foot..200 ton
Other lengths of bags are available.

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PHOSPHORUS MANAGEMENT ON DAIRY FARMS

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Abstract

With the increase in size and concentration of dairy farms in several regions of the U.S., more manure is available to be applied to agricultural land in the neighborhoods of these operations. In many cases, this has resulted in more phosphorus (P) being added to soils than crops require, an accumulation in soil P, and increased potential for P loss in surface runoff. Increased outputs of P to fresh waters can accelerate eutrophication, which impairs water use and can lead to fish kills and toxic algae blooms. As a result, information is needed on how P can be best managed on dairy farms to meet both production and environmental goals. This will involve feeding P to the requirements of the animal, use of manure and soil amendments to reduce P solubility, moving manure from surplus to deficit areas, and finding alternative uses for manure. Also, conservation practices, such as reduced tillage, buffer strips and cover crops should be targeted to critical areas of P export from a watershed. These critical areas are where high P soils coincide with parts of the landscape where surface runoff and erosion potential is high. Finally, economic realities facing dairy farmers and the dairy industry should be considered in the development and implementation of innovative management strategies and the formation of stewardship alliances within the food production system.

Water Quality

Since the late 1960s, point sources of water pollution have been reduced due to their ease of identification and the enforcement of the Clean Water Act in 1972. As water quality problems remain, attention is now being directed to controlling the contributions from agricultural nonpoint sources. Eutrophication has been identified as the main problem in surface waters having impaired water quality (U.S. EPA, 1996). Eutrophication restricts water use for fisheries, recreation, industry, and drinking due to the increased growth of undesirable algae and aquatic weeds and oxygen shortages that result from their death and decomposition. Recent outbreaks of the dinoflagellate *Pfiesteria piscicida* in the eastern U.S. have been linked to excess nutrients in affected waters (Burkholder et al., 1992). Neurological damage in people exposed to the highly toxic volatile chemical produced by this dinoflagellate has dramatically increased public awareness of eutrophication and the need for solutions (Matuszak et al., 1997).

Phosphorus inputs to fresh waters can accelerate eutrophication (Carpenter et al., 1998). Although nitrogen (N) and carbon (C) are also essential to the growth of aquatic biota, most attention has focused on P because of the difficulty in controlling the exchange of N and C between the atmosphere and water and fixation of atmospheric N by some blue-green algae.

Thus, managing P inputs to control the most limiting factor is critical to reducing freshwater eutrophication.

Changes In Farming Systems

The rapid concentration of the animal industry in certain areas of the U.S. has been coupled with an intensification of operations. Current census information shows that while the number of dairies has decreased 40% over the last 10 years, dairy cow numbers have decreased only slightly more than 10%, and herd size has increased 50% (Gardner, 1998). Prior to World War II, farming communities tended to be self-sufficient, in that enough feed was produced locally to meet animal requirements and the manure nutrients could be effectively recycled to meet crop needs. After World War II, increased fertilizer use in crop production made it possible to create specialized grain crop and animal operations and fragment animal agriculture. By 1995, some major animal producing states imported over 80% of animal feed from grain producing states (Lanyon and Thompson, 1996).

The potential for P surplus at the farm scale can be much greater in animal feeding operations, when nutrient inputs become dominated by feed rather than fertilizer, than cropping systems that rely on purchased nutrients (Table 1). With a greater reliance on imported feeds, only 50% of P in purchased feed for a dairy operation on a 100 acre farm in Pennsylvania could be accounted for in farm outputs (Table 1). Similar P surpluses (7 to 30 lbs/ac/yr) have been obtained by Aarts et al. (1992) and Brouwer et al. (1995), while Haygarth et al. (1998) estimated a P surplus of 23 lbs/ac/yr for a model dairy farm in England. These budgets show that the largest input of P for contemporary intensive animal operations and thus the primary source of any on-farm excess, is animal feed.

The accumulation of nutrients on many dairy farms where on-farm crop production is supplemented by feed inputs is generally not as great as in other systems where the animals depend primarily on off-farm feed (Table 1). The distinguishing feature among these animal operations, is the breakdown between the amount of crops produced on a farm (and the potential nutrient utilization by those crops) and the animal numbers on the farm, because the manure applied to crop fields will include both nutrients coming from those fields and from imports of off-farm feeds (Lanyon and Beegle, 1993). The application of "imported" nutrients to crop fields can compensate for those lost in marketed products and manure handling operations and help to sustain the farm, but the additional nutrients can also be the source of excess nutrient loading. Nevertheless, restricting feed purchases in order to maintain the balance of nutrients, such as P, can limit herd size and economic return if all manure from the herd must be applied to the farm cropland (Westphal et al., 1989).

Feeding Of Phosphorus

Phosphorus is an important dietary nutrient for dairy cattle and has a key role in various metabolic functions. Most feedstuffs used on dairy farms do not contain adequate P to meet the needs of lactating cows; thus additional P is brought onto the farm. The nutritional goal is to feed adequate P to meet the cow's requirements and minimize P excretion. The daily dietary P requirement for a typical dairy cow producing 70 lbs of milk is 0.20 lb (0.42% of total ration dry matter) (NRC, 1989). Fed to National Research Council (NRC) recommendations, this cow would consume over 60 lbs P and excrete about 40 lbs P annually (Van Horn et. al., 1994). About 1/3 of this dietary P would typically come from P supplements brought onto the farm.

A summary of some high producing dairy herds found that dietary P averaged 0.57% of the total ration dry matter, with an estimated P intake of 0.31 lb/day. The NRC allowance for average production levels is 0.42% of the ration dry matter, or 0.23 lb P/day. These herds were being fed 35% more than NRC allowances (Shaver and Howard, 1995).

The P requirements of dairy cattle in the NRC are higher than in most other countries and are primarily related to differences in assumed availability of dietary P (NRC, 1989; Tamminga, 1992). Feeding 0.35% and 0.45% P of the total ration for a full lactation did not affect milk yield (Wu and Satter, 1998). These results suggest that current NRC recommendations for dietary P (0.42%) are reasonably accurate and that many farms routinely over feed P. Clearly, the routine overfeeding of P on many dairy farms contributes to P surpluses on farms.

Current feeding management and animal grouping strategies may also contribute to excess P excretion. It is common to see total rations formulated from 0.50 to 0.55% P (dry matter basis) with the same ration fed to all lactating cows. At normal dry matter intakes for cows averaging 100 and 50 lbs milk/cow/day, P intakes would be about 0.28 and 0.24 lb/day, respectively. This compares to NRC allowances for the same cows of about 0.24 and 0.14 lb/day, respectively. Feeding excess P ranges from 16% on high producing cows to nearly 70% for low producing cows, when all cows are fed the same total ration for the full lactation. More than one feeding management group and P level is needed across the lactation cycle to minimize P excretion.

Phosphorus And Land Applied Manure

Fate in Soil

Continual long-term application of manure at levels exceeding crop utilization will increase soil P levels. In many situations dairy manure application has been based both on material handling demands and crop nutrient supply considerations. Contemporary concerns about the impacts of nutrient management practices on water quality have shifted the focus of applications to balancing for the N needs of the crop in the year of manure application. Minimizing the purchase of commercial fertilizer N and reducing the risk of nitrate leaching have been the basis of these recommendations. However, repeated applications at N-based rates can result in a build up of soil test P above amounts sufficient for optimal crop yields, due to the generally lower ratio of N:P added in dairy manure (5:1; Eck and Stewart, 1995) than taken up by major grain and hay crops (8:1; Fertilizer Handbook, 1982).

The difference in this ratio is aggravated by differential availability of manure N and P during the year of application. Dairy manure N is rarely more than 50% as available as fertilizer N, while manure P availability approaches that of fertilizer P. Consequently, even more manure is required to supply the crop N needs, increasing the collateral applications of P. Some nutrient recommendations encourage the application of manure only at rates that will supply the P needed throughout the crop rotation in a field in order to minimizes the build-up of P (Beegle et al., 1998). This will often require greater investment in manure application to cover more area in a given year and more total area for manure application than for N-based application.

Transport in Runoff

The loss of P in surface runoff occurs in sediment-bound and dissolved forms. Sediment P includes P associated with soil particles and organic material eroded during flow events and constitutes most of P transported in surface runoff from most cultivated land (Sharpley et al., 1994). Surface runoff from grass, forest, or noncultivated soils carries little sediment, and is, therefore, generally dominated by dissolved P. The dissolved form of P comes from the release of P from manure, soil, and plant material. This release occurs when rainfall or irrigation water interacts with a thin layer of surface soil (1 to 2 inches) and plant material before leaving the field as surface runoff. Most dissolved P is immediately available for biological uptake. Sediment P is not readily available but can be a long-term source of P for aquatic biota (Sharpley et al., 1994).

In most watersheds, P export occurs mainly in surface runoff rather than subsurface flow, due to fixation of P by P-deficient subsoils. Exceptions occur in sandy, acid organic, or peaty soils, with low P fixation or holding capacities and in soils where the preferential flow of water can occur rapidly through macropores and earthworm holes (Sims et al., 1998).

Increases in P loss in surface runoff have been measured after manure application (Sharpley et al., 1998). Phosphorus losses are influenced by the rate, method, and time of application; form of P applied; amount and time of rainfall after application; and vegetative cover. Incorporation of manure into the soil profile either by tillage or subsurface placement reduces the potential for P loss in surface runoff. Mueller et al. (1984) showed incorporation of dairy manure by chisel plowing reduced total P loss in surface runoff from corn 13 fold compared to no till areas receiving surface applications. The P loss in surface runoff was decreased by a reduction in surface runoff volume and a lower surface soil P content caused by incorporation of manure and tillage.

Manure Management

Farm advisors and resource planners are now recommending that the P content of both manure and soil be determined by soil test laboratories before land application of manure. This allows farmers and their advisors to estimate the fertilizer value of manure to be applied, while soil test results can help a farmer identify the fields in need of P fertilization, those where moderate manure applications may be made, and those fields containing sufficient P that should be at a low priority to receive manure.

Dietary manipulation of P intake indicates there is scope to reduce fecal P output without affecting dairy herd performance (Brintrup et al., 1993; Metcalf et al., 1996). Decreasing mineral P supplements to carefully match dietary P requirements of dairy cows and use of proper feeding management strategies, may help bring farm P inputs and outputs into closer balance. The dairy industry faces challenges unlike those of the other intensive animal agriculture industries since so much of the industry depends on feed ration formulation and allocation by private individuals rather than professional nutritionists employed by the feed industry. Even dairy farmers who receive professional nutritional assistance may not follow the recommendations completely. The departures can reduce the efficiency of feed utilization by the animal leading to excretion of any excesses (Dou et al., 1998). The multiple life-stages of the animals in a dairy herd also complicate the preparation and allocation of rations.

Unlike hog and poultry facilities in which most of the feed is utilized to raise rapidly growing animals, much of the feed on a dairy farm goes to mature lactating animals. Plus, the dairy farm usually invests in the feeding of heifers and dry cows that have different and dynamic nutritional requirements based on their life cycle. Variable forage quality on a dairy farm can confound even the best ration balancing intentions because within and among year variations make frequent adjustments of rations necessary. In addition to incremental improvements in the efficiency of nutrient utilization by dairy animals, management of nutrient load on a dairy farm could involve placing heifers and dry cows away from milk production facilities. In this way, the efficiency of milk production per unit of feed delivered to the farm where lactating animals are housed can be increased. At the same time, manure from non-producing animals can be located where field utilization will require less transportation.

Commercially available manure amendments, such as alum can reduce the solubility of P in dairy manure by several orders of magnitude (pers. comm. Dr. Philip Moore, Jr., USDA-ARS, Fayetteville, AR). Alum may also reduce ammonia volatilization, increasing the N:P ratio of manure. An increased N:P ratio of manure would more closely match crop N and P requirements. Composting can reduce manure volume and thus, transportation costs. Additional markets are also available for composted materials. Composted materials are more uniform in physical and chemical properties and therefore, can be spread more uniformly and at more accurate rates. However, it should be noted that composting increases NH_3 volatilization, which aggravates N and P imbalances even more. An even more difficult issue is that N availability usually decreases with composting so that to achieve the same available N for crop growth, the rate of application must be much greater than original manure.

At the moment, manures are rarely transported more than 10 miles from where they are produced. A mechanism should be established to facilitate movement of manure from surplus to deficit areas. This may initially require incentives to facilitate subsequent transport of manures from one area to another. Options for transporting manure from a planned dairy facility to achieve nutrient balance with potential crop utilization should be considered within the cash-flow projections for a new facility. There is also interest in using some manures as sources of “bioenergy.” Liquid wastes can be digested anaerobically to produce methane that can be used for heat and energy, while solid wastes may be burned directly. Anaerobic digestion tends to transform the manure N from organic to ammonium forms, but does little to reduce the N or P content of the manure (Lanyon et al., 1985).

Separating the solids from the liquids may increase the management options for dairy manure. Separation of liquids and solids also results in some separation of the nutrients. A large proportion of the available N will be in the liquid fraction while a large proportion of the P will be in the solid fraction. While this does not change the total amount of nutrients that must be handled, it may enable better targeting of the individual nutrients to locations where they will do the most good and/or have less potential for causing environmental problems. Also, because the solid fraction is more concentrated, it may be feasible to transport it to more remote fields or it can serve as the input stream for other biosolids products. Effective liquid/solids separation requires a dilute manure slurry that will generally result from an alley flushing system in which additional water is added to the manure. If manure has to be moved from a production facility in order to meet nutrient-balancing constraints of locally produced crops, the proposed facility might consider options other than diluting manure. This will often involve some different engineering of the facilities and impact the day-to-day labor demands of the dairy housing operations, but may provide more options for redistributing nutrients with less transportation of water.

Transport Management

Phosphorus loss via surface runoff and erosion may be reduced by conservation tillage and crop residue management, buffer strips, riparian zones, terracing, contour tillage, cover crops and impoundments (settling basins). Basically, these practices reduce rainfall impact on the soil surface, reduce surface runoff volume and velocity, and increase soil resistance to erosion. None of these measures should be relied on as the sole or primary practice to reduce P losses in agricultural runoff.

Most of these practices are generally more efficient at reducing runoff of sediment P than dissolved P. Several researchers have indicated little decrease in lake productivity with reduced P inputs following implementation of conservation measures (Carpenter et al., 1998; Sharpley et al., 1994). Many times the impact of remedial measures for improving water quality will be slow, as P stored in lake and stream sediments can provide a long-term source of P to overlying waters even after inputs from agriculture are reduced. Therefore, strategies to reduce P inputs to water resources in an acceptable timeframe must consider the P stored in the aquatic system.

Targeting Remediation

Environmental concern has forced many states to consider the development of recommendations for manure and watershed management based on threshold soil P levels (Sharpley et al., 1996). In most cases, agencies proposing these levels plan to adopt a single threshold value for all areas under their jurisdiction. However, threshold soil P levels are too limited to be the sole criterion to guide manure management and P applications. For example, adjacent fields having similar soil test P levels but differing susceptibilities to surface runoff and erosion, due to contrasting topography and management, should not have similar soil P thresholds or management recommendations. Therefore, threshold soil P levels will have little value unless they are used in conjunction with an estimate of a site-specific potential for surface runoff and erosion.

A sounder approach advocated by researchers and an increasing number of farm advisors personnel is to identify critical source-areas where high soil P levels coincide with high surface runoff and erosion potentials. This approach addresses P management at multi-field or watershed scales. Further, a comprehensive P management strategy must address down-gradient water quality impacts such as the proximity of P-sensitive waters. Conventionally applied remediations may not produce the desired results and may prove to be an inefficient and costly approach to the problem if this source-area perspective for targeting application of P fertility, surface runoff and erosion control technology is not used. The issue of nutrient balance with the crop utilization potential must still be addressed. Since the resources invested in balancing the nutrients generally will not promote milk production nor reduce associated production costs, nutrient utilization should be accounted for before a new facility is constructed. Otherwise, accommodating increased costs in the operating cash flow might be difficult after the facility is financed and in operation.

A simple P index has been developed by USDA-NRCS in cooperation with several research scientists as a screening tool for use by field staffs, watershed planners, and farmers to rank the vulnerability of fields as sources of P loss in surface runoff (Lemunyon and Gilbert, 1993). The index accounts for and ranks transport and source factors controlling P loss in surface runoff and sites where the risk of P movement is expected to be highest (Gburek and Sharpley, 1998). The index is being considered for implementation by NRCS as part of their national nutrient management planning strategy to help identify agricultural areas or practices that have the lowest P loss potential. It will identify management options available to land users that will allow them flexibility in developing remedial strategies.

Strategic Initiatives

Perhaps the most critical and challenging area to initiate real and lasting changes in agricultural production is by focusing on consumer driven programs and education to create alliances for water quality protection with farmers. Farmers are at the bottom of the “food chain” with regional and often global economic pressures and constraints, over which they have little or no control, influencing their decisions (Lanyon, 1994). Since World War II, greater fertilizer N availability that increased corn grain production and reduced cost, along with the promotion of a domestic soybean processing industry, dramatically increased the feed energy and protein available for enhanced animal productivity. Improved animal breeding, specialized feed concentrates, and new production technologies promoted greater animal productivity and increased concentration on a smaller land area (Fig. 1). At the same time, the land base available for manure management has declined due to urban development, idled land, reforestation, and the increased concentration of the industry. As a result, animal farming has changed from land-based to capital or economically-driven systems. Thus, manure production and management issues facing farmers are to a large extent driven by external economic factors rather than environmental issues (Fig. 1).

Clearly, we have to look at new ways of using incentives to help farmers change the performance of farming systems where P losses threaten the status of shared water resources. The challenge is to recognize how social policy and economic factors influence the nutrient-management agenda. Equally important is that everyone is affected by and can contribute to a resolution of P-related concerns. Rather than assume that inappropriate farm management is responsible for today’s water quality problems, we must address the underlying causes of the symptoms (Lanyon, 1998). These causes are related to marketplace pressures, the breakdown and imbalances in global P cycling, and the economic survival tactics of farmers. Research is needed to develop programs that encourage farmer performance and stewardship to achieve agreed upon environmental goals (Lanyon, 1998). These programs should focus on public participation to resolve conflicts between economic production efficiency and social issues such as water quality.

Conclusions

From the preceding discussion it is clear that agricultural P, dairy production and water quality can be compatible in most areas, as long as the following factors are considered and management criteria met.

1. Attempts should be made to balance P inputs and outputs at a watershed scale. Considering nutrient balance and potential crop utilization at the farm scale will be important for planned dairy farm expansions.
2. Feed management and P supplementation should be carefully tailored to the animals' requirements during lactation, nonlactacting, and other (lifecycle) physiological stages.
3. We must develop, implement, and monitor the success of cost-effective best management practices that increase the utilization of manure P and reduce P loss to surface waters.
4. Remedial strategies should be targeted to critical source areas of P in a watershed.
5. Stewardship programs should be considered that provide some form of economic incentive to implement environmentally-sound practices or reward for producers, who protect water quality while producing milk.

We have not been successful at translating basic P research information to implementation of management programs that are both effective and practical to farmers. Thus, we must conduct interdisciplinary research involving soil scientists, hydrologists, agronomists, limnologists, animal scientists and policy specialists. Development of guidelines to implement such programs will also require consideration of the socio-economic and political impacts of any management changes on both rural and urban communities, and of the mechanisms by which change can be achieved in a diverse and dispersed community of land users.

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Table 1. Farming system and P budget (data adapted from Lanyon and Thompson, 1996 and Bacon et al., 1990).

Farming system	Phosphorus input in		Output	Balance
	Feed	Fertilizer		
	- - - - - - - - - - - - - - - - - lbs/acre/yr - - - - - - - - - - - - - - - - -			
Cash crop †	--	20	18	+2
Dairy ‡	28	10	13	+25
Hog ¶	95	--	60	+35
Poultry §	1390	--	470	+920

† 70 acre cash crop farm growing corn and alfalfa.
‡ 100 acre farm with 65 dairy Holsteins averaging 14550 lbs milk/cow/yr, 5 dry cows and 35 heifers. Crops were corn for silage and grain, alfalfa and rye for forage.
¶ 70 acre farm with 1280 hogs; output includes 40 lbs P/ha/yr manure exported from the farm.
§ 30 acre farm with 74,000 poultry layers; output includes 7 lbs P/ha/yr manure exported from the farm.

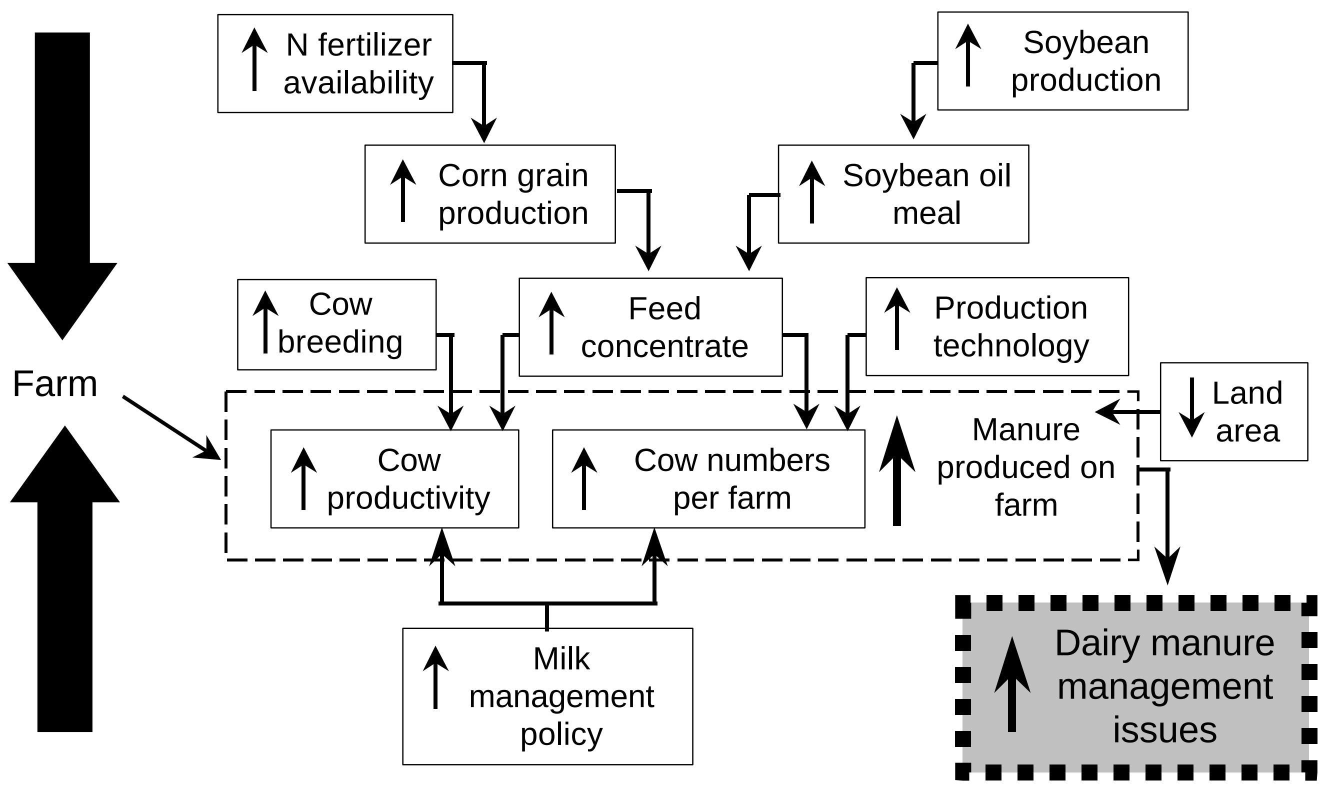

Figure 1. Relationships in the recent evolution of animal production and dairy manure management issues (adapted from Lanyon, 1994).

DEVELOPING A COMPREHENSIVE MANURE MANAGEMENT PLAN

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Introduction

Traditionally, nutrient management has been concerned with optimizing the economic return from nutrients used to produce a crop. Whereas, once agronomic science placed the greatest emphasis on determining the optimum yield response from fertilization, the development of animal agriculture demanded that evaluations of economic returns include animal as well as crop response. To these two concerns must now be added concerns about the impact of these nutrients on environmental quality. Leaching of nitrogen (N) through the soil can raise groundwater nitrate levels above the EPA drinking water limit adversely affecting the health of young children and livestock. Surface movement of N and phosphorus (P) in runoff increases levels of these nutrients in surface waters, such as the Chesapeake Bay, and there are other consequences of surface water pollution which can lead to eutrophication and fish kills.

Contrary to common belief, the problems that we have with nutrient pollution are not completely the result of mismanagement by farmers but are more a result of our agricultural systems evolving with no direct costs associated with environmental quality. The intensive animal agriculture that many blame for the nutrient problems we face, developed because of strong economic incentives for this type of agriculture. Thus, managing nutrients to address these additional concerns will mean more than just eliminating bad management it will mean changes in our agricultural systems. To meet this challenge will require innovative management approaches.

Nutrient management generally involves decision-making about a wide range of farm operations. The decisions in this process are made as frequently as several times a day to as seldom as once every five years or more. Decisions may deal with the day-to-day details of farm operations, such as spreading manure on a specific field on a particular day, or deal with long-range strategic decisions about the future of an entire farm, such as the decision to expand the herd or build a manure storage. Nutrient management is an integrated ongoing process.

Decision Case	*The decision here is a strategic decision about the long-term future of the dairy. This decision is based on the goals and values of the farmers, on the resources available, and on external factors such as the farm economy and environmental policy. It is very important to have a clear understanding of the strategic plans for an operation before developing a nutrient management plan*

Selecting Appropriate Nutrient Management Strategies

Nutrient management starts with an assessment of the overall nutrient balance on the farm. An initial assessment of the farm and the potential environmental impacts of the existing or planned farm operations is an effective starting place in many situations. In the assessment the approximate nutrient balance of individual fields, groups of fields that are treated similarly, or even the whole farm can be determined depending on the purpose of the assessment. The outcome of the assessment can be used to determine what options should be considered for farm nutrient management to protect the environment while producing crops and animals. The extent of nutrient management assistance required to change the farm operation will also be influenced by the type and extent of the options to be incorporated. This will form the basis for developing the nutrient management plan.

A major goal of nutrient management for crop production and to protect the environment is the balance between agronomic crop requirements and the supply of nutrients available on the farm. Based on the evaluation of nutrient sources and movement, approaches to nutrient management that are sensitive to specific farm situations and strategies of farm management can be developed. Plant nutrient management decisions deal largely with farm nutrient cycles. Understanding various types of farm organization and the flow of plant nutrients to, from, and within farms, can be helpful in understanding the nutrient management problem and in practically all activities associated with the nutrient management process for crop production and environmental protection. The intensity of the dairy operation is a key factor in the nutrient cycle on a farm. This intensity is often quantified by the number of animal equivalent units (AEUs) per acre available for manure application. An animal equivalent unit, as used here, is 1000 pounds of live weight. Thus a 1300 pound dairy cow would be 1.3 AEUs.

On a primarily feed-self-sufficient dairy farm, nutrients are harvested from the farm fields with the crops. The crops are then used as feed in the animal enterprise resulting in some nutrients (usually less than 25%) leaving the farm in the animal products and the rest of the nutrients being returned to the farm fields in the manure. Nutrients may be added to this cycle as fertilizer on the farm fields and as nutrients contained in feed purchased for the dairy operation, but the primary nutrient flow is from the farm field to the barn and back (Figure 1a). These farms are characterized by animal densities less than 1.25 AEUs/A. In this group the strategy will be to utilize soil tests and manure analysis to assure distribution and timing of manure applications to maximize nutrient utilization from the manure and minimize purchase of commercial fertilizer. In short, maximize efficiency of nutrient use. Many of the standard best management practices for manure management will be applicable. Practices such as storing manure, applying it in the spring to non-legumes, incorporating it immediately, etc. will be used. The environmental impact of these operations should be nominal except where there is currently gross mismanagement. Changes in these operations would have a small beneficial effect on the environment. The bottom line is that there is the possibility for substantial economic benefits to the farmer for developing and implementing an improved manure management plan on this category of farm.

Decision Case	*Currently this farm has approximately 0.3 AEU.A. This would put the farm in a nutrient deficient situation as described above.* *Calculation: (65 cows x 1400 lb/cow ÷ 1000lb/AEU ÷ 293 A = 0.3 AEU/A))*

There is an accelerating trend toward greater intensification in the dairy industry. With larger numbers of animals on farms, the on-farm cropland can no longer support the feed requirements of the dairy. Therefore, much larger proportions of the feed requirements of the animals must come from off the farm (Figure 1b). Usually this comes from a cash crop farm either locally or at some distance and thus the nutrients usually do not cycle back to their original locations. Even if additional land is acquired to meet the feed needs of the cows, the distance and amount of manure to be hauled can increase substantially if the nutrients are to be spread uniformly over potentially suitable crop areas. This often results in more manure in limited areas.

Farms that have animal densities between 1.25 and 2.25 AEUs/A generally do not produce enough feed for the dairy and there is likely to be enough manure to meet total crop N needs, however there may be an excess of P on the farm. In this group the strategy will be to utilize soil tests and manure analysis in conjunction with appropriate management practices to match, as closely as possible nutrients available in manure with crop needs over the entire rotation. In most cases the emphasis will be on maximizing the safe utilization of the manure nutrients. Where there is a slight excess of nutrients, efficiency may be intentionally compromised to increase the utilization of the manure as long as it does not create an environmental threat. An example of this is applying manure to legumes. Even though the legumes do not need the N in the manure, they will utilize it. Intensive management will be needed to provide the most favorable economic situation while protecting the environment. There is good potential for environmental benefits from improved management on these farms. However, generally the economic impact on these farms will be small. A detailed manure management plan will probably be necessary on these farms. Also, other changes in the overall farm management, such as altering the cropping system, may be necessary on this group of farms. Most farmers in this group will probably want to take advantage of technical assistance from public agencies and/or private consultants in developing and implementing a manure management plan.

As the animal density increases above 2.25 AEUs/A, the feed demands greatly exceed the capacity of the cropland and thus livestock manure production significantly exceeds total crop nutrient needs for both N and P. In this group the objective will be to utilize every available means to remove all excess manure not needed for crop production. Alternative off-farm uses for the manure will need to be explored. In most instances this will mean locating a stable long term market for the manure and arranging the logistics of transportation and appropriate application. The on-farm plans for this group of farms will involve determining the maximum amount of manure that can be safely disposed of on the farm. However, in most cases the available land and the high residual nutrient levels in the soil may severely restrict on-farm use of the manure. Detailed nutrient management plans will be important for the farms where the manure is ultimately utilized. This group of farms has the highest potential to negatively impact the environment. In many cases, unless a favorable marketing arrangement can be developed, implementing improved nutrient management on this group of farms will have a negative economic impact on the farm. Assistance from public agencies and private consultants, manure brokers, and manure haulers will be critical to improving nutrient management. Unfortunately, this is not currently well developed in many regions.

Decision Case	*After the proposed expansion this farm would have approximately 2.5 AEU.A. This would put the farm in a nutrient excess situation as described above. Thus a completely different set of management tactics will be required as compared to the situation before expansion.* *Calculation: (525 cows x 1400 lb/cow ÷ 1000lb/AEU ÷ 293 A = 2.5 AEU/A)*

We must also recognize that there may be other potential nutrient problem areas on dairy farms. Since dairy animals often spend part of their time outside of buildings, the number of animals in barnyards and holding areas can be greater than when the number of animals supported on the farm was less. The result is that the areas around farmyard facilities can be degraded and become sources of nutrient losses from the farm directly to the environment. This is an area that is often overlooked but must be addressed in nutrient management plans.

The bottom line conclusions from analysis of these nutrient cycles is that nutrient management varies on different types of farms and is directly related to the intensity of the dairy operations and thus the external feed requirements. Even though many people think about fertilizer when we talk about nutrient management, feed is a much more important component of the system especially as dairies intensify.

Nitrogen vs Phosphorus Nutrient Management Planning

Whether manure plans should be based on N or P has become a major issue in nutrient management policy. Both N and P can have a negative impact on water quality. A major concern with N is nitrate contamination of ground water by leaching of nitrate from the soil. High nitrate N in groundwater can have adverse health effects. The most practical methods of minimizing nitrate leaching from cropland are to balance rates as close to crop removal as possible and timing N applications to avoid times when loss potentials are high. The major concern with P is eutrophication of surface waters. Biological activity of many surface water bodies is P limited. When P inputs are increased, algal and other plant growth are stimulated. The resulting eutrophication restricts the use of surface waters for aesthetics, fisheries, recreation, industry and drinking water. Because P movement within the soil is limited, the major pathway for P loss is by surface runoff and soil erosion. Management practices to limit P loss focus on reducing soil erosion and runoff. Until recently, it was commonly assumed that P losses could be controlled solely by reducing erosion. However, runoff has been found to contribute significantly to highly bioavailable soluble P losses. For example, where conservation tillage systems are used for erosion control, total P loss is reduced significantly. However because of the buildup of P at the soil surface in these systems due to repeated application of excess P, runoff water is in intimate contact with highly nutrient enriched soil resulting in potentially high soluble P concentrations in the runoff water.

If manure application rates are based on achieving a balance between the P applied in the manure and the P requirement of the crop, approximately twice as many acres will be required for manure application and purchase of N fertilizer will be necessary to meet the needs of the crops. Many intensive animal production operations have less and less acreage per animal and consequently a major practical problem is having enough acreage to properly utilize the manure even on a N basis let alone if they base their application rates on P. Basing manure application rates on P will often carry a significant cost to the operation for excess manure disposal off-farm and the expense of purchasing supplemental N.

Decision Case	*Note that the total manure P goes from 1.7 ton/yr to 11.5 ton/yr with the expansion. As noted earlier, this expanded dairy is likely to have an excess of manure based on balancing the N requirements of the crops. Since approximately twice as many acres are required to balance manure P with crop requirements it will not be possible to meet their strategic goal of achieving nutrient balance based on P without exporting significant amounts of manure from the farm. This will mean acquiring more land or long term agreements for neighboring farms to utilize the manure or finding a stable market for the excess manure. Also, note that many of the fields on this farm are already very high in soil test P. This further reduces the feasibility of achieving a nutrient balance based on P.*

It is unlikely that this issue can be resolved simply by managing dairy manure based on N Vs P. The first goal is to minimize some of the negative effects of the excess P. There are two factors that must be considered in developing effective management strategies to accomplish this. For nutrient loss to occur there must be a source of P and there must be a mechanism for transporting it to the water. A key concept to effectively managing nutrient pollution is to focus on where these two factors over lap i.e. a high source coupled with high potential for transport. Recent research has shown that a majority of the P lost from agricultural fields to water comes from a limited area in most watersheds and from a few storm events. These areas are called critical source areas. With this approach, we can recommend best management practices targeted to these areas rather than applying a broad, zero tolerance P limit to all agricultural land. This is a compromise where the nutrient management plans for some fields may be based on N while others must be based on P. This approach should maximize the benefits from agriculture's efforts to control P and still be practical and economically feasible for farmers.

Other research is ongoing across the country investigating the effects of animal feeding programs on the P content of manure. Examples of this include the use of phytase in poultry feed to make the animal more efficient in utilizing P in the feed and balancing amino acids in dairy feed, thus reducing the nutrients in the manure. There is also work on manure additives to tie-up the P in forms that are not bioavailable, thus reducing the potential environmental impact. Another example is manure separation. When manure solids and liquids are separated a greater proportion of the available N is in the liquid fraction and a greater proportion of the P is in the solid fraction. This provides some flexibility in matching manure nutrients to crop needs by targeting the individual nutrient applications to fields where they will be most beneficial and/or have the least potential for environmental impact.

Decision Case	*Because they recognize that the farm will likely have excess nutrients they have made a major effort to explore this type of management options as possible ways to bring the farm closer to balance. These practices are as important if not more important than the traditional manure management practices in developing a nutrient management plan for the expanded dairy operation.*

In Pennsylvania and in most other places, manure application guidelines and regulations are based on balancing N. This is driven by the practical and economic reasons discussed above and on the assumption that best management practices can be developed and implemented which will minimize P losses to surface water even when excess rates of manure P are applied. It is important to recognize that these are only remedial actions and that the ultimate solution to the problem will require elimination of excess P applications.

Developing a Nutrient Management Plan

Decision Case	*While it is recognized that a major component of the nutrient management plan on this farm will involve removing excess nutrients from the farm, an on-farm manure management plan will also be essential for the cropland where manure will be utilized.*

The first step in developing a plan for on-farm manure management is to collect information on the manure production, nutrient content, and application system for the farm. Manure production can best be determined from the amount of manure in a manure storage. However, not all farms have a manure storage and it is not always possible to determine the amount of manure in a storage even if there is one on a farm. Also, in planning a new operation or an expansion, actual measurements are not possible. In this case manure production can be estimated from animal numbers, animal weights, and time of confinement. As a rule of thumb, a dairy cow produces about 20 tons of manure per year. The actual amount to be handled and spread will vary from this depending on how much of the manure is actually collected and the amount of bedding or dilution water added.

Decision Case	*After the expansion the cows on this farm will produce over 10,000 tons of manure per year. Most manure management manuals contain more exact methods to estimate manure production. Calculation: 525 cows x 20 tons/cow = 10,500 tons/year*

Manure nutrient content should be determined by manure analysis. "Book" values for manure nutrient content are good as averages for a type of manure on many farms but because of farm to farm variability they are of little value for making decisions on an individual farm. Results of analysis of many dairy manure samples in Pennsylvania has shown that there is a very wide range in nutrient content for nominally similar samples of manure from different farms. Generally we must assume 100% error in the manure nutrient content if we use book values to develop a manure management plan. On the other hand a single manure sample may not be much better. Even in agitated storages there can be considerable variation in the manure analysis. A manure storage should be intensively sampled at least once to characterize the variability. This could be done by sampling every so many loads as the storage is emptied or by taking a sample every time there is an obvious change in the manure consistency.

The behavior of the nutrients in manure in terms of how they can contribute to the nutrition of a crop must be known if the true fertilizer value of the manure is to be determined. You cannot determine the fertilizer value of manure simply by multiplying the nutrient content by the current fertilizer nutrient price. Such a calculation will give an indication of the potential value of the nutrients in the manure but the actual fertilizer value realized for a given crop will depend on how the manure is handled and used. Approximately 50% of the total N remaining in dairy manure after storage is potentially available to the crop during the year the manure is applied. How much of that N is actually taken up by the crop, however, is significantly affected by the method of application. If the manure is not incorporated only about 20% of the total N will be available. The N that is not immediately available will become available over time as the organic material in the manure decays and releases the N. The amount of the residual N from past manure applications that will become available in any given year is very difficult to predict especially as the intensity of the farm increases. However, it can be estimated from the history of previous manure applications or in situations where there will be a change in management, such as with an expansion, the planned manure applications. For corn, the Pre-Sidedress Soil Nitrate Test has been used successfully in the humid regions of the east to help estimate residual N from previous manure applications.

Decision Case	*During an expansion there will be a transition period when higher rates of manure can be applied because of the low residual nutrient levels in the soil due to the much less intensive dairy operation on the farm in the past. However, as the dairy is expanded manure application rates will increase as will the residual nutrient s in the soil. Consequently the long-term manure rates will likely be lower than in the immediate time period following expansion.*

Another important consideration in managing manure nutrients is the effect of the cropping system. Different crops have very different nutrient requirements. Manure nutrients, especially N, are used more efficiently by corn and cereal grains than by legumes. But, in general, if manure is applied to meet the N needs of a continuous grain crop, P and potassium (K) will likely be applied in excess of crop needs and eventually build up to excessive levels in the soil. Forage crops, to which manure is not applied, planted in rotation with grain crops receiving manure will help remove the excess P and K and keep the three nutrients in balance over the rotation. This is illustrated in figure 2. In each example in figure 2, manure was applied to totally meet the N needs of the corn crop. With continuous corn (Figure 2a.), note the large excess of P and K that are applied. In the rotation example (Figure 2b.), when manure is applied to meet the N needs of the corn, the unmanured forage crop in the rotation uses the excess P and K and some fertilizer P and K will probably be required to meet the needs of the forage crop. This effect will vary with different rotations but the concept will be the same.

Decision Case	*As the dairy is expanded, the cropping system will likely also change to optimize the mix of home grown Vs purchased feeds. Thus the nutrient management plan should be based on this modified cropping system not on the current system.*

If manure is also applied to the forage crop in the rotation, for example, to utilize excess N present on the farm, this rotational balance will be disturbed. Large excesses of P and K will now be applied and soil test levels will increase. This raises serious environmental concerns because of the excess P. If manure is to be applied to the forage crops in the rotation it should be applied at a rate based on the P needs of the forage crop.

Regular soil testing is helpful to monitor the balance of P and K over the crop rotation. The bottom line is that over the rotation the trend in soil tests is level and in the optimum range. A rising trend in soil test levels is an indication of an imbalance due to excess manure nutrient applications. Developing a nutrient management plan requires soil tests for the entire farm or land where manure will be applied, cropping and manure application history, planned crop rotation, and other characteristics such as field location and soil characteristics. Using this information, the fields on the farm can be prioritized from high to low for manure applications as outlined in figure 3.

After the fields have been prioritized and the manure amount, nutrient content and nutrient availability have been established the available manure is allocated to the fields in the priority order. Rate calculations are based on the priority nutrient (N or P). If the rate is based on N, the manure analysis must be adjusted for N availability and the crop requirement must be adjusted for residual N from previous manure applications and legume crops. The best approach to determining an environmentally sound manure application rate would be to use the rate that does not apply an excess of any nutrient over what is needed for the crop as indicated by a soil test. In our experience, P is usually the limiting nutrient when this approach is followed. In fields where there is a crop rotation this limit should be calculated on the basis of the nutrient needs of the entire rotation rather than just on the current crop. However, this can still be very restrictive. As noted above, currently in Pennsylvania we base manure application rates on N and try to limit the P and K applications based on the rotation requirements. In practice many farmers still apply excess P and K. Since the major loss pathways for P and K are runoff and erosion, good soil conservation practices are critical in minimizing the environmental effect of excess P applications in manure.

Once a manure rate has been established for each field on the farm, the rates are adjusted for practicality. This usually results in the fields being grouped into one or a few standard rates that the farmer is able and willing to apply. Using these standard rates the available manure is allocated to the fields in the priority order until all of the manure is allocated or all of the fields have been used up. If all of the fields are used up and there is still manure left then the emphasis shifts to developing a plan for dealing with the excess. This usually means finding ways to get the excess off of the farm. Sometimes, if the excess is small, the cropping program can be adjusted to utilize the excess manure nutrients. Note that this priority order has nothing to do with the order that the manure is spread on the fields. That is an operational management decision. The main point is that when the manure is spread, it is spread on the high priority fields rather than on low priority fields.

Finally, the nutrients supplied in the manure must be compared to the needs of the crop to determine if additional nutrients are required or if there is a serious excess of any nutrient being applied. Deficiencies are taken care of by applying supplemental fertilizer nutrients or manure from other sources. Serious excesses must be evaluated in light of the nutrient needs of the crop rotation and may require a change in the manure application plan.

Decision Case	*An analysis was done for the expanded farm of the costs if manure would have to be hauled to fields 10 miles away from the dairy. For 325 cows this cost was $12,525 and for 525 cows the cost would be $25,683. In the analysis they assumed that about 1/2 if that cost would be recovered from the fertilizer value of the nutrients in the manure. This assumption would only be valid if the nutrients were needed by the crops where the manure is spread. For example, if the fields were already high in soil P the P in the manure would have no value.*

Nutrient Management Plan Implementation

Manure should always be spread uniformly on fields at the planned rates. Manure spreader calibration is the key for implementing the nutrient management plan. Procedures for calibrating different types of manure spreaders are available. Nutrient losses, pollution, and odor are reduced if manure is spread as near as possible to the time when plants will use the nutrients and incorporated into the soil as soon as possible, after it is spread.

The longer manure is in the soil before crops take up the nutrients, the more those nutrients can be lost through volatilization, denitrification, leaching, runoff, and erosion. The season in which manure is applied will reflect the nutrient availability for crops. Nutrients are best conserved by applying manure in the spring, as close as possible to the time when plants can use the nutrients and soil conditions permit. Manure spreaders have been implicated as a major cause of soil compaction on many farms, generally because most farmers want to apply manure before the soil is fit to till. Where soil compaction may be a problem, the selection of a chisel, field cultivator, or moldboard plow for incorporation is recommended to help alleviate the problems related to soil compaction.

Manure applied to the surface without incorporation can potentially lose available N through the volatilization of ammonia gas and losses by runoff. Losses increase with time, temperature, wind and low humidity. Surface applied manure is less likely to volatilize during early spring when temperatures are lower and rainfall may be more frequent. One half inch of soaking rainfall without significant runoff is comparable to incorporation if surface applied manure is a part of the manure management system. Generally, surface loss of nutrients and, to a lesser extent, volatilization losses are reduced as the amount of bedding increases.

Surface applied manure may be lost through surface runoff, especially when good management practices are not followed. On soils with a high erosion potential, conservation practices such as strip cropping, contour farming, crop residue management, cover crops, cropland terraces, diversions and grassed waterways can effectively reduce the loss of soil and manure nutrients. There are also certain areas which are particularly sensitive such as near streams, water bodies, or sinkholes, in areas where there is potential for concentrated flow of water particularly in the winter, and near wells and springs.

Summer application of manure is suitable for summer annual grasses, small-grain stubble, non-crop fields where vegetation exists, or little-used pastures where nutrients are needed. Manure may be applied to pure grass stands or to old grass-legume mixtures. However, manure application is not recommended on young stands of legume forage because legumes do not need N and the N will stimulate competitive grasses and may introduce weeds. If manure must be applied to alfalfa, the alfalfa can effectively utilize the nutrients from the manure, including N. Weed control is important if manure is applied to alfalfa and care must be taken to not physically damage the stand with heavy manure spreaders or by applying too much manure and smothering the crop. Liquid and slurry manure can be irrigated on growing crops, but flushing of the leaf surfaces with clear water may be needed to avoid problems with leaf burn and impaired photosynthesis. Corn should not be irrigated with manure when the plants are very young or during silking. In addition to concerns about nutrients, you must consider the infiltration capacity of the soil when irrigating with manure.

Nitrogen loss from fall applied manure is generally greater than loss from spring application. If manure is incorporated immediately, the soil will stabilize some of the nutrients, especially at soil temperatures below 50^{o} F. In the fall, manure is best applied to fields that will be planted in winter grains or cover crops to improve recovery of N. If winter crops will not be planted, manure should be applied to the fields containing the most vegetation or crop residues. Sod fields to be cropped the next spring would be acceptable, while fields where corn silage was removed and a cover crop was not planted would be unsuitable. Winter application of manure is the least desirable, from both a nutrient utilization and a pollution point of view. The major problem is that frozen soil offers a relatively impervious surface that prevents rain and melting snow from carrying nutrients into the soil. The result is nutrient loss and pollution through runoff. If daily winter spreading is necessary, manure should be applied to the fields with the least runoff potential, and it should be applied to distant or limited-access fields in early winter, then to nearer fields later in the season, when mud and snow make spreading more difficult. The use of conservation practices which reduce or slow runoff will help reduce the adverse impacts of winter applied manure.

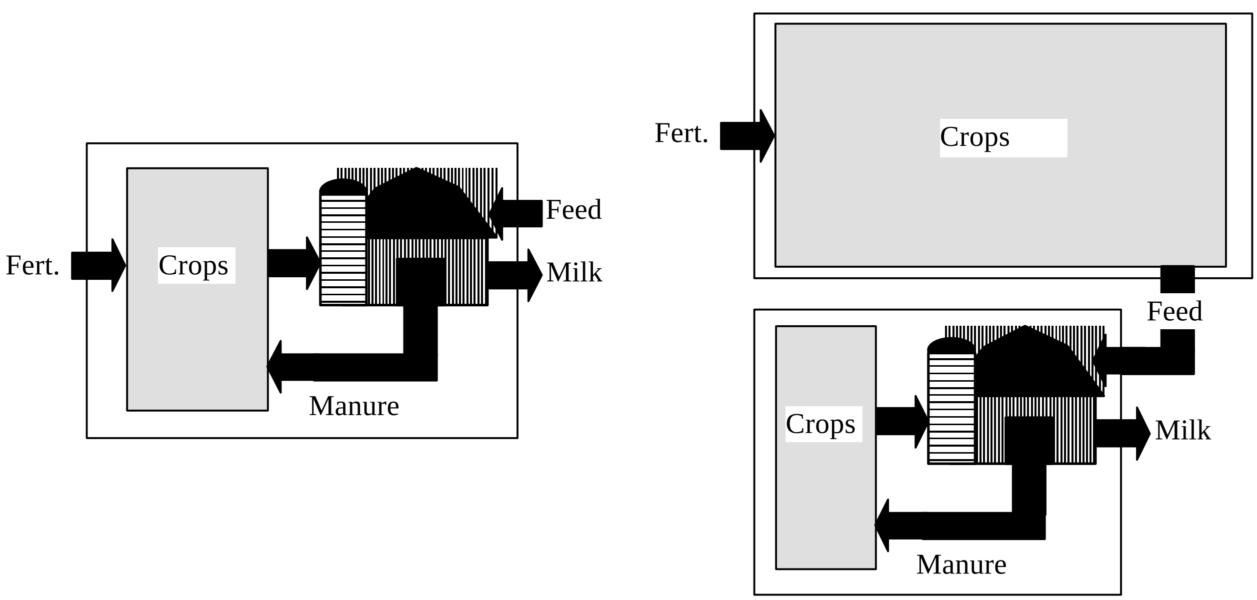
Decision Case	*There is a stream on the farm, which may dictate special environmental considerations. Conservation practices may be required and there may be restrictions on method and especially timing of manure applications in areas near the stream. Also, some of the soils on the farm are limestone soils, which commonly are associated with sinkholes, which are also an environmental concern.*

An important component of nutrient management plan implementation is keeping records. Records should be kept of manure application rates, timing, and incorporation. Also, crop yield records are important for determining nutrient balance.

Conclusion

Nutrient management is an on-going process of continually evaluating and adjusting nutrient management plans based on the strategic goals of the farm and the practical operational realities of dairy farming. The unique interaction of crops, feed, fertilizer, and manure: where they come from, where they go, and transformations as they cycle through a farm will determine the nature of the nutrient management process on each individual farm. Understanding plant nutrient cycles and how they differ on different types of dairy farms is critical to developing a nutrient management plan that optimizes the feed production and economics of the farm while minimizing the potential environmental impacts. Nutrient management is not a one size fits all procedure. If it is to be a practical and successful management operation it must be tailored to fit a specific farm and farmer.

Decision Case	*It would be challenging to develop and implement a nutrient management plan for this expanded dairy based on N as required by current regulations for a concentrated animal operation. It will be very difficult in this situation to develop and implement a nutrient management plan that meets the strategic goals of the farmer to balance phosphorus. They have taken a major step in looking at ways to improve the nutrient balance of the farm. However if this expansion is to be successful a long-term strategy for dealing with a significant amount of excess manure will also be necessary.*



a. Traditional, relatively self-sufficient dairy farm

b. Intensive dairy farm with feed imported from an external crop farm

Figure 1. Nutrient cycles on traditional and intensive dairy farms.

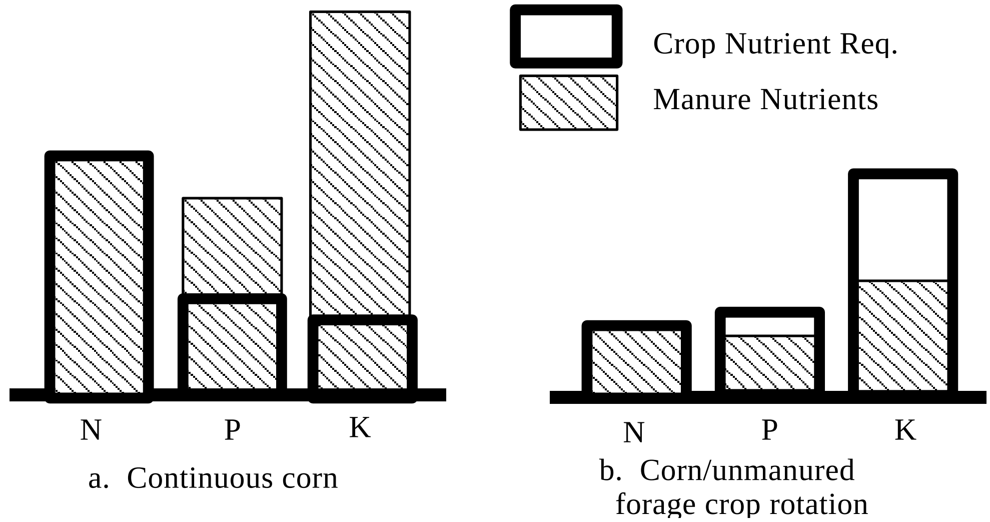


Figure 2. Crop nutrient requirement vs. manure nutrients for continuous corn and for a corn/unmanured forage crop rotation.

<u>Prioritize fields for manure application</u>:

By Crop
- N requiring crops ---> Non-N requiring crops

By N Requirement
- Highest N requirement ---> Lowest N requirement

By Residual N
- Lowest residual N ---> Highest residual N

By P and K soil test level
- Lowest P soil test level ---> Highest P soil test level
- Lowest K soil test level ---> Highest K soil test level

By Other management considerations
- Proximity to: Neighbors
  - Water bodies
  - Sink holes
  - Flood plain

Soil Limitations:
- N Leaching potential
- P Runoff potential
- Slope
- Cropping System

Figure 3. Prioritization of farm fields for manure application based on N.

FEEDING MANAGEMENT TO REDUCE PHOSPHORUS LOSSES FROM DAIRY FARMS

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Introduction

Nitrogen and phosphorus (P) contamination of ground and surface water are the leading environmental issues facing livestock farmers in Virginia, Maryland, and Pennsylvania. Increasing specialization and concentration of animal agriculture has led to nutrient imbalances on farms and across watersheds. When total P inputs to a farm or watershed exceed exports, P accumulates in soil, and may runoff, contaminating water resources. Phosphorus inputs to animal production systems include fertilizer, imported feeds (e.g. grains), and dietary mineral supplements, and P is exported in animal products and cash crops. Long term solutions to the problem of P losses from a farm or across a watershed must address this imbalance between inputs and exports.

Most efforts to reduce nutrient losses from farms have focused on manure management: handling nutrients once they accumulated on the farm. Relatively little attention has been paid to the "front end" of the system: management of the herd and feeding program to minimize nutrient excretion. Better understanding of the P requirements of dairy cows, and reducing the P content of diets to true requirements will reduce P excretion, a critical step in addressing this nutrient imbalance. This presentation reviews the current state of knowledge regarding dietary P requirements of dairy cows and focuses on the opportunity farmers and their advisors have to reduce P losses from dairy farms through improved nutrition.

Environmental Concerns

Environmental concerns with P are primarily associated with pollution of surface water. Excess P in water, like excess nitrogen, causes algae populations to grow rapidly, or to "bloom". The subsequent decomposition of the algae consumes dissolved oxygen in the water. Lack of dissolved oxygen is a major factor affecting the growth and reproduction of fish, clams, crabs, oysters, and other aquatic animal life. An algae bloom and subsequent decrease in dissolved oxygen is known as eutrophication, and may be caused by runoff or leaching of P or nitrogen from land.

It is well known that excess application of nitrogen, either as manure or chemical fertilizer, can result in loss of nitrogen to surface water. In contrast, P was thought to be fixed in soil in a relatively stable from, and the conventional wisdom was that excess P would accumulate in soils and only runoff if there was erosion. Management of P on farms was a matter of preventing erosion using favorable tillage and cropping strategies. Recently, however, it has been discovered that with excessive application of P to soils over a period of several years, the soils become saturated with P and runoff can occur even when erosion is controlled (32)

Increased soil test P from excessive application of fertilizer, manure, and crop residues has been linked to greater soluble P in runoff. No till practices, although they reduce soil erosion, may actually make runoff of soluble P worse, because P is kept near the soil surface. Still controversial is the soil test P level at which soluble P becomes a problem and the interaction of soil type with P solubility (33).

Livestock are inefficient in the utilization of P, and typically, more P is imported as feed and fertilizer than is exported in meat and milk. Figure 1 outlines P flows on an example 100 cow dairy farm. We assumed 100 mature dairy cows averaging 19,500 lbs of milk per cow per year, 80 replacement heifers, and 50% digestibility of dietary P. Forages (corn silage, alfalfa hay, and pasture) are grown on the farm, and grains are imported. Phosphorus imports exceed P exports on this farm by 1 ton per year, and this quantity accumulates in the soil.

High animal density, application of that manure to a restricted land base, and the resulting soil accumulation of P in the Shenandoah, Potomac, and Susquehanna River watersheds make the Chesapeake Bay particularly vulnerable to nutrient contamination. Rockingham County in Virginia is representative of the challenge facing many counties in the Chesapeake Bay watershed. Rockingham County has the highest population of both dairy cattle and poultry in Virginia, and as many as 20% of the dairy farms in the county also have at least one poultry house. Estimated manure nutrient production in Rockingham county exceeds crop requirements on a yearly basis (29).

There is a clear link between heavy application of manure over time and P accumulation in the soils. Manure phosphate per acre of cropland in Rockingham county increased by 90% between 1978 and 1992, and an analysis of soil tests in 1993 and 1994 indicated that nearly 90% of samples were ranked “high” or “very high” in P (29). Although there is controversy as to the threshold level of soil test P that leads to P runoff, these soils clearly need no additional P, and may not need any more for up to ten years.

This link between cow numbers, manure application to a limited land area, and P contamination of surface water was demonstrated dramatically in the Lake Okeechobee watershed in Florida. From 1973 to 1988, P concentration in the water of Lake Okeechobee in Florida increased by 250% (28). During this same time period, cow numbers in the three counties surrounding the lake increased by more than 900 cows per year (3), and dairies were identified as the source of 40% of the P load to the lake (28). The appearance of massive, lake wide algae blooms led to the imposition of stringent regulations designed to reduce agricultural runoff.

Areas facing the dilemma of an economically important livestock industry concentrated in an environmentally sensitive area have few options. If agricultural practices continue as they have in the past, continued damage to water resources and a loss of fishing and recreational activity are almost inevitable. If agricultural productivity is reduced, however, the maintenance of a stable farm economy, a viable rural economy, and a reliable domestic food supply are seriously threatened. If nutrient management regulations cause a displacement of farming activities in exchange for suburban sprawl, nutrient loading to water from septic systems and erosion may actually increase. Practices that reduce nutrient losses from farms without impairing profitability must be developed and implemented.

Reducing the amount of P in manure through nutrition is a powerful, cost effective approach to reducing potential P losses from dairy farms. Concentration of P in the diet of dairy cows has also been shown to have significant impact on P excretion. Several studies indicate a direct link between P intake and P excretion (11, 16, 22). A Florida study shows this link most clearly (22). Twelve cows were fed diets containing one of three levels of P (.3%, .41%, .56% of dietary DM). Excretion increased linearly with increasing intake, and nearly all of the difference in P intake with the high P diet compared to the low P diet was excreted (Figure 2).

Phosphorus Requirements of Lactating Cows

Phosphorus metabolism by lactating cows

Phosphorus is required by lactating cows for bone formation and maintenance, milk secretion, building muscle tissue, energy metabolism, fatty acid transport, phospholipid synthesis, amino acid metabolism, and protein synthesis. It is a component of nucleic acids involved in cellular metabolism, enzyme systems, and buffer systems.

Regulation of P metabolism is complex, and involves regulation of absorption from the gut, mobilization from bone, and secretion in saliva. Phosphorus is absorbed in the small intestine as phosphate, and this absorption is primarily in response to need – low serum P increases absorption of dietary P (12, 13, 20, 25, 31). Phosphorus in the bloodstream is either retained in meat, milk, or bone, or secreted through saliva back to the digestive tract. Ruminants secrete large quantities of P in saliva, and this is a key mechanism for the regulation of P metabolism. Absorbed P not used for growth, deposited in bone, or secreted in milk is secreted in the saliva and then excreted in the feces.

Phosphorus also enters the bloodstream through mobilization from bone, but there is no direct mobilizing mechanism for P like there is for Ca. Bone mineral is a complex Ca-P salt, so mobilization of bone Ca also results in mobilization of bone P (4). In early lactation cows, Ca is mobilized from bone, and thus P is also released in substantial quantities. In these cows, increased P demands increase P absorption from the gut at the same time that their need for Ca increases P mobilization from bone. This results in a surplus of P in the bloodstream which is then secreted in saliva and excreted. Feeding the early lactation cow to meet her calculated requirements for milk and maintenance may not be necessary and may have no effect on P retention (4). More effort needs to be focused on the best way to meet the requirements of these cows without inadvertently increasing excretion.

Development of published requirements

Table 1 outlines true P requirements for lactating cows according to the current NRC and other nutrient requirement publications from around the world. Published requirements for dairy cattle are based on peer reviewed research in ruminants, including very few studies with lactating cows. The small number of studies is because of the expense involved in conducting and interpreting mineral balance experiments in lactating cows.

Requirements for P are calculated using a factorial approach. The P requirement for a cow is the sum of the calculated requirement for maintenance based on body weight, the requirement for pregnancy, and the requirement for milk yield based on the P content of milk. True requirements are divided by the efficiency of absorption of dietary P to yield total P requirements, and Table 2 lists current total P requirements for lactating cows.

The maintenance requirement for P is currently estimated as 1.43 g/100 kg liveweight/d [Council, 1989 #821]. There is a debate as to whether or not this estimate is appropriate. The maintenance requirement for P is estimated based on minimum endogenous losses of P in the feces and urine. Fecal P is a combination of indigestible P, inevitable endogenous loss, and that excreted as part of a homeostatic regulation (e.g. that consumed in excess of requirements; 18, 35).

In a German study designed to clarify the inevitable endogenous loss of P, two groups of cows of similar body weight were divided into high or low milk yield groups and fed low P diets at different levels of intake (35). Both groups of cows were in zero P balance, so fecal P in these cows was a combination of truly indigestible P and inevitable endogenous losses. With such low P intakes, digestibility of P is typically very high, and the authors ascribed all excreted P to the inevitable endogenous loss category. Fecal P as a proportion of body weight was very different, but fecal P as a fraction of dry matter intake was essentially identical (1.2 g/kg DMI). The link to DMI is logical as salivary P contributes the bulk of endogenous P losses.

The requirement for P for milk yield varies primarily with milk fat content. The current true NRC requirement is .99 g of P/kg 4% FCM (Table 1).

Digestibility

The digestibility of feedstuffs has a dramatic impact on published total P requirements, but is based on relatively few studies (17-19). Digestibility of P declines with age of the animal, and the 1989 NRC requirements for growing animals account for this with P availability declining from 90% in calves to 55% in animals over 400 kg. NRC requirements for lactating cows assume a constant digestibility of 50%. The availability of P in lactating cows from all feeds was reduced from 55% to 50% in the last update of the NRC, apparently in an effort to build an additional safety factor into the published requirements. This change increased the total P requirement for P by 10 to 20%.

If improved P availability allows reduced P intake, the P content of livestock manure can be reduced. The development of phytase additives for monogastric animals is one example of nutritional manipulation of nutrient excretion, but this technology has little potential in ruminant animals because ruminal microorganisms already provide phytase activity. One important implication of this fact is that the natural phytase activity provided by ruminal microorganisms makes the P in grains and forages available to ruminants (8, 11, 22). Thus there is no need to discount the P in grains and forages, but some nutritionists still do.

The assumed digestibility of dietary P has a tremendous impact on the dietary P requirements of lactating cows. If digestibility of dietary P was increased by 5 units allowing decreased P feeding, P excretion could be reduced by about 15% in lactating cows[1]. With roughly 750,000 dairy cows in the Chesapeake Bay Watershed (14), an increase in P digestibility of this magnitude and the appropriate reduction in P feeding would reduce P excretion by 1750 tonnes per year, or the equivalent of 3500 tonnes of P_2O_5 per year. This example makes clear the need to better define the digestibility of P in feedstuffs, and to seek out technologies that may increase digestibility of dietary P in ruminants.

Changes in the NRC requirement for P?

Tables 1 and 2 outline current true (net) requirements and total P requirements (true requirements divided by assumed digestibility) according to the NRC and other nutrient requirement publications from around the world. There is variation among these publications, and published recommendations do change as our base of knowledge expands. Although more data is still needed, it seems apparent that modifications are warranted in the definition of the maintenance requirement for P, and in the bio-availability of P in feeds. Expressing the maintenance requirement of cows as 1.2 g P per kg DMI will increase requirements only slightly (Table 3), but is more biologically sound (35).

More work to better define the availability of P in a variety of feedstuffs is clearly necessary. There is some reported variation in the bio-availability of P sources for ruminants that has not been fully explored (30, 31), and there is obvious variation in the assumed digestibility of feed P among nutrient requirement publications worldwide. Of these publications, our NRC publication assumes the lowest digestibility of feed P (Table 2). European countries currently assume P digestibility of 58 to 70%, reducing recommended feed levels significantly compared to the U. S. system. Given the environmental and economic importance of P intake, reconsidering the assumption of 55% P digestibility across feedstuffs may be merited. In the long run, a system accounting for variation in availability of P among different feedstuffs would be beneficial.

Overfeeding P

The 1989 NRC P requirement for lactating dairy cows is about .41% of diet DM, but P content of rations in the field typically averages .55% or greater, 30% more P than required (34). Phosphorus is often fed to dairy cattle in excess of published requirements because high P diets are commonly believed to improve reproductive performance. This perception likely originates from the observation that severe P deficiency impairs reproductive performance in cattle. The original studies that established this belief were primarily with range cattle (2, 10), and the dietary P concentrations necessary to induce this impaired reproductive performance were below .25% of the dietary DM. This dietary concentration is far below the concentration found in most feedstuffs in modern dairy rations even without supplementation, and in all of these studies, P intake was seriously confounded with intake of energy and other minerals.

Although severe P deficiency may impair reproductive performance, there is no research data to suggest a benefit from feeding P to dairy cows in excess of NRC requirements. In fact several

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[1] Calculations assume lactating cows fed diets to meet current NRC requirement for P. Phosphorus intakes reduced with increasing digestibility of dietary P. Phosphorus excretion calculated as P intake – (milk P + maintenance P). Milk P = .99%* milk yield and maintenance P = .0143*body weight (NRC 1989).

studies reported no impact of dietary P concentrations of .33 to .35% of dietary DM on days open, services per conception, or calving interval (5, 6, 40). One study did indicate increased services per conception with P at .37% of dietary DM as compared to P at .56% of the diet (36), but cow numbers were much too small in this study (just 16 cows on the low P diet) to assess this parameter accurately.

A recent study by researchers in Wisconsin serves as an example of the studies indicating no effect on reproductive performance of P supplementation (40-42). Forty-eight cows were assigned at calving to low or normal P diets (.35% vs. .5% of dietary DM), and dietary treatments were continued through two lactations. With the data from the first year summarized, milk yield, 4% FCM, and DMI were not affected by treatment. Days to first estrus were 8 days longer for cows on the low P diet ($P < .09$), but days to first service, conception rate, services per conception, and pregnancy rates were not different. These were high producing cows, averaging 65 to 70 pounds of milk through the first year of the study.

Interestingly, one study actually reported depressed milk yield when P was fed at 35% over NRC requirements compared to cows fed at the NRC requirement (7). Forty eight primiparous cows were assigned to high or low energy and high or adequate P diets. Adequate P diets were formulated to contain P at .4% of dietary DM, while the P content of the high P diets were 35% greater than requirements, or .5% of dietary DM. Cows fed the high P diets had reduced milk yield of 1.8 kg/d during the experiment, and produced 816 kg less milk over the course of the first lactation, even though cows were fed a common diet after the first 84 days.

An important point to emphasize is that like other nutrients, the requirement of the cow for P is for quantities, not concentrations. For convenience in balancing rations, P requirements are commonly expressed as a percentage of DM. The actual dietary concentration required to yield the required quantity of P, however, varies with dry matter intake. For instance, the current NRC requirements for a 600 kg cow producing 30 kg of milk with 4% butterfat is 93 g of P per day. The percent of P required in the diet DM for this cow is .49%, .44%, and .40% with DMI of 19, 21, and 23 kg/d.

Again, field observations suggest that most dairy farmers feed diets containing P significantly in excess of these published requirements. Two factors that have led farmers to overfeed P are undetected variation in the P content of feeds, and inconsistencies between NRC requirements and the advice farmers receive. Undetected variation in the P content of feeds leads to imprecise ration formulation. Phosphorus content of forages analyzed by the Northeast DHI Forage laboratory from May 94 through April 95 was highly variable (15). The coefficient of variation in P content of forages was 20-25% for most forage types, and P content was more variable for grasses than for legumes. Despite this variation, wet chemistry analysis of forages for P content is not routinely requested.

Both ration balancing programs and field recommendations influence P intakes in the field. Although based on NRC, the DART ration balancing software lists P requirements about 15% higher than NRC for lactating cows (9). This inconsistency, and inconsistent recommendations from nutritionists, veterinarians, and extension personnel have led many farmers to feed P in excess of the NRC recommendations. Until the environmental consequences became obvious, overfeeding P was viewed as cheap reproductive insurance. Revisiting the literature makes clear that here is no documented benefit to overfeeding P. Now that we are realizing the true cost of overfeeding P, we must move aggressively to correct inconsistencies in our recommendations. Phosphorus intakes in the field are now typically in excess of current requirements by 25-40%, giving farmers a tremendous opportunity to benefit both economically and environmentally by feeding at the current published requirements.

Economic Impact of Reducing P Intake, Excretion, and Losses from the Farm System

The impact of reducing P intake on P losses from the farm system can be estimated several ways. One can predict P excretion simply as the difference between P intake, and P in milk, retained in body weight gain, and fetal development (39). Given allocation of manure to crops, and estimated nutrient uptake by those crops, one can calculate acreage required to land-apply manure for changing. Evaluating a dairy farm milking 100 cows with different cropping strategies, we can see the tremendous impact P intake has on acreage required for disposal of manure on a P basis (Table 4). Acreage required to dispose of manure generated by the herd increases by about 60% as P intake increases from .4% to .55%. Alternatively, given a fixed land base and different cropping strategies, we calculated the maximum number of milking cows supported by that land base. As P intake by the herd increases from .4 to .55%, herd size that can be accommodated with P-based manure application decreases by 35%.

The impact on net farm income of P intake depends upon the regulatory conditions affecting the farmer. If the farmer is not under P-based nutrient management, and applies manure without regard to its P content, the only impact of feeding excessive P is on his feed bill (Table 5). A 100 cow herd increases their feed bill by $750 to $850/year by feeding P at .45% of dietary DM vs. .4% dietary DM, depending on milk yield and feed intake. With P at .5% of dietary DM, the feed bill is increased by $1500 to $1700/yr, and at .55%, feed costs are increased by about $2250 to $2500/yr.

There is more and more discussion of mandatory P-based nutrient management, and Maryland has implemented a law requiring farmers to comply with such plans by the year 2004. Most livestock farms produce more manure P than their crops require, and P-based plans will require that the excess manure be exported so that excess P is not applied and allowed to accumulate.

For the farmer under mandatory P-based nutrient management, the costs of excessive P supplementation and P excretion are much greater. These costs include the increased feed bill, the cost of exporting manure in excess of what can be applied to land, and the cost of purchased N fertilizer to meet the needs of his crops because he won't be able to use manure produced on his farm to meet all of the crop N requirements. A study at Virginia Tech examined dairy and dairy poultry operations of different sizes, estimated potential P losses, and simulated net farm income under different policy scenarios (29). One of the policy scenarios was a restriction on P applications to that taken up by the crop harvested.

In this study, the policy limiting P application was the only policy with any measurable impact on P losses from dairy and dairy/poultry operations of varying sizes. P losses were reduced by 28 to 43% by this policy, but net farm income was dramatically affected, falling by 11 to 23%. The reduced net farm income was due primarily to the increased cost of purchased nitrogen fertilizer to meet the N requirements of crops (limiting manure application to P removal resulted in under-application of N relative to crop needs). The impacts on net farm income are likely underestimated in this study, as it was assumed farmers could dispose of excess manure off the farm at no charge. If a similar P-based policy were actually enacted, saturation of the market for this manure would likely mean farmers would have to pay to have manure removed from their farms, reducing net farm income still further. While manure obviously has fertilizer value, it is bulky and expensive to transport, and the cost of trucking the material any distance quickly exceeds its fertilizer value.

The economic importance of preventing P losses from dairy farms has been demonstrated in Florida as well. In the 1980's several regulatory and incentive programs were implemented in the Lake Okeechobee watershed in Southern Florida to reduce P losses to surface water (3, 21). Treatment facilities were required to manage wastewater from parlors and holding areas, waterways were fenced, wells were monitored, and farmers were required to meet rigid standards for P application. Noncompliance fines were steep. At the same time a voluntary buyout program was implemented. As a result dairy cow numbers decreased by 26% and milk production decreased by 17% from 1987 (the year of program implementation) to 1993. Despite cost-sharing of 60-70%, dairies remaining in the area faced increased costs of production of more than $1/cwt to implement mandatory and optional management practices and structures to reduce P loss from their farms. When increased culling, labor requirements and variable costs during construction were included, the net expense to producers staying in the area was $568/cow or $600,000 per dairy (21). The total economic impact of these programs in the region between 1987 and 1993 included decreases of 4% in both total income (down $18 million) and job numbers (down almost 500).

Conclusions

Additional research is needed in several areas to better understand the P requirements of lactating dairy cows. Key questions include the availability of P to lactating cows from various sources, and the question of just how low we can go with dietary P in high producing dairy cows without impairing reproductive efficiency. Answering this second question will be difficult because it will require large numbers of high producing cows.

From a policy perspective, perhaps we need to reconsider funding priorities. Most research and cost-share programs for reducing agricultural nutrient loading to water resources have been directed toward agronomic nutrient management and manure handling. However, improving nutrient utilization in the animal with more accurate diet formulation will reduce nutrient losses to the environment, cost less to implement, and may save farmers money compared with traditional approaches.

Most importantly, increased education of producers and their advisors is needed now to reduce overfeeding of P. The perceived impact of P intake on reproductive efficiency far exceeds the actual effect, and overfeeding is not of benefit. For farmers, reducing P intake to published requirements makes sense environmentally and economically. It would be difficult to overstate the economic implications of P-based nutrient management for livestock farms throughout the Chesapeake Bay watershed, and the importance of refining rations to reduce P excretion and subsequent land application of P. Legislation has been passed in Maryland that may outlaw the application of manure to soils that have very high P concentrations. Under this and similar laws, many farmers simply will not be able to apply manure on their farms because of high soil P concentrations. The sooner farmers begin to reduce soil P concentrations to acceptable levels on their farms the better off they will be. Reducing P intake to reduce P excretion is the most powerful, cost effective tool farmers have to achieve this goal.

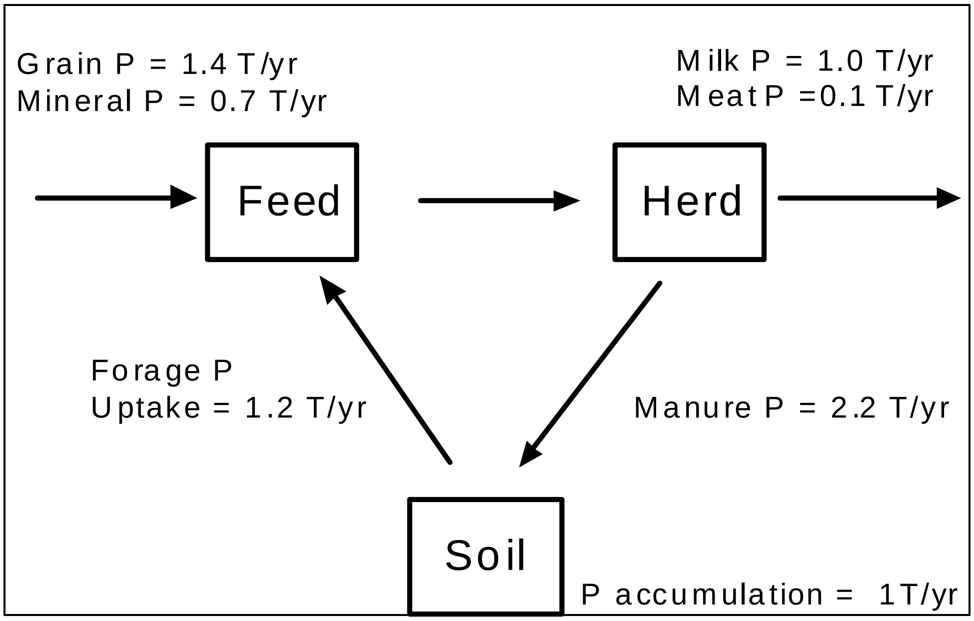

Figure 1. Phosphorus flows on an example dairy farm.

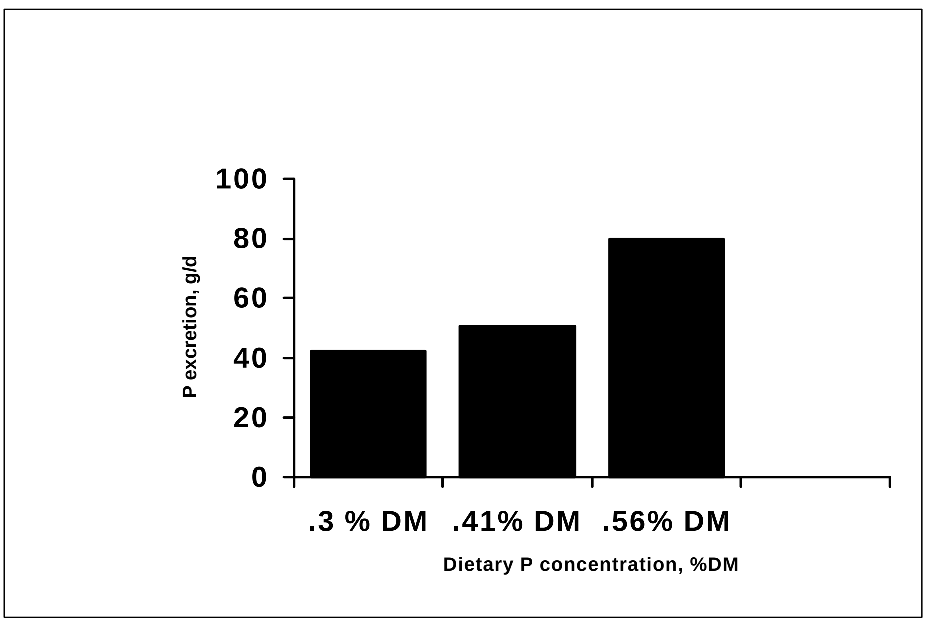

Figure 2. Effect of dietary P concentration on P excretion in lactating cows. (23)

Table 1. Published daily P true (net) requirements for dairy cows.*

System	Year	Assumed digestibility of feed P, %	True maintenance req't	True milk req't g/kg milk
NRC	1971	50	14.3 mg/kg BW	1
	1978	55	14.3 mg/kg BW	.9
	1989	50	14.3 mg/kg BW	.99
ARC	1965	55	16.8 g/d for 600 kg	.95
	1980	58	12 mg/kg BW	.905
Netherlands	1983	60	25.2 mg/kg BW	.9
France	1988	70	43.4 mg/kg BW	.875
Germany	1987	60	24 mg/kg BW	1
Germany	1993	70	1 mg/kg DMI	1

* Adapted from (1, 24, 26, 27, 37, 38)

Table 2. Published daily total P requirements, g/d, for a 600 kg dairy cow*.

		Assumed digestibility of feed P, %	P intake for maintenance	P intake for maintenance plus varying yields of 4% fat corrected milk, kg/d			
System	Year			20	30	40	50
NRC	1971	50	17.2	57.2	77.2	97.2	117.2
	1978	55	15.6	48.3	64.7	81.1	97.4
	1989	50	17.2	56.8	76.6	96.4	116.2
ARC	1965	55	30.5	65.1	82.3	99.6	116.9
	1980	58	12.4	43.6	59.2	74.8	90.4
Netherlands	1983	60	25.2	55.2	70.2	85.2	100.2
France	1988	70	37.2	62.2	74.7	87.2	99.7
Germany	1987	60	24.0	57.3	74.0	90.7	107.3
Germany	1993	70	varies	53.4	67.7	91.4	111.7

* Adapted from (1, 24, 26, 27, 37, 38)

Table 3. Impact of expressing the maintenance requirement as a fraction of body weight (1.43 g/kg BW) or of dry matter intake (1.2 g/kg) on P requirement, g/d. Assumes 50% digestibility

MY	BW	DMI	Body weight basis		DMI basis	
Kg/d	Kg	Kg/d	Maintenance P, g/d	Total P, g/d	Maintenance P, g/d	Total P, g/d
25	450	16.9	12.9	62.4	20.3	69.8
30	450	18.7	12.9	72.3	22.4	81.8
35	450	20.7	12.9	82.2	24.8	94.1
25	500	17.5	14.3	63.8	21.0	70.5
30	500	19.5	14.3	73.7	23.4	82.8
35	500	20.1	14.3	83.6	24.1	93.4
25	550	18.4	15.7	65.2	22.1	71.6
30	550	20.4	15.7	75.1	24.4	83.8
35	550	23.7	15.7	85.0	28.4	97.7
25	600	19.2	17.2	66.7	23.0	72.5
30	600	21.0	17.2	76.6	25.2	84.6
35	600	22.2	17.2	86.5	26.6	95.9

Table 4. Impact of P intake on manure disposal under P-based nutrient management

	Dietary P concentration			
	.4	**.45**	**.5**	**.55**
Acres required for given herd size and milk yield[1]				
100 cows, 60 lbs milk	91	108	126	143
200 cows, 60 lbs milk	182	217	251	286
100 cows, 80 lbs milk	93	112	132	151
200 cows, 80 lbs milk	186	225	264	303
Maximum cow numbers for given crop acreage				
100 acres, 50% corn 50% alfalfa	93	78	68	60
100 acres, 75% corn 25% alfalfa	93	79	68	60
100 acres, 50% corn 25% alfalfa 25% grass hay	86	73	63	56
100 acres, 50% corn, 25% small grains, 25% alfalfa	73	62	54	47

[1]Assumes cropping program of 50% corn, 50% alfalfa. Dry matter intake predicted from NRC, 1989, and crop nutrient uptakes as in (39)

[2]Assumes milk yield of 60 lb/d, dry matter intake predicted from NRC, 1989, and crop nutrient uptakes from (39)

Table 5. Increase in annual feed costs of a 100 cow herd relative to P at .4% of dietary DM[1]

Average milk yield, lbs/d	DMI, lbs/d[2]	Dietary P concentration .45	.5	.55
60	45.6	$754	$1500	$2260
70	48.4	$798	$1603	$2402
80	51.2	$850	$1693	$2542

[1]Assumes increased inclusion of Dicalcium Phosphate, at $350/ton.
[2]Predicted from NRC, 1989

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NUTRIENT MANAGEMENT AT TABLE ROCK FARM, INC. – A CASE STUDY

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Background

Table Rock Farm is a fourth-generation, 900-cow dairy farm, employing 16 people. It is located in a successful dairying region of Western New York. The farm owns 580 crop acres and rents 520. This is a ratio of 1.2 acres/cow, not including heifer units, which are also located on the farm. All forages are raised on the farm, and surplus corn silage has been sold to neighboring dairies for three years.

Table Rock Farm's mission is to produce quality milk at a competitive price to meet the needs of the public. One of the goals supporting this mission is that everyone at Table Rock will farm in an environmentally responsible manner. (Appendix A)

This paper will review the limitations Table Rock faces while working towards this goal and highlight the ways the farm carries out this facet of the mission. This review will also include an examination of conservation and nutrient management practices.

Limitations

Land

In the 10-mile radius surrounding Table Rock are 10 large dairies and a number of potato/crop growers. This concentration of agriculture has left little available cropland for sale and has put increasing pressure on land sale and rental prices. Quality land near Table Rock can cost $2500/acre, where acreage 5-10 miles from dairies and crop farmers can cost $400/acre. Leases are a challenge, both from the aspect of cost and the aspect of landowner personalities.

Additionally, purchasing land beyond current holdings will make Table Rock less efficient. Using careful crop management techniques, such as narrow row corn cropping, we currently produce enough corn silage to feed our animals and to sell the excess. If we purchased land, we would have to find more corn silage customers. Our debt/cow would increase dramatically. We would probably have to drive more than five miles to reach any new land, requiring more time on roads hauling heavy, water-based products (silage and manure). More travel might make the purchase of additional 10-wheel transport trucks necessary. It would also mean increased public visibility and perhaps travel through villages.

Neighbors

It is not pleasant to live near a large farm. The smell, dust and debris from a farm decrease the value of adjacent homes and make for low tolerance levels among neighbors. These less pleasant traits of farms are not always apparent to people drawn by the appeal of "country living".

Table Rock does not have too many neighbors, but we make a constant effort to remain on good terms with homeowners bordering our land. We hand-deliver letters in the spring that describe farm activities (Appendix B). We plant sweet corn and invite neighbors to harvest it. We hold an open house exclusively for neighbors every other year.

We also take a pro-active stance in buying homes bordering the main farm. This year we purchased a home at the end of our farm driveway in a foreclosure sale. The home was not salvageable and had to be destroyed, but the resulting purchase price of $10,000 acre was worth the security of knowing that a non-farm neighbor could not move onto the location.

Odor

Odor is probably the number one reason neighbors become upset with farms. It is more apparent and less controllable that any other aspect of the farm. Table Rock has tried many methods for odor control, from proven techniques including injection of manure to more speculative experiments including ground aeration and the addition of Pine-Sol to manure. We are constantly seeking solutions to this problem.

Current Practices

Farmstead

The guiding concept for our farmstead is to deliver clean water to the ditch without contamination and to collect contaminated water for delivery to our waste storage system. Techniques for accomplishing this include:

- Drip trenches with stone covered tile lines around all buildings.
- A single-sloped roof dry cow barn that tilts away from the sloped concrete dry lot.
- Herding run-off water from pasture and barns across sod.
- Tiling along driveways to bring water to ditches and to make the drives more solid.
- Monitoring ditches for effluent.
- Maintaining tile lines.

Bunk Silos

We take silo effluent run-off very seriously and have taken the following steps to combat this problem:

Our newest bunk silo was built this spring with the following conservation specifications:

- Sewer-type tile drainage lines laid every 30 feet placed beneath the silo base.
- 6 inches of #2 stone compacted with Bomag rollers.
- A 6-inch thick concrete pad base.

A slow-flo system serves both our bunk silos. This system allows fast moving water from a rain storm to flow onto a sod filter strip, while slow moving effluent is captured and runs to a containment tank which is pumped to our manure storage.

Every bunk is covered with plastic held down with a tire to tire covering. This also improves feed quality and decreases spoilage.

Manure handling system

Our main dairy facility has a 918,000 cu. ft. manure storage that can hold 300 days of wash waste and manure from 1050 cows. This allows us to spread manure at the optimum times for nutrient uptake.

Our manure handling system is designed to minimize mess and maximize efficiency. When spreading, a 5000-gallon spreader tank remains in the field while 4500-gallon nurse trucks travel the roads carrying manure from the farm to the field. This system keeps dirt and slower moving tractors off the road and minimizes compaction in the field. Any accident or manure spill is also limited to one truck tank load.

All manure is injected on corn ground to minimize odor and to maximize nutrient use. Manure is top spread on hay fields.

Nutrient Management Planning

According to guidelines being established in New York State, Table Rock can easily meet standards for nitrogen output with its current farming practices and land base. However, we are not in phosphorous balance. We continue to raise the phosphorous challenge with our farm team, with crop management specialists and nutritionists and with researchers.

Following are some ways we work on nutrient management.

- Use of crop management association

The Western New York Crop Management Association (WNYCMA) provides us with a written plan and records for all manure spreading, crop planting and chemical use. (Appendix C) They meet with our crop team twice a year for input on crop decisions and to explain the finished plan. They are available for questions throughout the year and are up-to-date on the latest techniques.

- Soil testing/Manure samples

Soil tests are performed on all fields and manure samples are collected a few times a year so we can calculate the inputs and the application rates. The soil tests also track a clear record of phosphorous levels on our land.

- Yield goals

Yield goals are set each year in conjunction with the WNYCMA. By reaching these goals, we know we are removing certain levels of nitrogen, phosphorous and potassium from the soil. We also employ techniques such as narrow row corn planting to successfully achieve the necessary yields.

Team Responsibility

Decisions regarding nutrient management involve the Table Rock team. Employees meet with crop management representatives and participate in decisions about bunk silo storage or other waste management issues. Everyone on the farm makes suggestions for improvements and takes pride in the appearance of the farmstead and the impression we make to neighbors.

Recent Efforts

We continue to work toward phosphorous balancing. To that end, we have recently initiated these steps.

Exporting manure

We have approached area crop farmers regarding use of our manure to fertilize their land. We supply manure for free, and they supply a hauling system. This is an excellent way to move more nutrients from the farm, but interest has been limited so far.

Exporting forages

We sold 2500 tons of corn silage this year, which increased our nutrient export off the farm. However, we do not have any year to year customers, so selling silage is not a long-term solution.

Feeding program

After consultation with our nutritionist and nutrition researchers, we have dropped the amount of phosphorous we are feeding to NRC standards. We are waiting for results of other research before taking additional action.

We are also trying to increase the amount of home grown forages being fed, both to save on purchased feed costs and to decrease the amount of additional nutrients brought on the farm.

We are preliminarily involved with whole farm nutrient planning research being carried our by Dan Fox and Larry Chase at Cornell University. This plan utilizes the Cornell Net Carbohydrate Model for feed ration planning as part of its overall plan to equalize nutrients entering and leaving the farm.

Conclusion

At this time, we continue to be balanced for nitrogen but not for phosphorous. The methods described under "Recent Efforts" should help us, but nutrient management experts tell us that further work will be required.

We will continue to search for and invest in methods that make us more responsible land stewards. We believe that our goal of farming in a more environmental manner will result in greater efficiency and a better quality of living for all involved in and affected by the farm.

HERD INFORMATION MANAGEMENT

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Introduction

The dairy industry is undergoing profound and rapid change. To survive in the future, today's dairy producer must adapt to cope with these new challenges. One of the largest challenges facing the typical producer is the need to change from a business that is primarily managing family manual labor to one that primarily deals with the management of hired personnel, borrowed capital, and information. This paper will address some concepts of managing the use of information on-farm and in conjunction with private consultants.

Managing Information On-Farm

With the price of computers dropping quickly while their power is increasing, computer technology is practical and affordable on almost any size dairy. While there may well still be use for some paper records on dairies, dairies in the future will almost universally use computers to help manage their business.

Monitoring systems need to be rapid, be routinely utilized in a timely manner, reflect current as well as past performance, and be easily expanded for more in-depth investigations. As margins have become tighter and herds have grown larger, rapid and timely management of the large amount of data needed to monitor dairies is required.

Examining these data usually require the use of computers. Although computers and software are potentially well-suited to this task, herd managers and their consultants should be wary of surrendering professional judgment and common sense to the computer. There will always be a need for expert interpretation and filtering of the computer's output for presentation to the herd management team.

Managing Information with Consultants

It has been said that knowledge is power. This is wrong. Taking action based on knowledge is true power. In other words, merely collecting and being aware of information is of no use unless some (positive) action is taken to improve the dairy and/or its profits. We have named this important step "data-based action".

However, before logical action can take place, some other steps are necessary:

1. Data Collection
2. Data Entry
3. Data Analysis

4. Data-based action

The *only* step that makes the dairyman money is the last one: Data-based action. The other steps, while essential to the whole process, are of no value unless the final step is taken. Too often in a monitoring program the management team has failed to take the final step, and no action was taken to improve the bottom line of the dairy.

Before embarking on this series of data steps, one must always determine exactly what question is being asked. If you don't know the question, how will you know when the computer is giving you a wrong answer? As we tell our veterinary students, "you must be smarter than the computer."

Data Collection and Data Entry

At the foundation of information management is the system that captures the data generated by a dairy into a usable format. Our goals are:

1. to capture only data that will be used later.
2. to capture the data accurately.
3. to keep the data current.

We would like to accomplish these goals with a system that is easy to perform and allows for the data to be entered as rapidly as possible. Once captured, the data should be easily accessible to whatever person or organization the producer has a need or desire to share the data with.

Since January 1994 Minnesota DHIA has been entering 100% of their data directly on farm into DairyCOMP305 on all 5,000 Minnesota DHIA farms. This has lead to fewer errors and faster turn-around time from the processing center, since there is no mail delay as with paper records. More importantly, it is much easier to correct mistakes on IDs and dates during the actual data entry while still on farm rather than two weeks later from hundreds of miles away.

The big differences between the Minnesota DHIA download system and others are that veterinarians and other consultant's are able to download ALL of the current year's DHIA records (including departed animals and usually at least one previous lactation) without having to maintain IDs, fresh dates, etc., from month to month. The data also is already in a format that needs no further "cleaning up" from one program to another. In other systems usually only pre-defined reports are available; since this is DairyCOMP305 the report flexibility is unlimited.

Rapid Data Analysis Techniques

Once the data has been collected and entered, we need data analysis screening tools that flag problems as early as possible. We have incorporated reports within DairyCOMP305 that produce sorted lists and summarize data by group. One technique we have found especially useful in smaller herds has been scatter graphs. These graphs allow us to get a sense of the average value in the herd without losing sight of the underlying variability of the data and extreme individuals that may skew averages.

As mentioned earlier, it is important when performing data analysis to formulate the question being posed carefully so that the appropriate data can be selected. The following list are examples of typical questions one would pose when examining production, reproduction, somatic cell counts, and other management categories:

1. What is the current absolute status/level of each cow?
    a. Which days in milk cows are high?
    b. Which lactation number cows are high?
2. How has the status of the cows changed from last month to this month?
3. What is the status of the cows that freshened recently, both on an absolute basis and as compared to cows that freshened longer ago?
4. How has the status of cows changed from freshening to the current test?
5. What is the highest cows have been this lactation?
6. How have cows changed over the dry period?

We recommend doing this on farm with the herd management team and on the computer screen rather than printing out very many of these reports. This gives opportunity to all members of the team to be much more involved in both identification of problems and the decision whether to take action.

Using a combination of approaches, including scatter graphs, lists, and tables, we have found we can screen a herd for somatic cell count, production, reproduction, and disease in only a few minutes and have a very good idea of where potential problems lie. We can then make our action lists and go look at the cows. Many times the records do not make the diagnosis, but they can greatly help us narrow down the things we need to look at.

On the next few pages are some examples of DairyCOMP305 reports that we have been routinely using.

Reproduction Examples

21 day Heat Trial/21 day Pregnancy Rate Analysis

This option performs several tasks. Its columns are:

Date	Start date of each 21 day interval.
Ht Elig	Number of cows entering the interval eligible to be detected in heat. Assumes a first heat at 50 DIM.
Heat	Number of cows actually detected in heat.
Pct	Percent cows actually detected in heat/Total eligible.
Pg Elig	Number of cows entering the interval eligible to become pregnant. Will usually be same as Ht Elig number.
Preg	Number of cows that actually conceived.
Pct	Percent cows conceived/Total eligible.

The other columns (25%, 50%, 75%, 100%) are used with the horizontal histograms. H is the Heat Detection Rate and P is Pregnancy Rate.

At the end of the report the total for the year (or other time interval if \D is used) is reported. The heat detection rate is calculated through yesterday. The pregnancy rate is current to 42 days ago. Not shown is conception rate, but could be calculated by dividing the number pregnant by the number detected in heat, assuming if a cow had been detected in heat she would have been inseminated.

```
Dairy Comp 305 10/30/98

    Date  Ht Elig   Heat   Pct  Pg Elig   Preg   Pct    25   50   75  100
========  =======   ====   ===  =======   ====   ===      %    %    %    %
10/17/97       20     15    75       20      5    25      P         H
11/ 7/97       17     10    58       17      3    17    P       H
11/28/97       14     11    78       13      5    38        P       H
12/19/97        6      2    33        6      1    16    P  H
 1/ 9/98        5      4    80        5      0     0                 H
 1/30/98        7      4    57        7      2    28      P    H
 2/20/98       11      5    45       11      2    18    P    H
 3/13/98       16     10    62       16      4    25      P      H
 4/ 3/98       17      8    47       17      2    11   P      H
 4/24/98       22     13    59       22      5    22     P      H
 5/15/98       22     13    59       22      4    18    P       H
 6/ 5/98       26     20    76       25      5    20     P          H
 6/26/98       23     11    47       22      6    27      P   H
 7/17/98       23     15    65       23      2     8  P          H
 8/ 7/98       25     16    64       25      4    16    P        H
 8/28/98       25     14    56       22      8    36        P   H
 9/18/98       19     14    73        0      0     0               H
10/ 9/98        9      8    88        0      0     0                  H
--------  -------   ----   ---  -------   ----   ---
   Total      307    193    62      273     58    21     P       H
```

If one of our goals is to identify problems as early as possible, we can generate reports that answer questions such as: What has the conception rate been recently? We have arbitrarily defined “recently” in this example to be the last 100 days.

Dairy Comp 305 10/30/98
Summarized By Breeding Code from 7/22/98 through 9/25/98

Breeding Code	%Preg	#Preg	#Open	Other	Total	%Tot	SPC
Gnrh Post-Inf.	66	2	1	1	4	6	1.5
K-MAR\Chalk	0	0	2	0	2	3	
Mucus Only	25	1	3	0	4	6	4.0
Standing Heat	37	12	20	8	40	68	2.7
Timed Breeding	0	0	2	4	6	10	
Vet Palpation	0	0	2	0	2	3	
TOTALS	33	15	30	13	58	100	3.0

Another important question to ask about a herds reproductive program is “What is the voluntary waiting period”. This can be answered by reviewing the days to first breeding (BRED1) in a scattergraph. In this example the dairy producer’s stated VWP is 55 days.

```
     121 |                                              3
     117 |
     114 |
     111 |
     108 |                                                  3
     105 |                            1
     102 |                   2
      99 |                                    2            2
      96 |
      93 |
      90 |
      87 |                              3
      84 |                                                          3
      81 |                                      3     1     3   1
      78 |                    11
      75 |                              2
      72 |                  3          3    2        1  1 13
      69 |                           3   1   2   3
B     66 |                 21   1 2                 1 1          3
R     63 |               2                  2   1     3         2    3
E     60 |          2 2    3  1           2   12 3      3  3   23    3    3
D     57 |                     1 3 3  31   1     3 1     1    3    3
1     54 |                   3            1        1  2
      51 |
      48 |
      45 |
      42 |
      39 |
      36 |
      33 |
      30 |
      27 |
      24 |
      21 |
      18 |
      15 |
      12 |
       9 |
       6 |
       3 |
       0 |2  3 122133          3      33  2    3 33  1                  3
         +--------------------------------+---------------------------------
         14      55      97     138     180     222     263     305     347
                                   DSFSH
```

In addition to generating analysis reports, on-farm systems with accurate and up-to-date information can generate lists of cows that need action. In this example, we have made a list of all the cows in the herd that are past the VWP of 55 days, and are not bred. It is safe to say that these cows are not likely to even have a chance of getting pregnant until semen is placed into the cow.

```
Dairy Comp 305 10/30/98 BNAME     DIM L RPRO        HDAT TBRD     EDAY EVT     REM
DSLH
======= ===== = ======= ======== ==== ======== ======= ======== =====
163         55 5 FRESH          -    0 10/21/98 CYSTIC  L-GNRH       0 _________

187         67 5 OK/OPEN        -    0 10/21/98 OK      SCL3         0 _________

288         55 2 OK/OPEN        -    0 10/21/98 OK      SCL3         0 _________

295         48 2 OK/OPEN        -    0 10/21/98 OK      SF10         0 _________

334         57 1 OK/OPEN 10/16/98    0 10/21/98 OK      SF15        14 _________
```

Somatic Cell Example

The example below uses a scatter graph approach to present the current testday somatic cell count for individual cows. Each point represents a cow and is labeled with the cow's lactation group number (1,2,or 3(=3+)). At a glance one can quickly assess the relative number above the cut-off line, as well as which lactation groups are affected as well as the days in milk of the affected individuals.

```
     7.0 |
     6.8 |                                                   3
     6.6 |
     6.5 |
     6.3 |                      3
     6.1 |
     5.9 |
     5.7 |
     5.5 |          1
     5.4 |   3
     5.2 |              2
     5.0 |               2
     4.8 |          2   3
     4.6 |
     4.4 |                  2       2
L    4.3 |             3
G    4.1 |                        3
S    3.9 |
C    3.7 |                     1      3
C    3.5 |3                         31
     3.4 |
     3.2 |  22  2 2                3
     3.0 |                    1
     2.8 |                       3  23                             1
     2.6 |3                       1   3                      2
     2.4 |                 1  1
     2.3 |               1  1                                             1
     2.1 |               1   3   1 3            2
     1.9 | 2           3
     1.7 |    2    1   1       1
     1.5 |       3        2    1 1
     1.3 |       131         3     3
     1.2 |
     1.0 |      22 1 3   12   1
     0.8 |                   3 3
     0.6 |  3                  1
         +------------------+----------------------------------------------
         17      95     174     252     331     410     488     567     646
                                   DIMTD
```

The next example illustrates the use of 2x2 summary tables to present the number and percent of cows falling into each of four categories (low/low, high/low, high/high, low/high) based on current and previous linear score.

```
                 PRVLG
                  4.0
                4  |     9    13
                6% |    13%   19%
LGSCC:4.0   -------+-------
               53  |     4    57
               76% |     6%   82%
            =====================
               57       13    70
               82%      19%  100%
```

Production Example

Current test day milk production, graphed by days in milk at test day is a quick method to view the current level of milk production for each cow currently in the herd.

```
     128 |  3
     125 |
     123 |      2
     121 |
     119 |
     117 |
     115 |                       3
     113 |   3
     111 |                     3
     109 |   2   3  2     2
     107 |3      3
     105 |  2
     103 |3     2  1              3                                1
     101 | 2      3      22        3  3
      99 |              3
      97 |               1                      2
      95 |       2   3
      93 |                      3
M     91 |        2    3   1
I     89 |    2         2          3
L     87 |             3       1
K     85 |                   3 1
      83 |          1    1
      81 |          1
      79 |       1          1          3
      77 |                           1
      75 |
      73 |         1           1 1   3
      71 |             1              3
      69 |         1          1
      67 |                    1
      65 |               1     1   32
      63 |         1
      61 |                    1   1
      59 |
      57 |
      55 |
      53 |                                                   2            1
      51 |
      49 |
      47 |                       1  2                        3
         +-------------------+---------------------------------------------
         17      95     174     252     331     410     488     567     646
                                   DIMTD
```

Below is another example that utilizes a scatter graph approach to present production data. Here the parameter under question is the deviation from expected milk (the difference between what a cow actually milked versus what she was expected to milk at most recent testday). One can see the early lactation are as a group above their expected milk, while the later lactation cows are at best equal to their expected milk. A logical follow-up to this report is a list of cows with negative expected milk to be discussed further with the dairyman.

```
      27 |           2                             3
      25 |                                                      3
      24 |
      23 |                     2
      22 |                                               3
      20 | 3             3                  2
      19 |                               1
      18 |                                                  3
      17 |                           3
      15 |
      14 |                                               1
      13 |                  1                          1             1
      12 |                    1                1 1
      11 |               2
       9 |                 1                         1
       8 |                                  2        1
       7 |     2                 3                          1
       6 |                   1             1          1
M      4 | 2                          3 3         3               3
K      3 |                                        3        3  3
D      2 |              1  1                                              3
E      1 |    3                                 2
V      0 |             3                                               3
      -2 |                                              1
      -3 |             2                                         3
      -4 |          2      1          2
      -5 |                                                          3
      -7 |                           1    1              1     3    2
      -8 |       2
      -9 |                                                    1     2
     -10 |                                                  1
     -11 |
     -13 |                                                               3
     -14 |
     -15 |
     -16 |
     -18 |
     -19 |
     -20 |
     -21 |
     -22 |2
         +---------------------------------+-------------------------------
         34      67     101     134     168     201     235     268     302
                                   DIMTD
```

Culled Cow Report Example

This report lists in table form the count of cows culled in the previous year, grouped by the reason reported to DHIA for culling. A follow up could consist of examination of the individual's cowcard or a list of the culled cows for further discussion.

Cows sold/dead from 10/30/97 through 10/30/98

By DCAR	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOT
Sold -- low product.	1	0	1	0	0	2	1	0	2	1	0	0	8
Sold -- breeding	1	0	1	0	0	1	0	0	0	1	1	2	7
Sold -- injury, sick	0	0	1	2	1	1	2	1	2	1	1	1	13
Died	0	0	1	0	0	0	1	0	0	0	0	0	2
Sold -- mastitis	0	0	0	0	0	1	1	0	0	0	0	1	3
Abort	0	0	1	1	0	0	0	0	1	1	0	0	4
Totals	2	0	5	3	1	5	5	1	5	4	2	4	37

Disease and Management Events Example

This example shows one available option for presenting counts of disease and management events by month of occurrence. A follow up could consist of examination of the individual's cowcard or a list of the cows experiencing a given event for further discussion.

#	Event	Total	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	FRESH	96	8	11	14	12	12	9	9	4	8	2	2	5
2	OK	202	3	19	19	18	18	36	21	23	16	14	12	3
3	RECK	38	1	3	4	7	0	7	1	7	3	5	0	0
4	HEAT	27	0	0	2	1	3	4	8	4	0	2	3	0
5	BRED	212	8	11	12	15	23	27	19	26	29	12	16	14
6	PREG	78	6	3	5	3	6	8	9	8	3	11	8	8
7	OPEN	32	1	2	2	1	4	3	6	1	5	1	3	3
11	DRY	67	6	9	10	5	4	6	5	2	3	4	8	5
12	ABORT	4	0	0	1	0	0	0	0	0	2	0	0	1
13	DNB	9	1	0	0	2	1	0	0	2	0	0	2	1
14	SOLD	29	2	0	2	3	1	4	4	1	3	3	2	4
15	DIED	1	0	0	1	0	0	0	0	0	0	0	0	0
16	CHECK	1	0	1	0	0	0	0	0	0	0	0	0	0
19	MISHEAT	12	1	1	1	3	1	1	1	1	0	1	0	1
23	VACC	251	30	17	22	35	46	11	31	12	14	11	4	18
24	SELEN	2	2	0	0	0	0	0	0	0	0	0	0	0
25	PROST	33	1	4	6	2	0	8	2	1	3	2	2	2
28	BSTART	75	4	1	3	7	15	1	9	16	6	3	9	1
29	BSTOP	21	7	0	0	0	0	0	0	0	0	0	8	6
30	CULTURE	2	0	0	0	1	0	0	1	0	0	0	0	0
31	CYSTIC	26	0	4	2	3	4	2	1	3	1	2	3	1
32	DA	5	1	1	2	0	0	0	0	0	0	0	0	1
37	MAST	11	0	2	0	3	0	0	3	0	0	0	3	0
38	METR	3	0	0	1	2	0	0	0	0	0	0	0	0
39	MF	7	0	1	2	1	0	0	0	0	0	2	0	1
41	PNEU	2	0	0	0	0	0	0	0	0	0	0	2	0
42	RP	2	0	1	0	0	1	0	0	0	0	0	0	0
	TOTALS	1248	82	91	111	124	139	127	130	111	96	75	87	75

Total cows listed : 183

CO-MINGLING -- A HERD HEALTH TIME BOMB?

Author: David Scott Tomsche, DVM, Veterinary Associates of Melrose-Albany-Upsala
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The expansion in the dairy industry has certainly had an affect on all other supporting dairy industries as well. As U.S. dairies grow in size, they have evolved into more specialized and efficient milk producing entities. In many cases the replacement heifers no longer make financial sense for the dairy. This specialization of dairy farms has opened the door for other business entities to step forward and take advantage of new economic opportunities. The heifer raising business is one such venture. The concept is not new; there have been "calf raisers" as long as there have been cows. The new twist to the calf/heifer raising business is the size of the operations and the amount of animals, which we congregate onto our ranches. The thought of encountering the proverbial "wreck" instills fear into even the bravest of souls---and it should. This fear of the wreck is strong motivation for enduring the planning process necessary for the success of all new business ventures. It is the reason that lenders demand business plans and cash flows prior to making loans in any business undertaking. They want to minimize the risk of failure and maximize the opportunity for success. Likewise, in the heifer raising business, we need to apply the basic knowledge known today to ensure that we, too, minimize our risks. The concept of managing risk on a heifer ranch is what I refer to as biosecurity. It is not likely that we will ever achieve complete biosecurity on our heifer ranches, therefore, we will always be in the position in which we must manage our risks. We are, as you know, dealing with living things (heifers) which originate from a multitude of beginnings (farms of origin). My experience has been pleasing when good planning has been instituted on heifer ranches. The chances of disease and acts of nature always exist, but, too much less degrees.

I have personally been in the heifer raising business for more than 13 years. Until the last two years, I purchased animals from auction barns and raised them from 'wet calves' until I could demonstrate a profit. This business was generally successful, but often times it was like a ride on a runaway train—it might be fast and exciting—but we might not like where, when and how the rides ends. After experiencing a few of the wild rides, I decided to implement basic principles of risk management, or biosecurity, in an attempt to slow down the ride to a pace in which we were all comfortable. I would like to share this "*work in progress*" with you today. The plan never seems to find a last page as we constantly critique and modify our protocols and standard operating procedures.

The first step was to assemble a group of people who had the same ideas and goals, thus the formation of Stearns Custom Calf. There are four partners in our business. Keep in mind that our business is premised on accepting 'wet calves' at two days of age. We raise most of our animals from birth to six weeks pre-calving. As in every new business it serves us well to first review the current state of the business in the USA in an effort to not only benchmark our progress but also help us to improve our current protocols and procedures. The results of this investigation were rather stunning to say the least. I will share a handful of the statistics with you.

- 72% of producers do **not** quarantine new calves and heifers when they enter onto the dairy farm.
- In milking herds of 200 or more cows approximately 60% require vaccinations for BVD, IBR and leptospira. 74% required Brucellosis vaccinations.
- 90% of dry cows are **not** vaccinated with rota/corona/E.coli vaccines.
- 54% of maternity pens are used two or more times before cleaning.
- Most cows in the US are in the maternity pen for more than ten days.
- 66% of operations performed no testing for BVD, Brucellosis, Johne's Disease or TB prior to bringing dairy cattle onto the milking farm.
- 5% of dairy farms wash cows' udders prior to collecting first milk.
- 34% of calves must suckle the dam to consume first colostrum.
- 40% of calves had failure of passive transfer when tested.
- 74% of calves are fed less than four quarts of colostrum at the first feeding.
- 53% of farms do not apply iodine to the navel of a new born calf.
- Pre-weaned heifer mortality is 11%.
- Post-weaned heifer mortality is 2.4%.
- 32% of non-weaned calves have physical contact with weaned animals and older.
- The average first post-weaned group size is 7.5 calves per pen.
- 55% of all horns are removed via the saw or gouge technique.
- 67% of heifer rearing facilities share feeding utensils without sanitizing.
- 46% of producers do not use coccidiostats prior to first breeding.
- 60% of producers do not vaccinate for BVD and IBR from weaning to first breeding.

To say the least, there is significant room for improvement relative to the current state of the heifer replacement business in the US.

Traditional Methods of Risk Management/Biosecurity:

In working with heifer raisers in my consulting practice, I have concluded that there are essentially nine steps that must be implemented to limit our risks.

1) *Establish a working relationship with a veterinarian.* Disease and the subsequent poor performance and/or mortality are the source of the 'wrecks' we all dread. In most cases the veterinarian is the only person who is in a position to help us in this regard. The veterinarian brings an understanding of biology, physiology, immunology and nutrition, and generally understands the farm as a production unit. It may be the case that your local veterinarian is only prepared to meet some of your needs, in which case you can seek help elsewhere for the balance. It is my personal philosophy that all animals that die must undergo a necropsy (post-mortem exam) by your local veterinarian. Within our 16 doctor veterinary practice, Stearns Custom Calf is by far the largest customer for diagnostic lab referrals. No animals die on our farm without a necropsy and a written report by the attending veterinarian, which is put into our database. Our clients are then informed at the end of the month via written illness and necropsy reports. There is no

doubt that having ongoing necropsy reports has allowed us to be able to abate problems much earlier then we ever could have before.

2) *Isolation/Quarantine*: This rule is frequently broken on heifer ranches. New arrivals must be isolated for 21 days despite the vaccination program. Most vaccines require 10-14 days to mount a proper immune response and 21 days is considered the required wait for incoming animals who may be incubating disease. A frequent mistake is to consider paddocks with fence line contact as adequate isolation—this simply is not the case. I suggest that sick animals be removed from the general population and isolated for 14 days. Sick animals need additional attention and the sick pen should be located in an area that will accommodate the tasks of frequent observation and treatment.
3) *Vaccination and Parasite Control Programs*: This issue requires the participation of you and your veterinarian. Be advised that the current immune status of your heifer calf will dramatically effect the success or failure of your vaccination program. *Remember also, all the vaccines in the world will not compensate for poor nutrition, poor management practices, or overwhelming exposure to disease organisms.* I have shared the program we use at Stearns Custom Calf. It is essential that these programs pass both the test of good immunology and the test of practicality— we have tried to keep the program as simple as possible while ensuring our goals. You must sit down with your veterinarian and identify which diseases you need to be concerned about. In our hutch farm we have all but eliminated the major causes of scours due to the vaccination program we demand of our dairy producer clients. Rotavirus, corona virus, E.coli, salmonella and clostridia infections are a true rarity in our 'wet calves'. We insist that the dry cows are vaccinated with two shots of Scour Guard 3K-C. In addition, all the newborn calves are vaccinated with Calf Guard at birth. In the event the dry cow is not vaccinated with two shots of Scour Guard 3K-C, we insist that the calf also receive a dose of Genecol 99 (Schering) or Bovine Ecolizer (Grand Labs) as well as the Calf Guard at birth to help prevent both the rota and corona viruses and E.coli bacterial infections. Animals vaccinated prior to three months of age must be boostered again due to the possibility of maternal colostral interference. We use only modified live vaccines for BVD, IBR, and BRSV protection. The recent release of Pasturella haemolytica vaccines has also eliminated a frequent cause of both death and illness. We make every attempt to avoid giving shots at times of possible stress and in fact, we attempt to vaccinate prior to anticipated stress, such as weaning or moving into larger co-mingled groups. Parasite programs are mandatory and the literature is filed with multiple options. This issue depends largely on your locale and housing schemes (pasture vs. dry lot).
4) *Metaphylaxis*: This is a new term for an age-old plan of mass or systematic treatment. Typically, we may choose to mass treat at stressful times such as weaning, transporting, or early indications of disease onset. For example, at Stearns Custom Calf we treat weaned animals with AS-700 for five days post-weaning.
5) *Test and Cull*: This technique is a great but underused tool. The recent advances in testing for persistent BVD infection is a good example. Brucellosis testing is an example of a successful program, however, it was both a government mandated and a government-funded program. In the test and cull programs I use in a heifer rearing operation, the cost of the test and the cost of the culling decision will have to be

incurred by either the buyer or the seller. Other disease examples will be discussed when we discuss the Quality Assured Heifer Program.

6) *All in - All out Housing*: We are currently trying to use this technique more in our heifer farm, especially in the younger animals. Clearly, the idea of continuous animal flow barns is dying in both the swine and poultry models. I suggest that we can eliminate significant disease problems if we embrace the thought as well. The jury is still out at our heifer farm but we are pleased with the early data. Our present facilities do not yet allow us to completely adopt this strategy. This concept is really what the success of both calf hutches and 'super hutches' is about. We can limit disease transmission if we move animals 'by groups' and into 'clean barns'.
7) *Fly, Rodent and Bird Control Programs*: It has been well documented that all the aforementioned pests can spread disease. The options of control are plentiful.
8) *Sanitation and Manure Management*: As a veterinarian, I subscribe to the "germ theory". This axiom states - if you expose an animal to enough pathogens it will eventually succumb to the disease, despite the number of vaccinations administered. There is no hope of long term success if this issue is not adhered to.
9) *Veterinarian to Veterinarian Contact*: This is also an idea I 'borrowed' from the swine and poultry models. It is common for the veterinarian of the buyer to personally call the veterinarian of the seller to establish the current and past health parameters of the animals to be transferred. Honesty prevails when two DVM's are talking about a group of animals. Without it, their next conversation will likely be in an attorney's office.

Farm Effect:

Despite using all the above strategies, we were frustrated to experience mortality and treatment rates at only slightly better than the national average or extraordinarily high treatment costs if we wanted to improve on the national average. We discovered that many of the problems we had to endure on our farm were really a result of actions or a lack of actions at the dairy farm---the farm of origin. We have come to term these actions as the "Farm Effect". Examples of farm effects, which the heifer raiser must endure, would include failure of passive transfer, navel infections, and most cases of neonatal scours. On the other hand, the dairy producer also must live with a similar list of "Farm Effects" which we at the heifer ranch can have significant effect upon. Examples of these include utilization of AI breeding, free stall 'broke' animals, steady state calving, pre-culling of persistent BVD and Johne's positive animals. It is the feeling of the author that extraordinary results can only be achieved when we eliminate as many of the 'farm effects' as possible. This requires that we rethink the current business and find a way in which we can have a positive effect on the animal before we actually take possession of the animal. I found that as a heifer raising business, we needed to demonstrate the 'added value' we would provide to the dairy producer. This added value will not only be in the form of more live animals returned to the dairy, but if we take the concept one step further, we could also provide an animal free of a specific disease(s). We have come to term this concept as the "Quality Assured Replacement Heifer".

See Chart 1

Quality Assured Replacement Heifer:

The Quality Assured Replacement Heifer is an animal in which Stearns Custom Calf raises in such a way as to be free of Brucellosis, Persistent BVD, and Johne's Disease when it is delivered back to the dairy producer. This concept requires that the heifer raiser and the dairy producer are in complete agreement and willing to cooperate toward this goal. The dairy producer must want his/her heifer calves back in an attempt to reach the goal of a secure herd status. This concept can be expanded to include control or testing measures for salmonella dublin and, to a degree, staph aureus mastitis and bovine leukosis as well. There is additional expense due to testing and labor. The issue of who should pay is paramount. It has been our experience that we can demonstrate to the dairy producer the cost savings for the dairy in the area of decreased cull rates. *Decreased cull rates is the benefit or payment received by the dairy producer for his/her added expense and labor*. In an effort to improve the understanding of the cull rate issue we have assembled the following data facts:

1) It is estimated that the cost of raising a heifer ranges from $.72-$2.00/cwt of milk sold. Factors affecting the amount would include cull rate, age at first calving, and pounds of milk sold/cow/year.
2) A 10% decrease in the cost of raising a heifer will result in $.08-.20/cwt milk sold increase.
3) A gain of 400 pounds milk/ cow /year is negated by a 5% increase in cull rate.
4) If we decrease culling by 1% annually, we will increase net income by $750-$800 annually.
5) Involuntary culling reduces net revenue on a dairy by limiting the opportunity for voluntary culling.
6) If we could cull 10% of the cows, we could eliminate 50% of clinical mastitis cases.
7) It is unusual that a heifer generates $400 net profit her first lactation, therefore, our goal must be that 75% of first lactation heifers survive to the second lactation.

There are a number of diseases the dairy producer would be well advised to attempt to eradicate from the premise. Persistently infected BVD (PI-BVD) animals are a logical place to start when thinking about utilizing the Quality Assured Replacement Heifer concept. The test is relatively inexpensive and very accurate. Persistently infected BVD animals are plentiful, one in every 100 to1000 births, and the animals who are infected average a 50% mortality the first year of life. PI-BVD is the major mechanism by which BVD is maintained in a dairy herd population. Family lines are subsequently infected, abortions are frequent and increased culling ensues for the dairy producer.

Control is easily achieved at the dairy by testing the calf pre-colostrum or at the heifer farm after four months of age and before the first modified live vaccine. The cost of each test is approximately $5-10. Remember that if a pregnant cow tests negative for PI-BVD, her calf can still be positive. Pregnant animals must be considered as two animals. All farms should insist that all bulls used on either the open heifers or the milking animals be tested for PI-BVD prior to employment! If we are dealing with either a closed herd or a secure herd, we can make significant progress toward completely eliminating the disease after the first year! I define a "secure herd" as a milking herd, which purchases multi-source animals but utilizes testing procedures to screen for diseases.

Johne's Disease is another nemesis of the US dairy industry, which I feel needs immediate attention, and this program is a way to address it. Johne's is a contagious bacterial disease of the intestinal tract. The animals develop intermittent diarrhea, which eventually evolves into a chronic, persistent diarrhea. There is no cure. Infected cattle often develop signs after calving despite the fact the initial exposure and probable infection occurred when the animal was only months old! It is the opinion of this author that Johne's Disease is a problem of massive consequences and is another great example of how a heifer raiser can provide 'added value' to a dairy operation. Here are some statistics regarding Johne's Disease.

- Regional surveys estimate a 3-18% infection rate in individual cattle. It is thought that approximately 2.6% of all US cattle are infected.
- It is a worldwide disease.
- It is worse in the northern tier of states, MN., WI., MI., OH., NY., Penn.
- It is estimated that 33% of Wisconsin dairy herds are infected.
- Estimated risk of an animal purchased from either an auction market or an individual dealer is 10% per animal.
- All things being equal, the likelihood of infection in a herd is in direct proportion to the frequency that owners buy replacements from outside sources.
- 90% of total cases are estimated to be sub-clinical.

Control of Johne's Disease involves both management and testing. Without the efforts of both the heifer raiser and the dairy producer our results will result in moderate improvement at best. It is the single best example of how the dairy producer and the heifer raiser must cooperate to achieve a better end. Both businesses have healthier animals to run through their systems. This is the "Win-Win" relationship that any two businesses need to prosper together.

The control measures must begin in the maternity pen. It is well documented that one of the main sources of infection is colostrum from infected mothers, therefore, any control program, which avoids dealing with the dam, will result in only minimal control within the herd. Calves must be fed colostrum from a Johne's-free cow. This mandates that the dairy farm personnel must make efforts to test animals that will be used for colostrum donation and cull them from the donor pool, and hopefully from the herd. They are a source of infection to all calves as potential frozen colostrum donors and to their individual calf via the womb. Also critical to a good Johne's control program is the exposure the young animals have to older animals, including the dam, while in the maternity pen. Animals must be born from a test-negative dam and into a clean, dry environment. As you can see, there is little that the *grower* can do if the animal comes to them infected. The grower can do a lot in the form of prevention if he/she takes possession of a Johne's free calf.

A complete control program involves two tests on each adult cow. First, test the cow at dry off with the BACTEC fecal culture test (8 weeks for results) or if we use the traditional fecal culture techniques, 16 weeks prior to calving. This generally coincides with the movement of the animal into the low production group. The fecal culture techniques accurately detect 50% of the animals and are somewhat more accurate in the early stages of the disease. Finally, at the time of dry off, the ELISA blood test should also be performed to catch any animals which may have evaded the fecal test. The ELISA test will generally identify 50% of the early infections and 85% of the animals showing clinical disease symptoms. Early sub-clinical infections in adults and in animals less than 18 months are likely to be missed by both tests.

As you can see, quality assuring replacement heifers for Johne's Disease is more cumbersome, labor intensive, expensive and somewhat less reliable than persistent BVD. Does this mean we should not bother? It is up to the dairyman to decide as much of the initial effort is on his/her side of the equation. I submit to you, can a dairy producer afford not to test? I have observed an explosive growth in the number of dairy farms diagnosed with this disease over the last ten years. Continued neglect will likely only delay the inevitable. In the case of herds who either do not see a benefit in testing or will continue to purchase animals on a "as need basis", blood testing with the ELISA test prior to purchase and good hygiene in the maternity area will have to carry the day.

There are a number of reasons why a dairy producer and a heifer producer would want to team together to help prevent the spread of certain diseases into both operations.

1) *Liability:* Disagreements about the introduction of diseases into animal populations have been food for litigation for many years. I have seen many "multi-source" heifer ranches bring a virulent disease into their ranch from an outside source farm and in turn have the entire ranch population contract the disease in short order as well.
2) *Increase profits:* There is absolutely no doubt in my mind that we save significant dollars annually because we control the management practices of the dairies for whom we raise calves. I have evidence that the efforts we undertook resulted in a healthier animal for the dairy producer. Time will tell what the cull rates on the quality assured animal will calculate to be.
3) *State or Federal Mandate:* Brucellosis is the best example of this issue. If there is ever an association between an animal disease and a human ailment as well, a mandate will likely result.
4) *Consumer Demand:* Mad Cow Disease is the best example of this reason. Consumers were demanding government action even before all the evidence was compiled.
5) *"Right Thing To Do":* I believe that if we can improve the "state" of our business, we must do all that is reasonable to do so.

Conclusion:

The issue of Quality Assured Replacement Heifers is still in its infancy—a work in progress. Many issues need to be clarified. Included, but not exclusive, to this list are the following questions:

1) Who will pay for the testing?
2) Will the dairy producer perceive the value for "today's efforts"? The benefits of decreased culling, improved salvage value, and decreased therapy costs are delayed by two years and difficult to directly attribute to the efforts of the heifer raiser.
3) Are today's dairies and today's dairy managers satisfied with 35-40% cull rates?
4) What do we do with the positive animals? Does 'cull' mean resell, slaughter, or destroy?
5) Are the processes described here and their future modifications going to survive the test of practicality? Is only a DVM foolish enough to attempt this?
6) Is there a desire on the dairy producer's part to migrate to a 'closed herd' status?
7) Are 30% cull rates in first calf heifers, as is the case in many 'commercial dairies', as good as it gets?

Chart 1:

Farm Effect Control and Consequences

	PRIMARY CONTROL Heifer Farm	Dairy Farm	PRIMARY CONSEQUENCES Heifer Farm	Dairy Farm
Failure of Passive Transfer		X	X	
Navel Disease		X	X	
Peri-Natal Scours		X	X	
Genetic Improvement/Al	X			X
Calving Health	X			X
Free-Stall/Feed Bunk Conditioning	X			X
"Steady State" Calving	X			X

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SPEAKER BIOGRAPHIES

PRESENTED IN ALPHABETICAL ORDER

Douglas B. Beegle

Douglas is a native of Blair County, Pennsylvania. He received his B.A. in chemistry from Lycoming College, his M.S. in chemistry and Ph.D. in agronomy from the Pennsylvania State University. After receiving his bachelor's degree, Douglas managed a dairy farm in Roaring Spring, Pennsylvania, before going back to graduate school. In 1981, he was appointed to the faculty at the Pennsylvania State University, where he is currently a professor of agronomy and extension soil fertility specialist.

Douglas's program at The Pennsylvania State University has focused on extension programs and applied research in soil fertility, nutrient management, soil testing, and related topics. He has worked extensively with farmers, county agents, the agricultural industry, public agencies, and farm organizations to develop and conduct educational programs to help farmers manage nutrients for maximum agronomic and economic benefit with minimum environmental impact.

The speaker's paper "Developing a Comprehensive Manure Management Plan" begins on page 82.

Roger Cady

Roger was born and raised in upstate New York near Albany. He received all three of his degrees from Cornell University. He earned his B.S. in Biology and Genetics, a M.S. in Animal Science, and a Ph.D. in Animal Breeding. Following graduate school, Roger spent two years working as a post-Doctoral research assistant at the University of Guelph where he developed the prototype sire-evaluation program for the Ontario Calving Ease Report. Roger began his faculty career as an extension dairy specialist at the University of New Hampshire in 1982. While in that position, he focused on developing decision aid tools which integrated financial and production management analyses to assist producers in identifying weak areas in their reproductive and heifer management programs and thus capitalize on opportunities for financial savings.

In 1989, Roger moved to Washington State University to continue his career as an extension dairy specialist. While at WSU, Roger has continued his research and extension program to discover effects of heifer rearing programs on herd productivity and financial performance. Roger has been part of the WSU DairyPro development and delivery team. Their focus is to help dairy industry members improve their business management skills and leadership development. Roger's most recent activities has been as chair for the National Professional Dairy Heifer Growers Conference series and serves as facilitator for the Professional Dairy Heifers Growers Task Force.

The speaker's paper "Managing Contract Heifers – A Western U.S. Perspective" begins on page 60.

Bernard “Joe” Conlin

Joe currently resides in Shoreview, Minnesota. He received both his B.S. and M.S. in Dairy Science from the University of Wisconsin and a Ph.D. in Animal Breeding from the University of Minnesota. He has been active in extension programs and international consultantships. His current title is Professor Emeritus at the University of Minnesota in the Department of Animal Science. Currently he is a consultant for Quality Dairy Management Services.

Joe’s major areas of work have included evaluating critical success factors for profitable and rewarding dairying, decision models for managing profitability, quality management of dairy systems, and dairy farm resource management. He has been very active in international agricultural development, dairy growth, and expansion.

The speaker’s paper “Growing the Dairy Business” begins on page 29.

Willard T. De Golyer

Willard is a 1969 graduate of Cornell University’s College of Agriculture and Life Sciences. After graduation, he managed a dairy in Texas for a year, prior to becoming part of the management team at Table Rock Farm. Willard is President of Table Rock Farm, Inc., a 940 cow, 1100-acre dairy located in western New York State. He operates the farm with his uncle, daughter, and 17 full-time and part-time employees.

Willard serves on the Animal Industry Advisory Council of Cornell University’s Department of Animal Science. Table Rock Farm received the 1997 New York State Environmental Stewardship Award for exemplary use of wise farm management practices. The farm was also cited by the NYS Department of Labor as an Outstanding Farm Employer in 1995.

The speaker’s paper “Nutrient Management at Table Rock Farm, Inc. – A Case Study” begins on page 108.

Dewayne E. Dill

Dewayne received both his B.S. and M.S. in Dairy Science at the University of Illinois. In 1990, he received his Ph.D. at the University of Illinois in Animal Sciences. After graduate school, Dewayne started his career as an Assistant Professor in the Department of Animal Sciences at the University of Illinois. He served as Chief Editor of the National Dairy Database. In 1992, Dewayne became the Technical Development Manager for the Feed Division at Land O'Lakes, Inc. in Minnesota. He managed design, development, and training of dairy and poultry software applications. Dewayne's current position is Senior Consultant for Dairy Strategies, LLC, in Madison, Wisconsin. This is a dairy business and financial management consulting firm.

Dewayne's major areas of work include management and information systems, training, and education. He has experience working with dairy producers and industry leaders in both the public and private sector.

The speaker's paper "The Dairy Business as a Living Company" begins on page 21.

Tom Frey

Tom currently resides in Conestoga, Pennsylvania. He is the president and majority stockholder of Frey Dairy. His position is general manager overseeing the staff and planning and directing custom crop operations. Tom began buying his brother's 50% of the company in 1992. He is currently building a barn and milking parlor to replace outdated facilities. He is working to make improvements in their nutrient management program.

The speaker's paper "Growth Requires Change" begins on page 57.

William Heald

Bill received a B.S. from the Pennsylvania State University, a M.S. from the University of New Hampshire, and a Ph.D. from Virginia Tech in 1969. He was on the faculty of Virginia Tech before his current employment as Professor of Dairy Science at the Pennsylvania State University. His primary research has involved mammary gland function, udder health, farm management data, and expert system development. Bill's major areas of extension work have included enhancing dairy farm management and profitability, farm-level decision making, and animal health and well being. Bill is currently Chair of the National Mastitis Council's Education Committee and participant in the Northeast Extension Leadership Development Program.

The speaker's paper "The Final Permit: Will Environmental Policy Crack the Retirement Nest Egg?" begins on page 6.

Katharine F. Knowlton

Katharine grew up on a dairy farm in Connecticut. She received a B.S. from Cornell University in Animal Science and Agricultural Economics, a M.S. in Dairy Nutrition from the Department of Animal Science at the Michigan State University and a Ph.D. in Dairy Nutrition from the Department of Animal and Avian Science at the University of Maryland. She is currently a member of the faculty in the Department of Dairy Science at Virginia Tech.

Katharine's primary responsibilities include research and extension programming on environmental issues associated with the dairy industry. Her specific research activities include developing nutritional approaches to reduce nitrogen and phosphorus excretion by dairy cattle, developing a computer model predicting nutrient excretion by dairy cows, and nutrient loss from manure storage. She also is looking to implement and evaluate this model on farms. Katharine's teaching responsibilities include a course in Livestock Feeds and Feeding. She also works as a nutritional consultant for dairy farms and contract heifer growers in Maryland, West Virginia, and New York.

The speaker's paper "Feeding Management to Reduce Phosphorus Losses From Dairy Farms" begins on page 93.

Steven A. Larson

Steve holds degrees from Kansas State University and the University of Wisconsin-Madison. Since 1969, Steve has been with Hoard's Dairyman, a dairy industry magazine with 100,000 subscribers throughout North America and 60 foreign countries, including Japanese and Spanish language editions. In 1998, he was named Managing Editor and now directs the editorial content and production of the magazine.

His duties include preparing editorial commentary and Washington news. He is responsible for the magazine's coverage of milk marketing and dairy policy, dairy product promotion, feeding and nutrition, and mastitis and herd health. He works with the Hoard's Dairyman Farm that has a 100-cow registered Guernsey herd on 530 acres. Steve has served on advisory committees for the Upper Midwest Dairy Industry, Wisconsin Center for Dairy Profitability, Western Herd Management Conference, and the U.S. Dairy Forage Research Center.

The speaker's paper "Changes in Dairy Farming" begins on page 1.

Art Logan

Art received his B.S. in Dairy Science from the Ohio State University. He is the owner, operator, and manager of Logan Acres Farm in Farmdale, Ohio.. His major area of work is heifer raising. He won the Environmental Friendly Farmer Award in 1997.

The speaker's paper "Contract Heifer Production" begins on page 67.

Paul Rapnicki

Paul received his DVM from Michigan State University in 1986. He spent 12 years in private clinical practice in Wisconsin where his primary responsibilities were dairy cattle medicine, surgery, and heard health programs. He is currently an Assistant Clinical Specialist in Dairy Production Medicine in the College of Veterinary Medicine at the University of Minnesota. He has also been a dairy consultant to several companies involved in the animal health industry.

The speaker's paper "Herd Information Management" begins on page 112.

Andrew N. Sharpley

Andrew was born in Manchester, England and in 1987 became an U.S. citizen. He received degrees from the University of North Wales, United Kingdom in 1973 and Massey University, New Zealand in 1977. Andrew is currently a soil scientist at the USDA-ARS, Pasture Systems and Watershed Management Research Laboratory at University Park, Pennsylvania and an Adjunct Professor of Agronomy at the Pennsylvania State University.

His research has investigated the cycling of phosphorus in soil-plant-water systems in relation to soil productivity and water quality that includes the management of animal manures, fertilizers, and crop residues. Most recently he has developed decision-making tools for field staff to identify sensitive areas of the landscape and to target management alternatives and remedial measures to reduce the risk of phosphorus loss from farms. He has focused on achieving results that are both economically beneficial to farmers and environmentally sound to the general public. He is editor of the Journal of Environmental Quality and Nutrient Cycling in Agroecosystems.

The speaker's paper "Phosphorus Management on Dairy Farms" begins on page 71.

Gary Snider

Gary holds an associate's degree in Agricultural Business from Alfred State College and a B.S. in Agricultural Economics from Colorado State University. He is from a family of dairy farmers in western New York. Gary has worked for the past 18 years as an Accredited Agricultural Consultant with Farm Credit. Prior to that, he served on the Cornell Cooperative Extension Regional Dairy/Farm Management Team. He has consulted on a personal basis with over 1,000 farm businesses across the Northeast. He is an expert in agricultural tax laws and has also served as a loan officer. Gary conducts various seminars for farmers and agribusiness's each year. He is on the advisory committee of the agricultural business curriculum at Alfred State College and a member of the Professional Agricultural Consultants Association.

The speaker's paper "Leadership and the Ability to Direct Those People Who Care About Your Business" begins on page 53.

Keith Snoddy

Keith received his B.S. in Business Administration from Youngstown State University in 1980. He is currently the owner of Wasuka Farms in Shreve, Ohio. His major areas of work are custom forage harvesting and forage sales. In 1998 Keith was the winner of the American Forage and Grasslands Council's National Forage Spokesperson Contest

The speaker's paper "Custom Forage Harvesting and Sales" begins on page 68.

Charles C. Stallings

Charles received a B.S. from Eastern Kentucky University and both his M.S. and Ph.D. from the Michigan State University. In 1981, he began his career as an Assistant Professor at Virginia Tech and he currently holds the title of Professor in the Department of Dairy Science. His major areas of work include dairy cattle nutrition and management and forage quality. He has been involved in international work in thirteen countries. Charles is currently the Extension Dairy Program Coordinator and Director of the Virginia Tech Forage Testing Lab.

David Tomsche

David received his DVM in 1983 from the University of Minnesota College of Veterinary Medicine. He is a third generation veterinarian and the managing partner of an 18-doctor practice in central Minnesota. The practice is 80% dairy. In addition to the practice he is also a managing partner and founder of Stearns Veterinary Outlet Store (SVO) and Stearns Custom Calf, Inc. SVO is a retail animal health supply store that also offers parlor supplies, dairy barn construction and construction management services. Stearns Custom Calf raises calves for the central Minnesota dairy industry. David is a frequent speaker, both nationally and internationally, to dairy producers and the veterinary medical community. David is a member of the American Association of Bovine Practitioners, the National Mastitis Council, and the Great Plains Dairy Consultants, Monsanto, Inc.

The speaker's paper "Co-Mingling – A Herd Health Time Bomb?" begins on page 121.