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A constant goal, changing tactics: The Krusenbaum dairy farm (1996–2005)

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Abstract

This case study documents the trajectory of a successful alternative dairy farm in southeastern Wisconsin. The 1990s were a difficult period for dairying and the Krusenbaum family entered this shifting field in 1990 with a 37-cow Holstein herd in a stanchion barn, 88 tillable hectares and a vision to gradually develop a biodynamic dairy. Low milk prices and the unrelenting workload associated with conventional dairying forced the family to look for alternative strategies. By 1995 they had converted all their land to 47 rotationally grazed paddocks, increased herd size to 70 cows and their annual net farm income had grown to a solid $54,000. The workload remained very heavy, and during the next few years they introduced a swing-16 milking parlor that approximately doubled their milking efficiency and allowed them to again increase herd size, implemented seasonal dairying and constructed an outwintering shed (1997) that greatly facilitated animal management during the winter. By 2002 the farming system had been, by and large, consolidated and by not focusing solely on milk production and crossbreeding with non-Holstein breeds, the herd benefited from improved reproductive vigor. They were then able to synchronize annual calving and the herd's maximum nutritional needs with the spring flush of their pastures, which resulted in lowered purchased feed costs per cow. By this time, annual milk production was fairly constant [around 7400 kg rolling herd average (RHA)], herd health was good and annual net farm income had grown to $75,600. In 2003, the farm became certified organic. With this change the value of the milk increased dramatically from $0.31 liter^{-1} to $0.45 liter^{-1} ($14.27–$20.24 per hundredweight), but feed costs climbed sharply due to the high cost of organic feed, as did labor costs due to the decision to train new farmers in grass-based dairying rather than simply hire employees. Due to very sound farm management, good money management and an entrepreneurial philosophy, this farm, by most performance standards, is now both highly profitable and environmentally sound and the families living on it have a good quality of life.

Key words: management intensive grazing, seasonal dairying, subacute ruminal acidosis (SARA), mastitis, organic dairying, share milking, case study

Introduction

The 1990s were a difficult period for dairying in Wisconsin. The trend of decreasing profit margins that began in the mid-1980s continued as the cost of production increased and real milk prices declined. Net dairy farm numbers continued to decline at the long-term rate of 4–5% per year, from approximately 34,000 at the beginning of the decade to 21,000 in 2000; by 2005 there were only 15,300[1]. The general profile of the remaining dairy farms has also been changing. Whereas between 1985 and 1995, about 90% of the dairies were moderate-sized (30–100 cows), had 70% of the dairy cows and produced about 70% of the milk[2], by 2002, there was a greater concentration of production in large farms. The farms that had more than 200 cows represented only 7% of the dairymen, but they had 31% of the cows and produced 34% of the milk. The under-100-cows group represented only 80% of the dairy farmer population, had 50% of the state dairy herd and produced 46% of the milk[3].

An in-depth analysis of the loss in overall dairy farm numbers in Wisconsin had found that while the exit rate, as a percentage of remaining dairymen, has been fairly constant since the mid-1970s, the entry rate had dropped off significantly in the 1990s[4]. An interesting alternative to the capital-intensive, large-scale confinement operations is the use of the low capital-intensive strategy of management intensive grazing (MIG). It has been estimated that as many

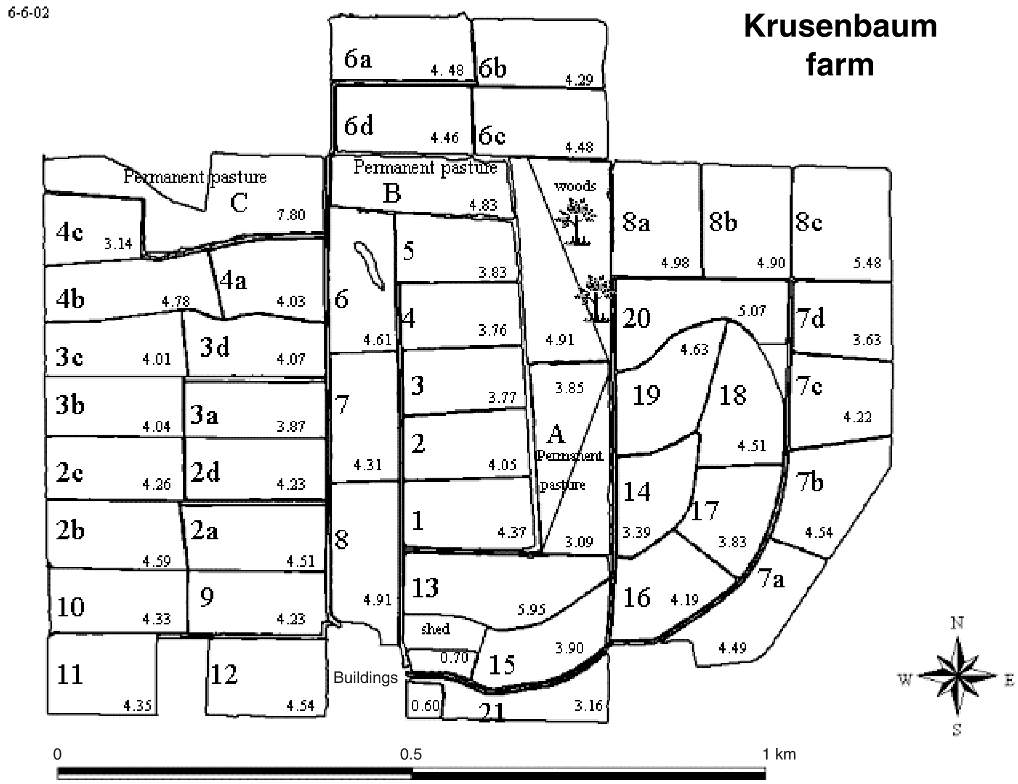

Figure 1. Map of the Krusenbaum field layout.

as 30% of the new entrants into dairying during the late 1990s were primarily using rotational grazing to feed their cows, and a surprising 23% of all dairy farms were using managed grazing (moving the animals at least once a week) in their operation by 2003[5]. The Krusenbaum family entered this shifting field in 1990 and what follows is the sequel (1996–2005) to an earlier paper[6] describing the farm start-up (1990–1995).

A Look Back

In March 1990, the Krusenbaum family leased a dairy farm in southeastern Wisconsin and purchased the existing herd of 37 Holsteins. Their original plan was to establish a mixed farm that included dairying, cash crops, tree crops and vegetables. By the end of 1995, however, the entire farm was seeded down and rotationally grazed (88 ha in 47 paddocks, 4 ha in a woodlot and 4 ha in buildings) (Fig. 1), they were milking 70 cows on a strictly seasonal basis (cows were dried-off in mid-January and began calving in mid-March), and production was at 7700 kg (17,000 pounds) of milk as measured by rolling herd average (RHA). Net farm income (return to the operator and family's unpaid labor and management time) per cow was \$790 or \$54,000 for the farm[6]. The family was, however, getting ready to install a new 'swing-16' milking parlor (16 milking machines running while on the other side of the pit, 16 more cows are being prepared to be milked) in May 1996. It was estimated that this change would double their milking efficiency (from 40 to 80 cows h^{-1}) and allow them to immediately increase herd size from 70 to 90 cows with the goal of going up to 120. The expectation was that the larger herd size would help the family meet its financial objectives, and the combination of the grazing, the new swing-16 parlor and further improvements in winter management of the livestock (an outwintering shed was constructed in fall 1997) would help the family reach its 'quality of life' objectives. Both members of the couple had experience working on dairy farms prior to starting their own and they knew the work was satisfying but could become both very physically taxing and consume their lives, 7 days a week, leaving little time for family and community. As a result, they continued their focus on the way they would work, but also grew very optimistic about the role that grazing could play in revitalizing the dairy industry and set for themselves, as another 'quality objective', teaching others how to develop MIG dairies.

Methods

We continued to monitor three broad sets of variables: (1) agronomic performance (agricultural production and land stewardship); (2) milk production and herd health; and (3) economic performance. Farm data were collected using a number of different techniques. Soil sampling and on-farm trials were continued, and agronomic and grazing diaries were maintained. Herd production data were monitored by registering with the national Dairy Herd

Figure 2. The interior of the barn constructed in 1997 for the wintering of the cow herd.

Improvement Association (DHIA) program, and economic data were analyzed using the Agricultural Accounting Management Systems (AAMS) software developed by the University of Wisconsin's Center for Dairy Profitability[7].

The monitoring data are presented on three tables following a similar format. The 10 years are divided into three periods: (1) a transition period (1996 and 1997) when the swing parlor and outwintering shed (Fig. 2) were built and herd size grew rapidly; (2) an equilibrium period (1998–2002) when the farm settled into a routine of milking 110–120 cows; and (3) the recent period (2003–2005) when the farm became certified organic.

Where possible, following the data from this organic period is a column representing a 'benchmark' based on a large set of conventional (primarily confinement) dairy farmers. These were developed from either a dairy economic survey (the annual Wisconsin Milk Production Costs Survey–UW Center for Dairy Profitability[8]) or from the annually available DHIA Benchmarks[9].

Agronomic performance

Using the land to feed the herd. The Krusenbaum farm has 88 ha of pasture that include a mixture of bromegrass (*Bromus inermis* L.), orchardgrass (*Dactylis glomerata* L.), perennial ryegrass (*Lolium perenne* L.), quackgrass (*Elytrigian repens* L.), alfalfa (*Medicago sativa* L.), red clover (*Trifolium pratense* L.), ladino and white clover (*Trifolium repens* L.). During the grazing season, the milk herd is moved to fresh grass after each milking (2 times per day), and then followed by the heifers. The 1.6 ha (4 acres) paddocks are generally grazed for a day and a half by the milk herd (100 cows, 570 kg each) and then followed over the next day and a half by the heifers (50 heifers, 360 kg each). Regrowth permits cycling through the paddocks five to seven times a season (April 15–November 15). The interval between grazing events starts in the spring at about 14 days and during the heat of the summer may be as long as 45 days. In an average year about 56 ha are hayed in May, and up to 20 ha in June for winter feed. Most of 1000–1200 round bales [270 kg dry matter (DM)] are wrapped put up as high-quality balage. As herd numbers climbed on the farm, an additional 9 ha (1995) and 24 ha (2002) were rented on a long-term basis and custom harvested as haylage.

Repeated sampling during the reporting periods indicated that good-quality forage was available throughout the grazing season [crude protein (CP) = 20–28%; relative feed value (RFV) = 160–180]. However, sward density was lower than desired and trials with potassium fertilization and adding additional manure were undertaken, as well as testing the value of annual frost-seeding of red and ladino clover and ryegrass into the paddocks. Although the increased soil fertility treatments had no impact on paddock productivity, several activities that have been continued maintain, and in some cases increase, sward density. They include: (1) frost-seeding legumes on a rotating pattern into the paddocks in March; (2) clipping the paddocks for weeds and refused forage in June and again in July; as well as (3) extension of the 'rest' periods between grazing

Table 1. Agronomic performance on the Krusenbaum farm.

Agronomic criteria	Krusenbaum farm: Expansion phase 1996 and 1997	Krusenbaum farm: New equilibrium 1998–2002	Krusenbaum farm: Organic 2003–2005	Benchmark: Conventional dairy farms 2003–2005[1]
1. Stocking rates (ha per cow)	1.14	1.01	1.12	1.3
2. Purchased feed ($ per cow)	550	294	754	663
3. Machinery costs ($ ha^{-1})	82	131	NA	256[2]
4. Fuel costs ($ per cow)	46	38	72	109
5. Fertilizer and lime ($ ha^{-1})	1	2	8	81
6. Farmgate nutrient budget				
N (kg ha^{-1})	58	67	NA	22[3]
P (kg ha^{-1})	12	10	NA	7[3]
K (kg ha^{-1})	45	67	NA	27[3]

[1] Reference values from the annual Wisconsin Milk Production Costs Survey–UW Center for Dairy Profitability. Mean results from participating dairy farms with 80–120 cows. Sample size from 2003 to 2005 was 145 farms.
[2] Assuming an average equipment complement for a 120 ha dairy farm with 40% of the area in hay and 60% in new seedings and corn (University of Wisconsin-Extension, 2001).
[3] Farmgate budget from a survey of 19 dairy farms in southern Wisconsin[10].

beginning in June from 15 to 30 days. This latter approach has been the most effective. Nevertheless, summer rainfall remains the largest determinant of forage production. Poor pasture and forage production were recorded in 1995, 1997, 2002 and 2005. Moisture deficits were the common factor in these years: June 1995 rainfall was only 25% and July 2002 was only 15% of the 30-year norm; while the dry spring of 1997 (50% of long-term average for April/May) was exacerbated by the previous year's late summer (August/September) rainfall of only 4.3 cm (20 cm norm), resulting in depleted subsurface moisture. Forage production was the lowest in 2005 due to the combined problems of moderate to severe winterkill on the pastures and hay ground during the open, icy month of January, and grazing season rainfall (April–October) that was the lowest it had been since they moved on to the farm. Winter feed storage dropped to a low of 200 tons (DM), whereas in normal years it is closer to 650 tons (DM).

The stocking rate on the farm when the rented area is included is similar to the benchmark operations (Table 1, line 1) and well above the recommended limit of at least 0.72 ha per cow[11]. During the expansion stage (1996 and 1997), purchased feed costs per cow were high (Table 1, line 2). This was due to the back-to-back seasons of low winter moisture reserve and low grazing season rainfall, resulting in poor paddock production. During the equilibrium stage (1998–2002), with more normal rainfall, paddock production increased and feed purchases per cow returned to $294 or only 50% of that of the conventional benchmark herds. Once the farm became certified and organic corn and alfalfa were required, feed purchases per cow increased, especially during the dry year of 2005 ($950 per cow). As a result, average feed purchases are now slightly higher than that of conventional dairies of approximately the same size.

Evolving machinery park on the farm. Initially the farm was set up with a typical complement of equipment for a small conventional dairy farm. During the first 6 years (1990–1995), machinery costs per hectare were fairly constant ($62 ha^{-1})[6] due to the costs incurred as their row crop equipment became unnecessary and was sold (at a loss), and to their decision to buy equipment allowing them to wrap round bales and make round bale silage. The more recent data (Table 1, line 3) show that machinery costs on the farm have climbed somewhat as herd size increased, resulting from their decision to buy newer equipment to meet the increased need to put up winter feed. However, machinery costs still represent only about 50% of the university's estimates for a conventional dairy farm[12]. The explanation for the difference is that less machinery is needed on a rotational grazing operation and it is used on relatively few acres. For example, on a conventional dairy all the fields are crossed with machines several times a year in a typical corn and alfalfa rotation. Fuel use per cow (Table 1, line 4) also remains low and well below that of the conventional benchmark farms.

Manure management, farm gate budgets and soil test values. Manure spreading on the farm is based on regular soil testing every 3 years (one composite sample every 3 ha). Generally there is enough manure in the outwintering barn to manure 16 ha (25 tons ha^{-1}) in the spring

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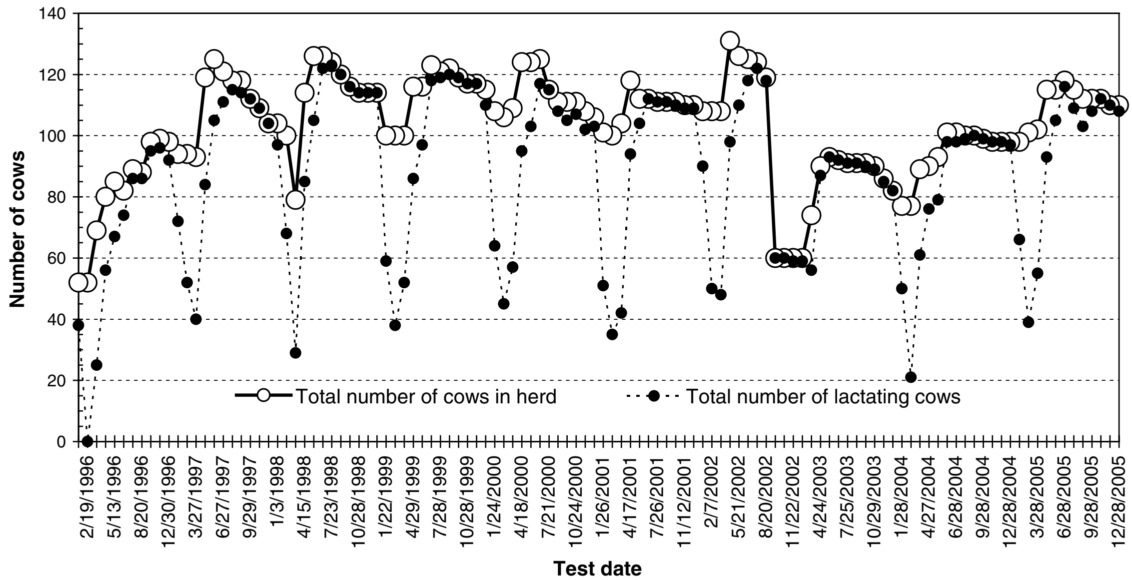

Figure 3. Evolution of adult cow numbers on the Krusenbaum farm.

and the yard scrapings in the winter are equivalent to approximately 30 tons week^{-1}. Generally manuring rotates around the farm over a 6- or 7-year cycle with greater emphasis on manuring the low soil test rented fields and less emphasis on the fields near the tree lines where manure accumulates during winter feeding from the round bales.

The increase in herd size from 70 (1995) to 120 animals (1998) was accompanied by only a modest change in estimated nutrient accumulation on the farm (Table 1, line 6). This was due to the fact that more land was rented for making hay, keeping purchased feed to a minimum as well as giving them a larger base for spreading manure. Due to modest phosphorus and protein feed purchases the P-budget is generally in balance and this is reflected by soil test values (0–15 cm) taken in 2007. Although the farm mean of 112 ppm is high (31 sampling stations), it has been constant, in spite of the increased number of animals. Potassium accumulation, however, has been taking place, but this is a good thing as soil test levels have been low on the farm (1990 = 81 ppm and 2007 = 114 ppm) and an increase in soil organic matter levels (1990 = 2.7% and 2007 = 3.3%) due to the perennial sod has also been noted.

Land stewardship. The entire farm has been in grass since 1995, and beginning in 1997, increased attention has been paid to ‘traffic problems’ caused by wet winters and rotational grazing. With the construction of the outwintering shed, they have had the option to keep the animals off the paddocks during the muddy season (March/April) and to feed them near the shed. This has prevented a lot of pugging in the paddocks and damage to the sward. The second investment was to put in new 5–7 m wide lanes with the help of a Natural Resources Conservation Service (NRCS) EQIP cost-sharing program ($18,000, farm; $50,000, Federal Government). The improved lanes and well-designed culverts greatly facilitate animal and machinery movement and ultimately animal health.

Milk production and herd health

Throughout most of the dairy industry, the primary emphasis of herd performance is maximized milk production per cow per day. While milk production is always important, in grazing dairies it becomes less important than synchronizing the time of maximal nutrient needs of the herd with the season of maximal pasture growth. This concept underlies many of the herd management strategies employed by the Krusenbaum dairy in its evolution to a grazing dairy operation.

Herd size. Between 1996 and 1997, the herd increased in size from approximately 70 to 120 cows, as shown in Figure 3. Once achieving a herd size of approximately 120 cows, herd size remained relatively stable until late in 2002. A drought in the spring and summer of 2002 created a severe shortage of stored forage heading into the winter and a decision was made to reduce herd size temporarily to 60 cows rather than purchase feed for the winter. Because relatively few cows are culled from the dairy, herd size rebounded to a total of 95 in 2003, 100 in 2004 and approximately 115 by the grazing season of 2005.

Milk production. The most common index of herd milk production in the US dairy industry is RHA milk (Table 2, line 1). RHA is an estimate of the average total weight of milk produced per cow in the herd over the previous 365 days. While RHA is obviously primarily a reflection of level of milk production of the cows, it is influenced greatly by length of dry periods, calving intervals and other herd management factors. For example, increasing the length of the dry period of a cow does not change the number of cow-days in the herd, but would reduce the number of days when milk is being produced.

In addition to increasing herd size for the 1997 grazing season, the practice of shutting down milking operations early in the year was modified, as shown in Figure 3. In

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Table 2. Herd performance on the Krusenbaum farm.

Herd performance criteria	Krusenbaum farm: Expansion phase 1996 and 1997	Krusenbaum farm: New equilibrium 1998–2002	Krusenbaum farm: Organic 2003–2005	Benchmark: Conventional dairy farms 2003–2005[1]
1. RHA (kg per cow)	6850	7355	7432	9477
2. Days dry per year	77	60	57	63
3. Calving interval (months)	12.8	12.1	12.1	14.1
4. First lactation cows, average age at calving (months)	24	23	24	27
5. Culling rate (% of herd)	37	29[3]	24	37
6. Holstein cows (% of herd)	100	70	55	95
7. Somatic cell count ($\times 1000\,ml^{-1}$)	384	241	293	326
8. Milk fat (%)	3.18	3.49	4.02	3.82
9. Veterinary costs ($ per cow per year)	74	69	84	106[2]

[1] Reference values, AgSource, Wisconsin DHIA, All Holstein Herds, December 2003–2005.
[2] Reference values from the annual Wisconsin Milk Production Costs Survey–UW Center for Dairy Profitability. Mean results from participating dairy farms with 80–120 cows. Sample size from 2003 to 2005 was 145 farms.
[3] Excludes 2002 when 50% of the herd was sold following a drought and a shortage of forage to winter the herd.

order to take a break from milking in winter, they had to stop milking a number of good producing cows relatively early in their lactation, which became viewed as a very costly practice every year. From 1997 onwards, the number of cows being milked through the winter usually stabilized at approximately 40%. There were cases, however, where winter labor was short and they did close down milking altogether. Nevertheless, in the summer months, it was typical for 100% of the cows to be producing milk. This change in winter milking policy resulted in reductions in the average length of dry periods from 83 days in 1994 and 1995[6], to close to the industry standard of 62 days by 2002 (Table 2, line 2). Milk production per cow climbed slightly following the transition period and, by 2002, RHA milk at 7355 kg per cow per year was about 80% of the average DHIA Holstein herd production. Milk production per cow climbed again slightly during the organic phase but now represents only 78% of the average DHIA Holstein herd production (2003–2005) (Table 2, line 1). While below average milk production per cow may appear to be undesirable, it may be consistent with achieving the larger goal of maximizing pasture use efficiency.

Herd reproduction. In the MIG system, unlike a system that depends on stored feed, it is crucial that the majority of the herd calves just prior to the onset of the spring flush in the pastures when the feed is most abundant and of highest quality. Approximately 60 days after the birth of the calf, a cow reaches her peak milk yield, which coincides with her peak nutrient needs and her maximal intake of feed. Following peak, milk production declines gradually over the subsequent months until the cow is ‘dried off’ or milking ceases. As a dry cow, she will consume less than half the amount of feed per day as when she was at peak milk production. To maintain this rhythm of the majority of the herd calving in March and April, the rate of successful identification of ‘heat’ (estrus) and insemination every 12 months must be very high. If, for example, the herd calving interval were to spread to 13 months for 6 years, cows would calve in the autumn and would require stored feed for most of their peak production period. Thus, in a seasonal grazing dairy, reproductive management to achieving a 12-month calving interval becomes actually more important than increasing milk production per cow (Table 2, line 3).

Maintaining an annual calving cycle in dairy cows has become a very difficult process that is rarely achieved in the industry today. In a review of reproductive trends in the US dairy industry, Lucy[13] reported that average calving intervals of 13.3 months in 1970 had stretched to 14.7 months by 2000. The longer calving intervals were mirrored by reduced fertility, measured as services per conception, which increased from 1.8 in 1970 to 3.0 in 2000. During this same 30-year period of time, production increased from 6400 to approximately 9000 kg of milk per cow per year. Simply stated, reproduction and milk production appear to be antagonistic.

In the case of a grazing dairy where there is a seasonality of forage availability, it appears that if lower production is the price that must be paid to maintain an annual calving rate, farm profitability may not be adversely affected, as it would in a dairy based on stored feeds. While this dairy is below average in terms of milk production, it has achieved the unusual accomplishment of a 12.1 month calving interval over the past several years—a full 2 months sooner than in the conventional herds in Wisconsin (Table 2, line 3). The seasonal imperative for spring calving also means that replacement heifers must be managed so that they calve at 23–24 months of age, not at 27 months as is the average in the conventional herds (Table 2, line 4).

In 1994–1995, 56% of the herd was culled[6]. Many of these cows were sold because their calving intervals had stretched to where they would not calve back in the desired early spring 'calving window'. By moving to a more flexible seasonal milking program and having animals in excellent reproductive health, the farm was able to reduce its culling rate to 24% in recent years, dramatically less than the 38% culling rate common in the industry (Table 2, line 5). This number is even more remarkable considering that only half of these animals were involuntary culls (disease, don't get pregnant), while the remainder were sold to other dairies (pregnant but going to calve outside the 'calving window'). In conventional dairies, nearly 100% of the cull animals are involuntary and sent directly to the slaughterhouse.

Herd genetics. One of the reasons for the lower milk production per cow on this farm is due to genetic selection for traits other than milk production. In 1995, the adult cowherd was 100% Holstein with most cows fathered by high-production bulls using artificial insemination[6]. During the transition period however, much of the service sires or semen being used in the active breeding program was purchased from New Zealand Friesian bulls and a number of cows were being bred to non-Holstein bulls. The primary cross has been between Holstein and Jersey, but semen from Normande, Dutch Belted and Scandinavian Red bulls has been used to breed some Holstein cows. Because the semen of several breeds was purchased from several countries, comparable genetic index values cannot be provided in this discussion. This policy continued during the new equilibrium phase and, by 2002, 30% of the cows in the herd were crossbreds and by the end of 2005, 45% of the cows were crossbreds (Table 2, line 6). In comparison with the overall industry, approximately 95% of the dairy cows in the AgSource data set maintained by Wisconsin's DHIA testing service were purebred Holsteins in 2005.

Milk volume from the crossbreds is expected to be less than that of purebred Holsteins because the starting point of the other breeds is so much less[14]. However, the crossbred cows are expected to show hybrid vigor resulting in increased fertility, longevity and calf viability[15]. The current excellent reproductive performance of the herd may be partly due to absolute reduction in milk yield of the herd as sire selection has not emphasized milk volume, partly due to improved fertility related to hybrid vigor of the crossbred cows and, of course, excellent management. Again, both factors of reduced yield and hybrid vigor would favor reproductive health so that calving can coincide with the spring flush of pasture growth.

Herd health.

Mastitis. While pastures present very clean conditions for the cows and are associated with excellent mastitis control, outwintering the cows on pastures presents risks for cows in the late winter and early spring. When the stanchion barn was converted into a milking parlor in 1996, the cows no longer had a barn for housing. And as the frost leaves the soil in March and April, the feeding areas in fields can become muddy and soiled and the teats become contaminated, a risk factor for mastitis infections.

The standard monitor of mastitis is the herd average somatic cell count (SCC). Herd average SCC of 150,000 per milliliter of milk or lower is considered excellent, whereas herd average SCC greater than 500,000 is considered to represent herds where a large proportion of the cows have infections of their mammary glands. As shown in Figure 4, and Table 2, line 7), the herd SCC exceeded 500,000 in the early months of both 1996 and 1997, a problem attributed to the outside conditions. Although the herd SCC improved when the grazing season began, mastitis problems in the first weeks after calving are a serious health and production risk to the cow.

Because of these mastitis problems with the fresh cows, and for cow comfort, a barn with a straw bedded pack and cement floor outside the feeding area was constructed and used first during the winter of 1997–98 (Fig. 2). The new barn improved the hygiene of the cows through the late winter and early spring and was associated with excellent mastitis control from the summer of 1997 to 2000. An increase in herd SCC in the winter of 2001 was not diagnosed as to cause.

Since the herd achieved organic status, the use of antibiotics on the mammary glands, called 'dry cow treatment', has been discontinued. Dry cow treatments are a standard practice in the US dairy industry, as they have been shown to eliminate some of the existing subclinical infections and have been effective in reducing the number of new cases. The herd average SCC during the first 3 years of the organic phase has averaged 293,000, a modest increase over previous years (Table 2, line 7). While managing the herd on pasture resulted in excellent udder cleanliness and reduced risk of mastitis infections, the inability to use antibiotics in an organic dairy reduces the ability to manage mastitis infections and has resulted in an increased SCC for the herd.

Subacute ruminal acidosis (SARA). Milk production declined by 13% in 1996 and 1997 from prior levels. For example, in June of 1995, the herd had averaged 80 lbs of milk per cow per day, but produced 66 and 67 lbs per cow per day in each of the subsequent June test dates, respectively. Herd average milk fat percentage reached

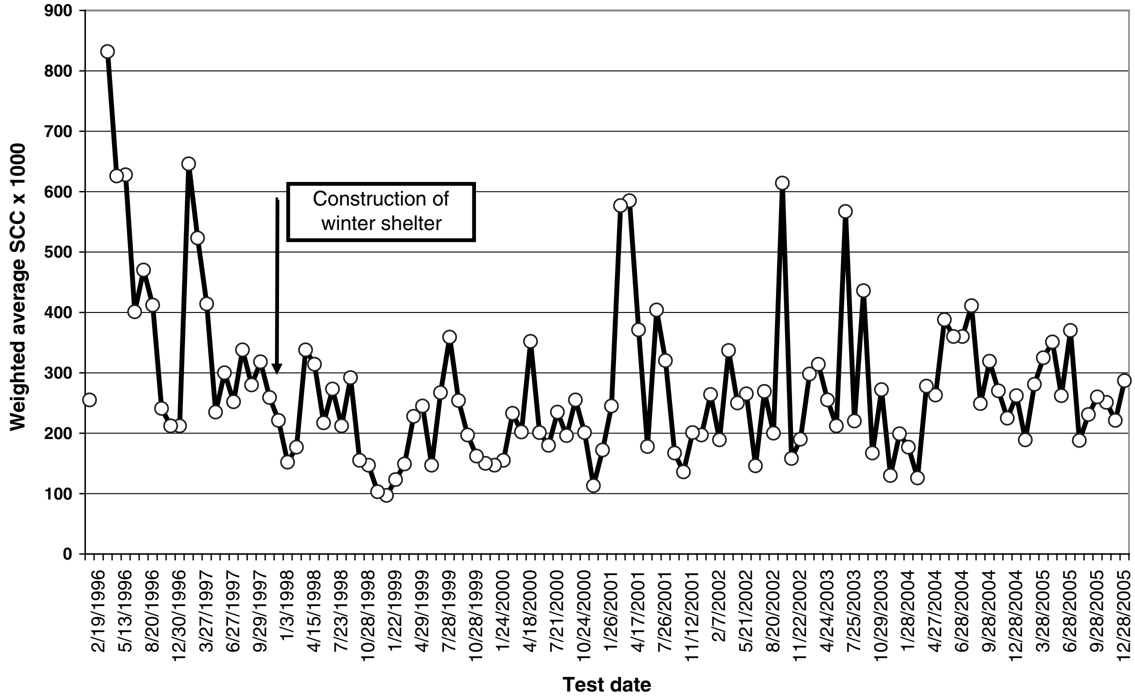

Figure 4. Herd average SCC.

very low levels of 2.7% in the grazing season of 1997. Because low production and low milk fat percentage are commonly found in herds experiencing SARA, an investigation was conducted. Using the rumenocentesis test[16], a positive diagnosis of SARA was made. SARA usually occurs in cattle being fed diets with an excess of starch, resulting in excessive production of volatile fatty acids and lower ruminal fluid pH below 5.5[17]. In grazing cattle, highest milk yields are associated with ruminal pH between 5.8 and 6.2[18].

Following the diagnosis, various modifications were made to the feeding program to reduce the ruminal acidosis problem. The daily feeding of corn grain (7 kg day^{-1}) was reduced and, by 2001, was approximately 3.5 kg per cow per day. The reduction in corn grain was replaced by increased consumption of purchased alfalfa silage and, by 2001, ruminal pH values returned to the normal range. This modified feeding program replacing grain with forage may partly explain, along with genetics, why the RHA milk production is below that of comparable conventional dairies. Similarly, the improved control of ruminal acidosis would have contributed, along with crossbreeding with breeds that produce higher fat content milk, to the increased milk fat percentage in the past few years (Table 2, line 8). As with many grazing-based farms, the overall health of the herd has been good and veterinary expenses ($84 per cow per year) now represent about 80% of the costs incurred by conventional dairies (Table 2, line 9). Even these numbers are a bit high and this is largely due to a commitment to animal welfare and high-quality health care. They do not spare expense on animal health. A result of this philosophy is that these dairy cows remain in the production herd for an average of 4.2 lactations, whereas the industry average is 2.7.

Economic performance

As with any business, success must also be measured in economic terms. Table 3 summarizes several whole-farm economic indicators and provides industry benchmark comparisons from similarly sized farms (80–120 cows) from the AgFA survey results[8]. Total farm income per cow was fairly constant from 1996 to 2002, while actual herd numbers markedly increased from 69 in the fall of 1995 to 115 in the fall of 2001. And then total farm income per cow increased dramatically once the farm became certified organic and was nearly equivalent (94%) to the conventional dairy benchmark (Table 3, row 2). Most of this income was from the sale of milk and it appears that, although production levels were lower on the Krusenbaum farm (by 2000 kg per cow from Table 2, line 1), high organic milk prices ($0.45 liter^{-1} versus $0.31 liter^{-1}) mostly offset this effect.

A historical strength in the Krusenbaum system has been their low cost structure (inputs, labor and interest payments). Basic cost per hundredweight equivalent (CWT EQ) is a measure of the input costs that farmers incur in generating total farm income, by converting all their income streams (milk, cull animals, custom work, and crop sales) to milk equivalents (Table 3, row 3). During the equilibrium phase, these input costs were 85% of that of conventional dairymen. Since becoming certified organic, however, basic costs have gone up and now are equivalent to the baseline sample, in large part due to the increased

Table 3. Economic performance on the Krusenbaum farm.

Economic criteria	Krusenbaum farm: Expansion phase 1996 and 1997	Krusenbaum farm: New equilibrium 1998–2002	Krusenbaum farm: Organic 2003–2005	Benchmark: Conventional dairy farms 2003–2005[1]
1. Average number of cows	85	111	96	96
2. Total farm income ($ per cow)	2520	2779	3709	3946
3. Basic cost ($ CWT EQ^{-1})[2]	8.56	7.55	8.75	8.68
4. Labor costs ($ per cow)[3]	252	128	272	362
5. Interest payment ($ per cow)	160	114	62	159
6. NFIFO ($ per cow)[4]	242	670	775	752
7. Net farm income ($ per year)	23,240	75,600	73,595	74,088

[1] Reference values from the annual Wisconsin Milk Production Costs Survey–UW Center for Dairy Profitability. Mean results from participating dairy farms with 80–120 cows. Sample size from 2003 to 2005 was 145 farms.
[2] Basic cost per CWT EQ measures the input costs that farmers incur in generating total farm income, by converting all their income streams (milk, cull animals, custom work and crop sales) to milk equivalents.
[3] Direct labor costs for non-family members minus benefits.
[4] Net farm income from operations (NFIFO) is the return to the operator family's unpaid labor and management plus the return to their equity capital.

cost of buying certified organic feed. This measure does not include the effects on cash expenses associated with paid labor or debt servicing. In fact, on many farms labor and interest payments add greatly to the actual costs of production. On the Krusenbaum farm, cash labor expenses per cow to non-family members were lowest during the equilibrium stage (1998–2002). Although labor costs for the recent period are still only 75% of those on conventional farms, they have more than doubled from that lowest point, primarily due to the presence of a pair of interns (married couple) and part-time employment of a neighbor (Table 3, row 4). The third component of the cost structure for producing milk is debt servicing. It is especially noteworthy that although the Krusenbaum farm has a modern milk parlor, an outwintering shed and a good line of farm equipment, it is carrying only 40% as much debt per cow as the benchmark farmers (Table 3, row 5).

The third group of economic variables reflects the actual income available to the farm family. Net farm income from operations (NFIFO) per cow (Table 3, row 6) is strictly the return to family labor, management and equity capital. Due to the construction of the swing parlor and outwintering shed plus the adoption of seasonal dairying during the transition period, the farm experienced a low NFIFO per cow during those two years. However, during the equilibrium phase, when the construction was paid for and milk production was up, NFIFO per cow improved markedly. This number is also enhanced by a number of additional enterprises on the farm. They raise about 25 steers; have range-grown broilers and eggs; and grow a few pigs every year that they market (gross sales $40,000). During the organic period, although production costs had risen (inputs and labor), the high price of organic milk ($0.45 $litre^{-1}$) resulted in still higher returns per cow, equal to that of the conventional benchmark herds. And this was accomplished at only 80% milk production levels. Net farm income on the Krusenbaum farm (Table 3, row 7) both during the new equilibrium period and organic period has been nearly equivalent (102 and 99%, respectively) to conventional benchmark farms. The NFIFO per cow and net farm income both clearly indicate that this farm is a financial success.

Conclusions

The Krusenbaum farm, from all the indicators, is a success. The home farm plus rented land is supplying most of the dairy feed, the presence of well-managed pasture and improved lanes have resulted in almost no soil erosion on the farm, and soil test phosphorus levels are remaining constant, while needed levels of potassium and organic matter are increasing. Milk production is modest but steady and the problem of subacute ruminal acidosis has been solved. Most striking is the reproductive health of the herd, which allows for an excellent synchronization of herd feed needs with the spring flush of forage. Net farm income on the farm is equivalent to that of the benchmark sample, adequate labor has markedly reduced the stress of farming and the low level of annual interest payments all bode well for the future.

This farm has been a success, we hypothesize, for the following three reasons:

(i) ***The production strategy underpinning the farm operations is valid.*** Almost all of the herd management decisions have been focused on synchronizing calving with the spring flush of pasture, assuring that when the herd's nutritional needs are the highest, high-quality, cheap forage is plentiful.

(ii) ***Management has been creative and flexible.***
Farm management. The Krusenbaums have continually tried to improve their system through the building of an outwintering shed, a new parlor, expanding the cow lanes and shifting to strictly seasonal and then backing off to partially seasonal dairying. Although it took nearly 2 years to develop a diet that reduced rumen acidosis, by working closely with nutritionists they were able to solve the problem.
Investment decisions. The family was not afraid of investing money to improve their operation. Although an indirect measure of their willingness to invest, depreciation per cow over the past 10 years has been $420 or $61 per cow higher than the confinement dairy benchmark sample. They have a modern milking parlor, outwintering building and a first rate line of equipment for putting up forage as balage for winter feeding. By attention to detail, they have made each of these investments generate additional income due to the resulting labor savings or quality of the feed they harvested.
Money management. They have kept their debt-to-asset ratio low by shopping around for money when they needed it. Although they now have one of the largest dairy grazing operations in the state, they are carrying relatively little debt.
Entrepreneurial spirit. The Krusenbaums have continually looked for ways to develop value-added products and synergies on their farm, allowing them to increase farm income. They raise about 25 steers each year, which they market. They introduced a small poultry and egg operation that follows the rotating herd in the paddocks and helps break up the manure pies, and they have had several pigs per year that rut in their outwintering shed, helping to mix the hay and manure pack into compost. They also collaborated in an unsuccessful effort to market part of their milk as a grass-fed, locally produced cheddar cheese, but discontinued their participation when it proved uneconomical. The successful initiatives play a small but important role in the profitability of this operation.

(iii) ***The family has always prioritized quality of life issues.*** Dairying can result in a crushing lifestyle. Since the Krusenbaums started in 1990, the issue of quality of life has driven most of their major decisions. Starting with the shift from conventional to rotational grazing (1993 and 1994), the purchase of modern baling and wrapping field equipment (1995 and 1996), the shift to partial seasonal dairying and herd expansion and the construction of the dairy parlor (1996 and 1997), and the building of the outwintering shed (1997) have helped them meet their goal of making dairying a good family enterprise. And most recently, they have been dedicating more time and resources to training a new generation of dairymen using MIG techniques. In addition to participating in the university's School for Beginning Dairy Farmers and a local grazing network, they have developed a share milking agreement (2006). (Under this contract the young couple who were interns, and want ultimately to own their own dairy, manage the farm, and pay 16% of the variable costs. In return, they keep 16% of the monthly milk check, get free housing, and are building equity by keeping every fifth heifer calf.) The Krusenbaums' focus on quality of life issues was one of their most important decisions and they are today as enthusiastic about dairying as when they started in 1990.

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