Towards Sustainable Land Stewardship:
Reframing Development in Wisconsin's Dairy Gateway.

by

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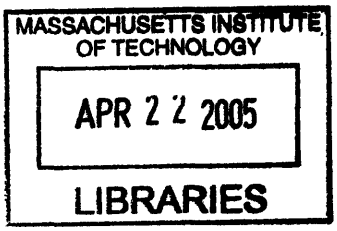

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TOWARDS SUSTAINABLE LAND STEWARDSHIP:

REFRAMING DEVELOPMENT IN WISCONSIN'S DAIRY GATEWAY

by

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ABSTRACT

Changing economic realities in the dairy industry have profoundly affected the viability of the dairy farming community in Wisconsin. In addition they face mounting local opposition to dairy modernization and expansion, and an increased regulatory burden. This survey looks at ten farms in the Dairy Gateway counties and the broader trends in the industry, and reveals incongruities with neo-classical economic theory. An ecological economics framework is then applied in an attempt to better explain what it happening in the Dairy sector and to support policy directions that might lead the dairy community back towards both economically and ecologically sustainable land stewardship.

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Figure 1: Wisconsin, and the 'Dairy Gateway' counties:

Door, Kewaunee and Manitowoc

Chapter 1 – Introduction

The historical land managers in the three county region of Wisconsin's 'Dairy Gateway' have been the dairy farmers. Over many generations, their land stewardship practices combining feed cropping and grazing pastures, have contributed to a managed landscape that supported a prosperous dairy sector alongside a 'natural' environment with added aesthetic value to the tourism and recreation sectors. Changing economic realities in the dairy industry, however, have profoundly affected the viability of the dairy farming community, and combined with changes in regional demographics have raised questions about their ability to coexist as sustainable and popular custodians of the land. In addition, growing concerns about the environmental impacts of intensive farming have increased regulatory burdens on farms and created opposition within communities to farm expansions and modernizations.

Farmers are responding to economic pressures and environmental regulation in order to keep their farms viable. There appears to be widespread acceptance of the need for greater economic efficiency and the potential benefits of nutrient regulation. Where there is greater concern is over the potential community opposition to dairy modernization and expansion, since many farms feel compelled to modernize facilities in response to a steady erosion in the viability of their livelihoods. The long-term decline in agricultural commodity prices has created a crisis in many farming communities with social and environmental costs, in addition to economic consequences. In the case of Wisconsin's dairy sector, this price pressure has resulted in an 85% reduction in the number of working dairy farms between 1959 and 2004.

California and other Western states with fewer but much larger confinement dairies have increasingly taken market share away from the smaller farms in Wisconsin. This suggests that large-scale confinement dairying is economically more 'successful', but despite these

economic signals, most remaining Wisconsin dairy farmers and agricultural communities are not able or willing to move to the same scale of production.

The responses of farmers within the dairy sector of Wisconsin can be broadly summarized by the following three approaches:

(i) The confinement dairy 'modernizers' are responding to economic pressure by adapting to the neo-classical market economics approach. This leads to herd size expansion, land consolidation and increased farm mechanization, typically requiring significant new capital investment and greater debt burdens, but providing greater revenue streams.

(ii) In contrast, a smaller but growing group of farmers are focusing on economic sustainability by reducing external factor inputs, and changing land and feed practices to intensive grazing. In the case of organic grazers they are adopting additional standards in order to sell at a higher and more stable milk price.

(iii) Thus far the majority of Wisconsin's remaining dairy farms appear to be only partially committed to either of these approaches. They are adopting new technologies and farming practices where the early adopters have shown them to be successful, however, they are reluctant to take on a significant debt burden in order to change their scale of operations or to commit to organic land certification. Some see themselves as the last generation of dairy farmers, as in the medium-term, it is unclear if these predominantly small-scale family farms can continue to compete with large-scale producers, or how new farmers can get started without major capital investment.

Those farmers who have chosen to adopt the approach of expansion as a means of retaining economic viability are increasingly aware of local and national opposition to 'factory farms'. Wisconsin farmers focusing instead on smaller niche and organic markets are in turn facing the challenge of doing something new in a largely unsupportive institutional environment. All farmers claim an interest in stabilizing the industry, and

moving towards a sustainable dairy sector, however, the form this might take, and resulting policy implications have not yet been fully developed. Prior research and annual quantitative surveys of Wisconsin, notably in 1995 (UW PATS, 1997), have found that only a minority of Wisconsin's dairy farmers support farm expansion, yet the current economic paradigm and much of the agricultural policy and government-supported research assumes that expansion is the primary future development path.

To further investigate these incongruous findings, interviews were conducted with a broad range of dairy farmers in the Dairy Gateway counties of Wisconsin. Questions focused on farmers' perceptions of 1) changes in the past 5-10 years and 2) their expectations for the likely future of their industry in the region.

The apparent unwillingness of the remaining dairy farmers in the region to accept and adopt the economic trends in the industry suggests that either the local dairy industry is uncompetitive, or that the dominant economic paradigm is inadequate to explain and offer policy guidance to these shrinking farming communities. The current economic paradigm also does not provide a suitable framework to analyze the environmental and social aspects of sustainability.

Given growing concerns about the long-term health of the industry and the social and ecological environment that it operates in, there is increasingly broad recognition of the need for 'sustainable development' rather than a pure focus on economic maximization, and this will require an ongoing shift in approach, with significant institutional upheaval and social change. The phasing in of nutrient management plans and the change in practices towards less tillage are two examples of recent changes in farming practices reflecting a movement in this direction. In addition, in the three Dairy Gateway counties of Eastern Wisconsin there is increasing scope for State sanctioned experimentation with innovative policy approaches that focus on improving environmental performance and

resolving social conflicts, through the environmental performance act commonly referred to as the 'Green Tier' legislation.

Agricultural land use is critically dependant on natural capital and ecosystem services and has a multifunctional role in society that emphasizes the need to balance narrow economic goals with broader social and environmental outcomes. In seeking to explain the critical role of natural capital and ecosystem services to the agricultural sector, the theoretical framework chosen for this analysis is ecological economics. In contrast to neo-classical market-based economic analysis, this approach regards natural resources and ecological services as essential components of production and required complements to the use of manufactured capital and labor. As a consequence, ecological economics also emphasizes the importance of scale and the limits of carrying capacity on the economics of any ecosystem. Using this broader approach provides theoretical support for existing but marginalized policies to better consider what are currently treated as 'non-economic' factors. Adding theoretical justification for these policies, while exposing the inherent flaws in the some existing practices are important steps in reframing the choices and shaping the mindsets of the stakeholders in the dairy industry. It is hoped that this could clarify some policy inconsistencies and assist farmers seeking to manage their land in an ecologically sustainable fashion. It should also serve to better justify much of the existing environmental and community involvement of the State government.

Chapter 2 – Research Methods

Survey Methodology

This thesis takes a case study approach, supported by data and reports from secondary sources. The principle source of secondary data is the extensive pool of academic research and state data on the dairy industry in Wisconsin. The primary data collection in the form of in-person interviews was conducted within the three county 'Dairy Gateway' region of Eastern Wisconsin. The intent of this thesis is to use the state of practice on the ground as a starting point for discussions of how a shift towards more sustainable agricultural land use could enter into state policy and achieve buy-in and beneficial gains for the farmers involved in the process.

Interview Questionnaire

The primary objective of the survey interviews was to gaining insight into the core question of the ability of Dairy farmers to act as stewards for sustainable land use in Wisconsin's Dairy Gateway region.

The survey goals where as follows:

1) To verify the findings of previous surveys.
2) To better understand the diversity of farmer opinions and the nuances behind those perceptions.
3) To assess the feasibility of analyzing the factors in the Dairy Gateway scenario with a ecological economics model, and the plausibility that this approach could help capture the underlying dynamics and provide policy guidance on how to move forward.

A series of eleven key informant interviews were conducted with a broad cross-section of farmers spread throughout the three Dairy Gateway counties. The questionnaire was open-ended and asked the farmers to describe their background, their farm operations, and to discuss the most significant changes on their farm and in the region in the last 5-10 years. Farmers were then asked to look forwards, and describe what the future might

hold. They were also specifically asked which of several current farming approaches they expected to be successful in the future. The goal of the questionnaire was to elicit from farmers in the region what they had to say about the recent developments and consolidation in their industry, and how well their thoughts matched the findings of the statewide dairy farmer surveys by the University of Wisconsin since 1995. Farmers were deliberately not asked directly to talk about their position on farm expansions or disputes with neighbors, but these issues came through in their responses as dominant concerns.

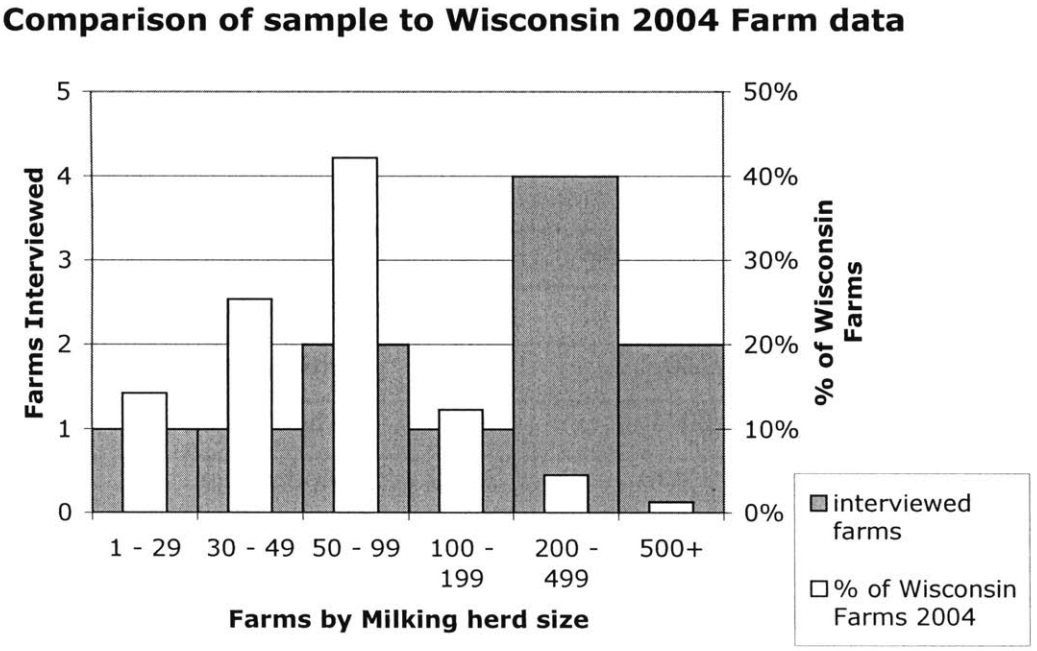
As a result, in discussing the findings the topic headings in chapter 4 do not relate directly to specific questions. The general form of the questionnaire is listed in the appendix, and was used as a guide and format for the interviews, the majority of questions were asked as written, and the order of the interview topics was followed. Due to time constraints on the part of the farmers, a couple of interviews were significantly shorter than desired at 12 and 26 minutes. The full interviews varied in length from 55 minutes to a little under two and a half hours, due to differing lengths in question responses. In 4 cases interviews were conducted with husband and wife pairs, the remaining 7 interviews where all with male farmers. The local mediator, Nancy Skadden, was present at all interviews as an independent and neutral observer. The interviews were recorded using a digital audio recorder and resulted in 14 hours of data for qualitative analysis.

Sample Selection

Ten farms from the three-county area were visited in July of 2004 and the current farmers were interviewed. Additionally one recently retired farmer was interviewed, to represent some of the many farms that have chosen, or been forced, to get out of the dairy farming business. Although each farm is uniquely different, a conscious effort was made to capture the full range of farming practices employed in the region. Other important criteria were a geographical spread of farms throughout the three county region and a range of farm sizes. Large farms were over-sampled relative to the total population due to the desire to include farms engaged in expansions, and also inadvertently as a result of including the specific practices of management intensive rotational grazing (MIRG) and on farm sales (See Figure 2).

Interviews were conducted during the busiest time of the year for most dairy farmers, so not all the desired interview candidates were available, but the acceptance rate among contacted interviewees was high. All interviews were conducted on a voluntary basis, and quotes were sent for farmer approval prior to inclusion. One of the interviewed farms did not participate in the quote review process and has consequently been treated anonymously, as have some sensitive quotes. All quotes are written verbatim except for minor edits of repeated words or pauses that do not affect the meaning.

Figure 2: Dairy herd size of interview sample relative to Wisconsin population



Within the initial ten cases, three Farms were selected as 'modernizers' having made a conscious decision to intensify and increase the scale of their farming operations. These farmers were judged apriori to have embraced the idea of modernization and economies of scale, and have expanded their herd size substantially in the past few years.

Similarly, three farms were selected as representative of non-expanding but high quality

'Alternative' routes. One farmer is using intensive rotational grazing for a medium sized herd, another is a small certified Organic farm, and the third is a small select breeder of dairy cattle primarily for agricultural shows and breeding stock.

The remaining four farms were representative of perhaps the majority of Wisconsin's remaining farms who have yet to commit to either camp, and while continuing to innovate, they are hesitant to change the scale of their farms and their 'traditional' practices.

During the interviews, it became apparent that the diversity of approaches to farming, defies this simple categorization, and the farms interviewed did not fit neatly into these groups. As a result the categories were dropped in the discussion of findings and each farm was instead given a one-word description for chart labeling purposes.

Table 1: List of Farms interviewed

Farm name	Herd Size	Acres	Initial Category
Schopf's Hilltop dairy	550	2,000	Modernizer
Farm A	240	4,300	Modernizer
Sunny Slope Farm	60	400	Alternative
Kinnard's Farm Inc.	1,400	2,300	Modernizer
Heim's dairy	280	900	Traditional
Olson Farm	115	1,000	Traditional
Diamond dairy	280	535	Traditional
D & R Fischer Farm	88	355	Traditional
Hagenow Farm	47	325	Retired
Roger Brogie	23	40-325	Alternative
Saxon Homestead Farm	435	930	Alternative

Framework of Analysis

For the purposes of this thesis the goal of sustainability is approached from a 'strong sustainability' and ecological economics perspective (Daly 1991, 2004). This approach privileges the maintenance of natural resource stocks and ecosystem services over time, both in terms of the quantity and quality of natural capital available to current and future generations. In this view, a critical level of natural capital and ecosystem services are a prerequisite for meeting ongoing economic and social goals.

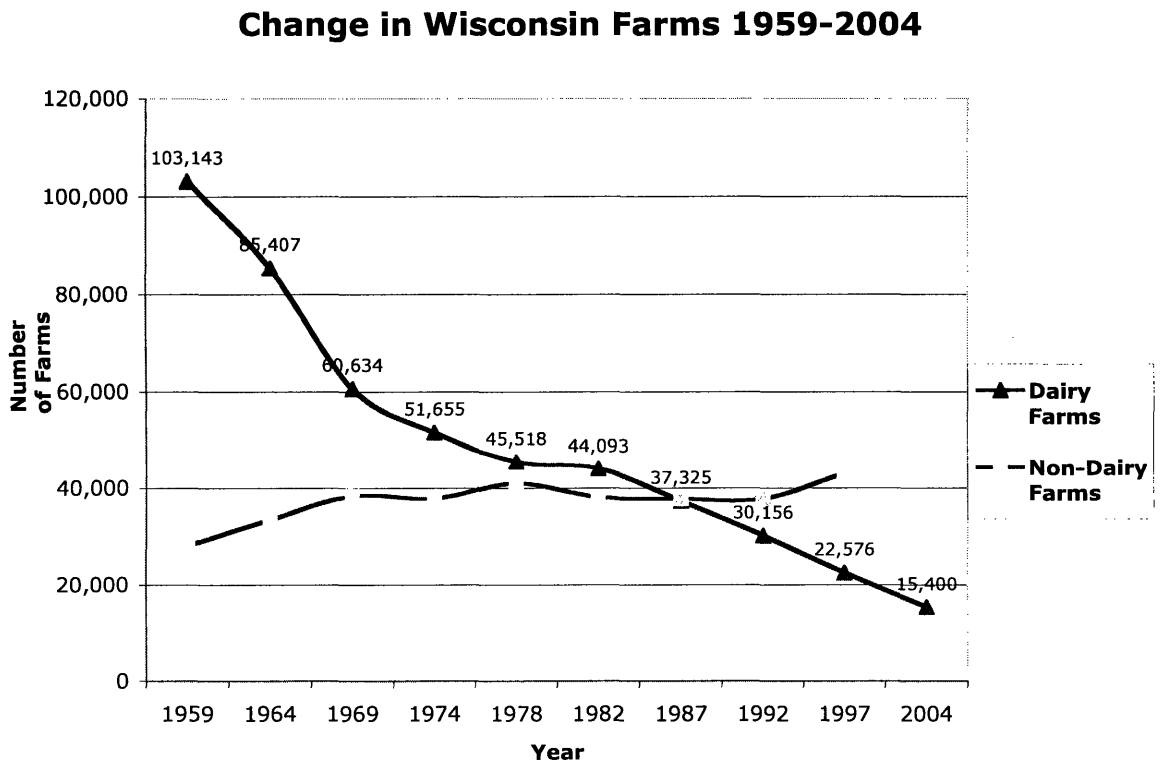
Elsewhere in the academic literature, the terms 'sustainability' and 'sustainable development' are more broadly used, and as such have acquired a reputation as rather fuzzy concepts. In contrast, I argue that at least the environmental component of sustainability, and hence of sustainable development, can be a fairly narrowly bounded concept. Its current 'fuzzy' usage is largely due to the difficulty in objectively measuring impacts on human and natural ecosystems and a widespread lack of application of the implications of energy flows and entropy. Applying what we know of the laws of thermodynamics places finite limits on efficiency gains from technology, and debunks the myths of costless material transformation or natural capital substitution. Long-term ecological sustainability is dependent on solar 'income', and the quantity and quality of energy thus provides a useful and pragmatic benchmark for measuring progress. This implies that well managed natural capital and an appropriate scale of production are of critical importance to sustainable agriculture and land-use management, although they have been undervalued by traditional economic theory and practice.

While the importance of ecologically appropriate scale and limits to growth shown in ecological economics can explain the environmental aspects of sustainable development, the institutional change being undertaken in Wisconsin reveals the importance of social factors in the implementation of environmental and economic management and by extension environmental and economic performance. In moving towards sustainable farming and land use practices we need to further integrate social and environmental factors into our economic institutional analysis.

Chapter 3 - Wisconsin and US Dairy Industry trends

Wisconsin was the dominant dairy producing state for much of the 20th century. As recently as 1959 Wisconsin had over 103,000 dairy farms, comprising the great majority of farms in the state. The last 45 years has seen a chronic decline in the number of these farms, amounting to an 85% reduction in dairy farms by 2004 (See figure 3){WASS, 2004 #22}. Wisconsin's dairy farms have traditionally been small family-run enterprises, with an average herd size remaining under 100 cows. The steady drop in the number of these farms has been attributed to the modernization and industrialization of the dairy sector, both within Wisconsin and the rest of the dairying world.

Figure 3: Declining Dairy Farms in Wisconsin, 1959-2004 {UWISC PATS, 2002 #89}



In the Western States of the US, a much larger scale of farming operations has become the dominant dairy model, and allowed California to overtake Wisconsin as the number one dairy producer in 1993 despite having far fewer farms {USDA, 2001}. Perhaps what is initially most surprising about Wisconsin's dairy industry is it's relative lack of response to these long-term trends and the apparent unwillingness of its remaining dairy farmers to adapt to the economically more 'successful' model. The continuing economic and institutional pressures in the dairy sector appear to be increasingly forcing those farmers that remain in the business to choose more explicitly between following the Western model through farm expansion or focusing on niche and organic markets. It is not clear yet what the outcome will be for the majority of farmers who do not easily fit into one of these camps. The University of Wisconsin PATS and CIAS programs[1] have highlighted this issue in their research on the declining agriculture of the middle {Barham, 1998 #25}{Kirschenmann, 2004 #23}.

Historical growth of dairy Farming in Wisconsin

Wisconsin's land-use was already dominated by dairy agriculture at the turn of the nineteenth century, due largely to the combination of lush pastures fed by precipitation from the great lakes, good soils, and a substantial population of dairy farming settlers from Northern Europe. Wisconsin was thus well placed to take advantage of the early industrialization that followed the invention of milking machinery, and the arrival of the railroads. Major dairy processor Land O'Lakes was set up in the 1920's as a cooperative in neighboring Minnesota but serving much of Wisconsin also. They were able to make product innovations due to new preservation and transportation technologies. Butter had traditionally been produced from sour cream, but Land O'Lakes and other dairy coops started mass-producing and marketing fresh cream butter and later pasteurized fresh milk.

The importance of schools for the milk market

In 1915 the National Dairy Council was formed, in the 1920s they sponsored US school milk trials which reported improved child health through drinking fresh milk. In the aftermath of

[1] PATS – Program on Agricultural Technology Studies, CIAS – Center for Integrated Agricultural Systems

world war two the UK 1946 Education act included free milk to all public school children. Based on this precedent, in 1948 the US Congress passed the school lunch act, including milk in the school lunch program, followed in 1955 by the Special Milk Program which provided Federal subsidies to support fresh milk consumption in schools. School milk subsidies were later incorporated into the Child Nutrition Act in 1966. These formal institutional supports led to growth in the dairy industry as a whole, and Wisconsin as the major dairy state was a principal beneficiary. At its peak in the late 1960's, school milk consumption amounted to over 3 billion half-pints a year (see Table 2), and milk consumption in the US was over 30 gallons per person per year {Putnam, 1999 #26}. School milk consumption began to decline from 1970 onwards, and that decline became dramatic under President Reagan following 1981 legislation that limited participation in the milk program to schools and institutions not participating in other child nutrition programs.

Table 2: US Special Milk Program in Schools (SMP), Congressional Appropriations, 1970-2001 {USDA FNS, 2004 #27}

Year	US Congressional Appropriation (unadjusted $)	Milk Served in Schools (million half-pints)
1970	$101.2m	~ 3,000 (1969 data)
1980	$145.2m	~ 1,800
1990	$19.2m	~ 181
1997	$19.2m	-
2000	$17.2m	~ 120
2001	$15.8m	-

Without continued political support, fresh milk was not able to maintain its position as America's drink and steadily lost ground after 1970 to the superior mass-production, marketing and lobbying efficiency of carbonated soft drinks led by Coke and Pepsi-cola as Table 3 and Figure 4 illustrate.

Table 3: Beverages in the US food supply, 1970-1997 gallons per person

Year	Milk	Soda	Diet Soda	Juice
1970	31.3	22.2	2.1	5.7
1975	29.5	25.0	3.2	6.9
1980	27.6	29.9	5.1	7.4
1985	26.7	28.7	7.1	8.3
1990	25.7	35.6	10.7	7.9
1995	24.3	39.8	11.8	8.7
1997	24.0	41.4	11.6	9.2

Source: {Putnam, 1999 #26}

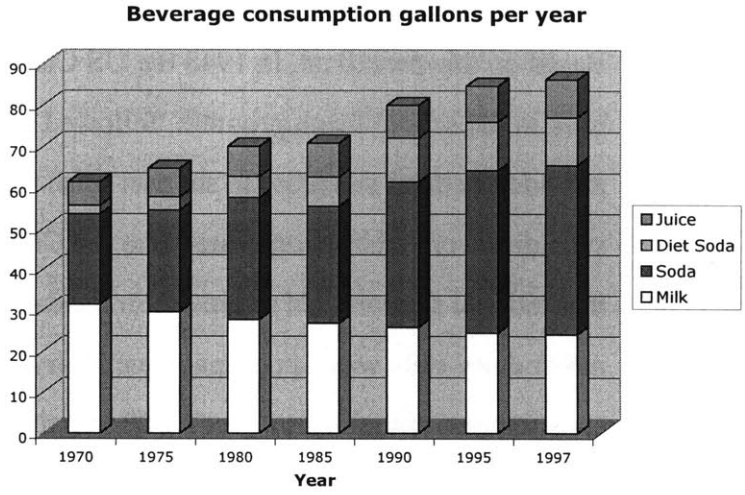


Figure 4: Beverage Consumption in the US Data from Table 3

Despite the loss of school subsidies, milk and other dairy products still accounted for nearly a quarter of the food costs for schools in the 1990s. This has continued to fall as the soft drink industry successfully lobbied to get soda vending machines into schools, and sweetened fruit drinks included in lunch programs. More recently schools in some states have started to sell exclusive 'pouring-rights' to soft drinks companies, which in turn has negative ramifications for dairy farmers.

"...it should be noted that pouring-rights contracts have economic implications beyond school meal service. Because they affect the sales of milk, the contracts also affect the livelihood of community dairy farmers. Milk used to be the only beverage provided to school-children. Once sodas were permitted, milk sales declined."
{Nestle, 2002 #11}

Classical economic theory typically attributes shifts in consumption of this sort to changing relative prices or as an exogenous change in individual consumer preferences. In this case, however, there are important institutional power dynamics at play. The dairy industry lobbied for, and benefited from, privileged access to school children in the post-war period, arguably based on the public health benefits of this policy. The dairy coops were subsequently outmaneuvered by soft drinks corporations. The informal institutions that evolved in parallel to the rise of the dairy industry such as door-to-door delivery and consumer milk consumption habits have also fallen away in the face of cheaper distribution, the dominance

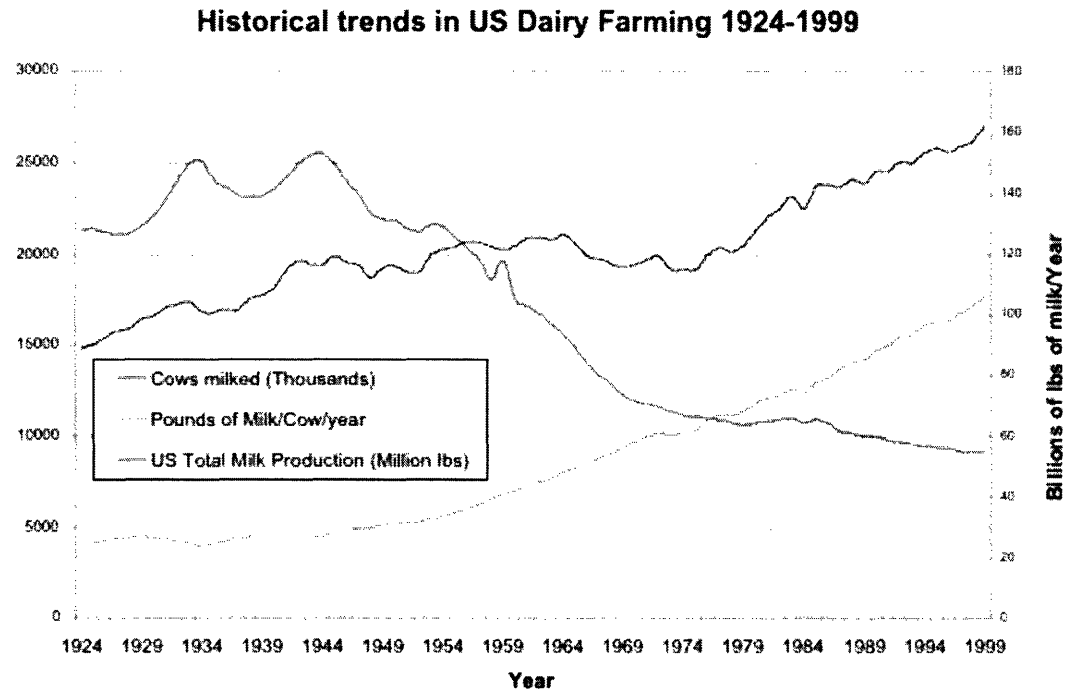
of supermarkets, machine vending, and sustained large-scale advertising from soft drink manufacturers.

US dairy trends – fewer cows, more milk

Reduced market access for fluid milk has contributed to a plateau in the volume of US sales, representing a decline in per capita consumption given the growing US population (IDFA, 2003). This is insufficient to explain the impact on Wisconsin though, as total US milk production has continued to rise since the 1920's even as fresh milk sales have leveled off (see Figure 5) and much of Wisconsin's milk production has gone into cheese production. The US dairy industry is composed of several regional markets for fresh dairy products due to their limited shelf life and significant delivery costs. In addition there is a more national market in processed dairy products such as cheese, dried milk and whey bi-products. In recent years due to global trade agreements, the national markets have become increasingly international with increasing competition particularly from Australia and New Zealand. Recent innovations, particularly the shift from pasteurized to ultra-pasteurized milk are now also blurring regional market boundaries for fresh milk and cream as the shelf life has now increased from weeks to months, and increased temperature durability has reduced transportation costs.

The continued rise in milk production has been enabled on the demand side by the growing consumption of cheese, and other dairy products used in processed foods. The downside of this growth is that milk for processed dairy products receives lower prices than fresh milk sales. This lower price has been achieved on the supply side by increasingly productive cows, and a growing aggregation of distribution.

Figure 5: Long-term production trends in the US dairy industry



California, and the rise of the mass production model

As the traditional dairy heartland, Wisconsin has experienced increased competition for market share with later developing US dairy regions, notably the dairy expansions in the South Western states of California, New Mexico and Arizona. A quick comparison between production figures in Wisconsin and California for 2003 (see Table 4) shows a stark contrast in farm characteristics.

Table 4: Dairy Production in key states - USDA data 2003

State	Average Herd size (cows)	Milk per Cow (lbs/year)	Number of Farms	Total Milk Production (million lbs/year)
Wisconsin	76	17,367	16,623	22,266
California	806	20,993	2,125	35,437
USA	-	18,749	70,410	170,312

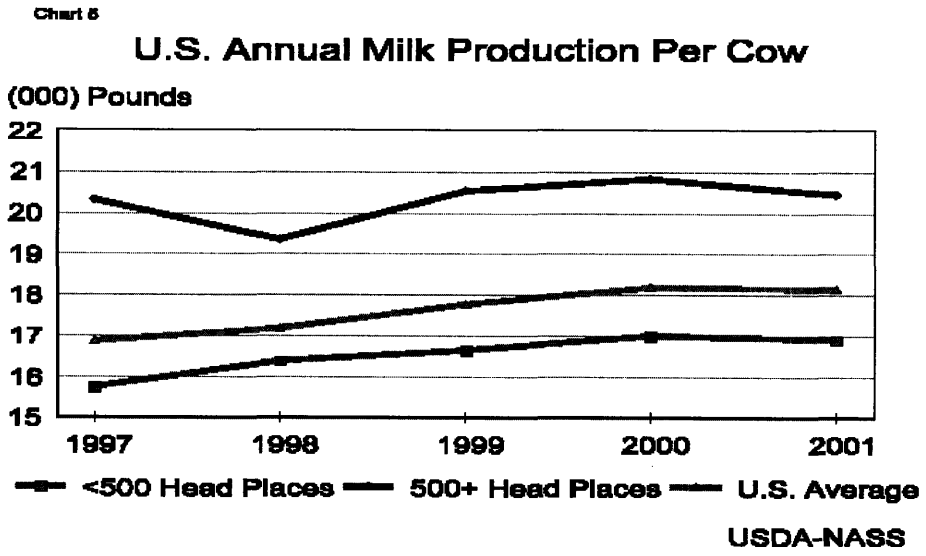
With an average herd size of over 800 milking cows, typical Californian dairy farms were an order of magnitude larger than typical dairy farms in Wisconsin where the state average was 76 milking cows per farm. In 2003 Wisconsin still had almost 8 times as many dairy farms as

California, but in total they produced less than two thirds as much milk. California's dairy sector is dominated by farms with over a thousand head of dairy cattle, and has farms with up to 18,500 cows (Successful Farmer, 1998). All farms with over 1000 animals units (equivalent to approximately 700 mature dairy cows), along with smaller farms designated by the EPA as a significant contributor of pollutants, are classified as Concentrated Animal Feeding Operations (CAFOs), and these farms require special permits {Berman, 2003 #85}. These CAFOs are also commonly referred to as 'factory farms' by concerned consumer and environmental groups. As a result of keeping cows in comfortable but confined barns and maximizing their milk output, these farms are able to produce substantially more milk per acre of land, and benefit from other economies of scale. Many of the largest farms have long-term contracts with major dairy processors. Indicative of this relationship, California is now home to four of the world's ten largest cheese producing processing plants and 45 percent of California's milk goes into cheese production {CDFA, 2004 #24}. It is California's growth in the commodity cheese market that appears to present the most direct competition to Wisconsin's traditional farms. However, the recent shift to ultra-pasteurized milk could signal a further erosion of Wisconsin market share through increased competition in the regional fluid milk markets.

Increasing cow productivity

Milk output per cow in confined dairy operations has steadily increased through a number of innovations. These include technological improvements in machine milking and feed preparation, long day-lighting of barns in winter, and a shift to more nutritionally targeted feed with higher protein content, commonly referred to as total mixed rations (TMR). CAFOs typically buy in a major proportion of their animal feed, and cropping has increasingly become a separate and parallel farming specialization. In addition, cows in close proximity are more routinely given vaccinations to prevent disease and many are injected with bovine growth hormone to boost their milk production. Keeping cows in a more conditioned environment enables the rearing of large and highly productive Holstein cows, that are generally kept in the milking herd for only 2 to 4 years rather than their longer lived, but also less productive pasture grazing relatives. All these factors lead to a significantly higher per cow productivity in large dairy operations, as shown in Figure 6:

Figure 6: Milk productivity per cow for large and small herds {USDA NASS, 2002 #84}



Some of these cow productivity measures are controversial from the point of view of consumer groups concerned about food safety, environmentalists, and animal welfare advocates. Recent high profile issues are water pollution from manure and fertilizer run-off into groundwater, the level of antibiotics and other chemicals in the environment linked to animal vaccinations, and health concerns around the use of growth hormones in dairy herds. Posilac, the synthetic rBST[2] growth hormone, is a monopoly market for Monsanto, who claimed in 2003 that a third of US dairy cattle were injected with it every two weeks {Barboza, 2003 #19}. Posilac is banned in Canada, Japan, Australia, New Zealand and most of Europe due to human and cow health concerns, and the European Commission food safety report links rBST to breast and prostate cancer {Health, 1999 #20}. Posilac suffered production quality problems in 2004, which may have reduced its use, but Monsanto recently announced that production will be back up in 2005 {Dumas, 2004 #21}.

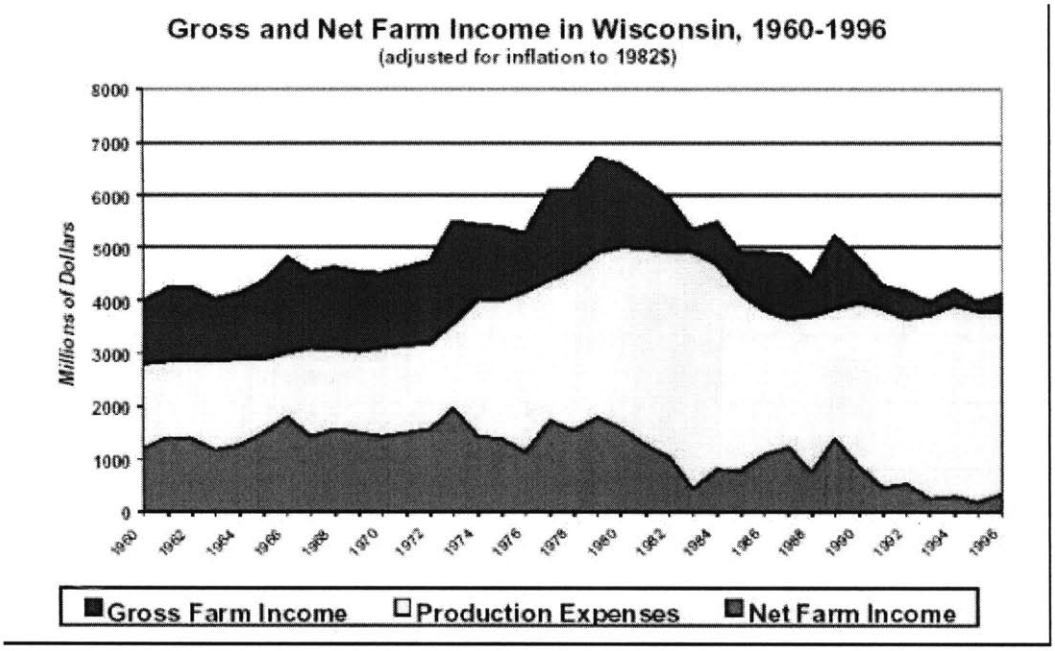
Despite the controversy surrounding some of their methods, the dominant trend in the industry as a whole is unquestionably towards fewer, but larger dairy herds as the 2002 USDA dairy herd structure report summarizes:

[2] rBST is also known as rBGH (recombinated Bovine Growth Hormone)

"In conclusion, the number of small operations continues to decline while the larger, more efficient operations continue to increase their share of milk cow inventory and milk production. Even though operations with more than 500 head accounted for only 3 percent of the milk cow operations during 2001, they accounted for nearly 40 percent of total U.S. production."
{USDA NASS, 2002 #84}

The result of steady increases in the milk supply primarily from new and increasingly large farms has been a steady decline in milk prices. One of the consequences for the industry as a whole has been a downward trend in net farm income as Figure 7 illustrates for Wisconsin.

Figure 7: Increasing economic pressures on Wisconsin Farmers {Barham, 1998 #25}



The economic pressures are felt disproportionately by the smallest farmers, as they have fewer cows to derive their income from. Larger farms may not be more efficient on a per cow or per hundredweight basis, but can gain a greater total income from managing a larger herd. This logic is driving many farms to seek further expansion, and sends them the signal of 'grow or get out'. This ongoing process has led to considerable consolidation of the number of farms and reduced the number of self-employed dairy farmers. While the expanding farms that stay in business are able to hire additional workers, as with many agricultural sectors in the US, the majority of these jobs are relatively low paying manual labor. An increasing

proportion of the dairy workforce are migrant laborers, primarily recent immigrants from Mexico, and Central America.

Wisconsin's limited ability and willingness to respond

The response of Wisconsin's dairy sector has reflected the national herd expansion trend, with a steady increase in the herd size of it's remaining farms, and herds of over 500 cows showing the fastest category increase in percentage terms over the last decade. However, there are physical and financial limits on the ability of Wisconsin's small farms; the majority of which have less than 75 cows, to transition to a scale of production that is an order of magnitude higher.

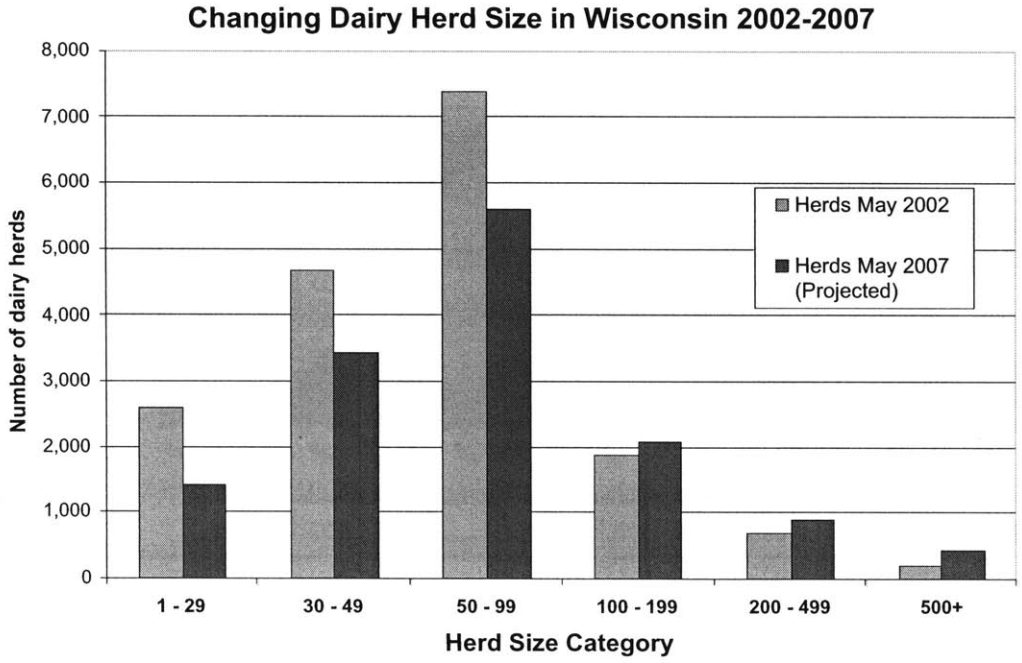


Figure 8: Herd Size distribution in 2002 and 2007 (projected) {WASS, 2002 #54}

A 2002 statewide survey, asked dairy farmers about their plans for the next five years though 2007. The projections formed predict a continuation and amplification of the current trends. While 20% of farmers plan to increase their herd size, another 20% plan to discontinue milking. As Figure 8 shows, the majority of Wisconsin's farms will remain below 100 cows,

and continue to go out of business, whilst the number of larger farms is expected to grow. In Figure 9, we see a far greater intention to expand from the farms that are already large, while those planning to retire are almost all small.

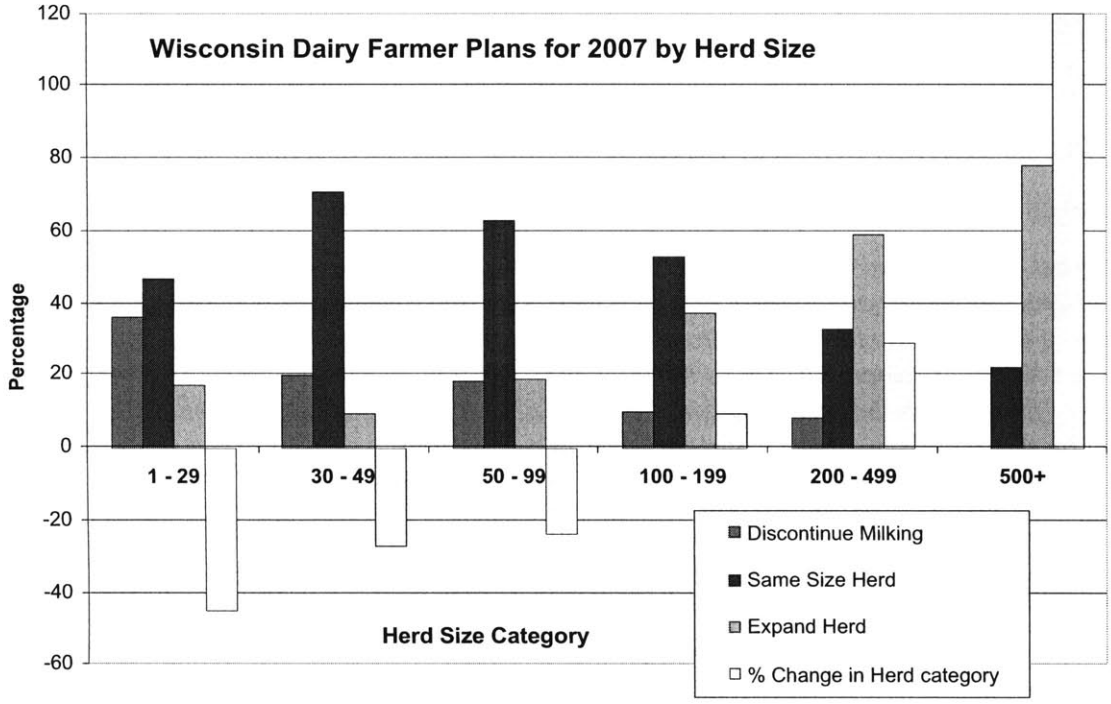


Figure 9: Predicted changes in Wisconsin Dairy Herds 2002-2007 {WASS, 2002 #54}

Several of Wisconsin's largest dairy operations are recent entrants to the industry that have bought and rented land from small farmers who are no longer viable, and have brought with them the significant capital investment required to start a large herd confined dairy. Modern barns and milking parlors, and adequate manure storage facilities require a multi-million dollar capital outlay, and a large land-base for distributing manure nutrients. These physical and financial constraints previously led researchers in Wisconsin to conclude that the Mass production model is not a viable option for most of the State's current dairy farmers {Barham, 1998 #25}. A large majority of Wisconsin farmers surveyed in the winter of 1995 reported that they were against farm expansion, and not primarily for environmental reasons:

"These results provide evidence that farmers' opposition to large-scale livestock production is not based primarily on environmental concerns. This is true despite the fact that the typical farmer feels that smaller-scale livestock production is best for the environment. ...
In all cases, operators of medium-size farms (gross annual sales between $40,000 and $99,999, and gross sales of $100,000 to $199,999) were least favorable to livestock expansion. This was also the case with respect to the variables measuring farmer expectations of the benefits and costs of livestock expansion"
{Buttel, 1997 #28}

Instead their concerns over farm expansion lay more with the ongoing impact on the structure of rural communities and the erosion of family farming.

"The vast bulk of Wisconsin farm operators—virtually regardless of the size of their farming operations, the major commodity produced, or their age or education —strongly endorsed a system of family-scale farm operations. It would appear that the bulk of farmers who opposed livestock expansion did so because they felt it would lead to further erosion of the status of family farming in Wisconsin. To some degree, most farmers feel that their survival might be threatened by new and larger units of production."
{Buttel, 1997 #28}

Mounting environmental concerns over mass production

While the farming community has not focused on the environmental impacts of farm expansions, the same is not true of the growing non-farming community. Particularly in the Dairy Gateway region of Eastern Wisconsin where there is a steady expansion of summer and retirement homes for people seeking to escape to the countryside. Groups of new and old residents have been increasingly vocal in their opposition of farm expansions, filing nuisance complaints and protesting at the public hearings required for CAFO permitting (See Figure 10) {Rhines, 2004 #86}. Local opposition has been aided and abetted by local and national environmental advocacy groups seeking to highlight their mounting concerns around increasingly industrialized livestock farming practices. This makes it hard to pin down whether in each case there are specific issues that can be addressed, or a more fundamental concern with changing land-use that threatens social and environmental values and fails to meet the desired image of country living.

Figure 10: Visible local concern in Manitowoc county

While the voices of local concerned citizens are using the language of environmental issues, their appear to be social concerns about the disappearance of traditional farming in addition to the environmental and health aspects of pollution {personal communication with Centerville resident}.

The State response

The State Department of Natural Resources (DNR) and the Federal Environmental Protection Agency (EPA) have acknowledged that both point and non-point source pollution from farmland manure spreading runoff is a potential threat to the safety of the public water supply. In the past, the primary State involvement has been in promoting investment in new farming technology and farm expansions through State and Federal Agriculture programs. These have been criticized as disproportionately beneficial to large-scale farmers. However, more recently the DNR and the Department of Agriculture have been implementing a statewide requirement for farm nutrient management plans. Within the Dairy Gateway region, they have also sponsored a pilot program to build and improve relations between farmers and their neighbors and explore innovative environmental management opportunities.

Two of the three counties in the Dairy Gateway; Kewaunee and Manitowoc, remain among the most densely cow populated areas of the state. To the South and West, these counties face a growing demand for land for residential development following highway upgrades that

have made Green Bay and Metro Milwaulkee increasingly accessible. While to the North and East, the lake Michigan coast and Door County in particular, continue to attract new retirees, summer residents and tourists. Additionally, this region of Wisconsin has relatively shallow soils, and fractured bedrock in places, but remains dependent on local aquifer well water. This unique combination of factors make the Dairy Gateway an increasingly high pressure environment in which to modernize a dairy farm, and this makes it a likely harbinger of what is to come elsewhere in the state and the region.

Chapter 4 – Interviews with Dairy Gateway farmers

The Farmers and their farms, listed by the order of interviews:

Dennis Schopf - Schopf's Hilltop Dairy. Central Door County.

A Farm of 550 milking cows, milked 3 times a day, and farming 2000 acres of cropland. This is a modern confinement dairy, that the Schopf's have developed to combine as a tourist attraction. Visitors to the farm can take an educational guided tour of the milking parlor explaining how modern dairies work, and watch cows being milked from behind a glass partition. They have a farm-shop, sell homemade icecream, and have other summer activities for farm visitors.

Farm A.

An expanding dairy farm that is part of a larger crop farming operation, this farm is part of an extended family business that manages 4,300 acres of cropland. Currently they milk 240 cows twice a day but are in the process of expanding to twice that size, and 3 times a day milking in a new facility. Expansion will be in two phases over the next few years.

Gary Mosgaller - Sunny Slope Farm, North Central Door County. (Organic)

A former conventional crop farmer, now in organic dairy with 60 cows milked twice a day that graze 75 of the 400 acres from Spring to Fall and are fed crops during the winter months. The cows are a cross of Holsteins and Lineback breeds. Sons help on the farm and are interested in continuing the farm.

Rodney and Maureen Kinnard - Kinnard Farms Inc. Central Kewaunee County.

A large family run confinement dairy. Currently milking 1,400 cows and cropping 2,300 acres. Managed by the family but with 23-4 employees working on 8 hour shifts, to allowing milking 3 times a day.

Lloyd Heim - Lloyd and Jeremy Heim's dairy, Central Kewaunee County.
A medium-sized, modernized confinement dairy, with 280 cows milked 3 times a day and 900 acres of cropland.

Richard Olson - Olson Farm, South Eastern Door County.
A conventional confinement dairy farm with no expansion plans. Milking 115 cows and cropping 1000 acres, with high milk yield per cow, milking twice a day.

Dale Bogart - Diamond Dairy, Central Manitowoc County.
280 cows milked three times a day, and 535 cropping acres. Didn't inherit a farm and has been working hard to build enough capital to modernize his milking parlor. Recently changed feeding strategy and accepted lower milk output to better balance input and output costs.

Dean & Renee Fischer - D&R Fischer Farm, Western Manitowoc County.
A family-run conventional dairy. Milking 88 cows twice a day and cropping 355 acres. Don't expect their children to continue farming, but heavily involved in the community.

Carl Hagenow - Hagenow Farm, Western Manitowoc County. (Retired)
Used to milk 47 cows twice a day and run 325 acres in crops. Retired due to old age. Two daughters married and farming, one is editor of a farming newspaper. Expects to see farming continue.

Roger Brogie – former Hagenow Farm, Western Manitowoc County.
A red Holstein breeding specialist. Milking 23 cows twice a day, but running business for shows and breeding stock rather than milk primarily. He previously worked on the family farm, but is now setting up on his own for the first time.

Karl Klessig - Saxon Homestead Farm, Southern Manitowoc County. (Grazer)
A medium-large sized farm, but one of the larger intensive rotational grazing dairies with 435 milking cows and 930 acres of grazing and cropland. A three family farm competing

on price with confinement dairies but preferring the grazing lifestyle. Their cows are a cross between Holstein, Brown Swiss, Normande and Jersey breeds.

Discussion of findings

It is readily apparent from this selection that there are a broad range of approaches to farming, and different methods and configurations being employed. For comparison, the largest farm in the Dairy Gateway region at the time of the survey was believed to be milking 2,400 cows, with a total herd size of around 5,000 cows and heifers.

In addition to the diversity of farms in the sample, there was a perceptible openness to the discussion of dairy issues, and considerable thought behind many of the interviewees' responses. The findings summarized below cover the key issues discussed in the interviews, and raised by the farmers about their farms, the farming community and their aspirations for the future.

I. Why farm? - Dairy farming as a lifestyle and a vocation.

Dairy farming appears to be viewed by all the farmers interviewed as very much a lifestyle choice and a vocation. Farmers consistently made the case that they farm because they want to, not because it makes them any money. And almost all the interviewed farmers referenced the time and responsibility that a commitment to farming demands.

"I like working with cows, and I get a good feeling from producing a good product, a safe good food product that other people need. I could go out and get a pretty good job somewhere else, doing something else, but I find it rewarding doing what I do, and that's why I do it. And I like doing it. Because if I didn't like it, it's too hard of a job to not like. ...there's a lot of stress, it's a hard life, a lot of long hours. It's still the job I like the best."
Richard Olson – Olson Farm

When asked to calculate their weekly work hours, the average was over 70 hours a week. The busiest times are during the summer months due to cropping, and the winter is the quietest time. This was equally true on larger farms where the owning family no longer does the day to day milking or farm work, but has a primarily management role. All of the farmers interviewed had relatives that were dairy farmers, and all but two grew up on dairy

farms, most of them on the land that they farm now. While several had 2 or 4 year college degrees in farming, it was not seen as a requirement for successful farming to have attended higher education, whereas hands-on farming experience was viewed as essential.

II. How do they farm? Farming Practices

While dairy farms historically were grazing operations with crops grown to provide fodder for the long winter months, in recent decades grazing has been largely phased out. The most recent state survey estimates that 14% of Wisconsin's dairy farms are grazing operations {WASS, 2004 #22}. The remaining 86% of farms are now confinement dairies, where the cows are fed year-round, rather than grazing for feed during the growing season. For confinement dairies, Holstein cows are the breed of choice given their high milk production. Farmers still attempt to grow most or all of their bulk feed and buy in only protein supplements, and additional feed requirements as needed. The lowest percentage of home-grown feed among the interviewees was 75% by volume.

Only one of the eleven farmers interviewed was an organic farmer, and he had previously been a conventional crop and dairy farmer. Organic farms amounted to 2.2% of Wisconsin dairy farms in 2004, and are expected to grow to around 4% in the next five years. One other farm visited was a conventional grazing operation. The grazing farms typically have milking herds that are a cross between high production Holsteins and other hardier, and smaller breeds such as Line-back, Brown Swiss, Jersey and Guernsey cows. That said, grazing operations appear to be enjoying something of a resurgence in popularity, with a significant coverage in dairy magazines and several confinement dairy farmers expressing an interest in higher butter-fat Jersey and Guernsey cross-breeds. A significant barrier to moving in this direction is that their existing milking parlors are designed for larger Holstein cows.

III. What motivates Farm and herd expansion?

The ongoing trend towards farm expansion in the state, and the country, was reflected in the interviewees. The majority of whom have expanded the number of milking cows in the past 5-10 years, and many expressed plans to expand further in the future. Below are some of the reasons given for this strategy of growth:

Modernizing equipment and housing for greater milk production and herd health

The more recently upgraded farms have moved to free-stall milking barns, which speeds up the milking process and consequently makes milking 3 times a day more feasible. Farms with older equipment, such as stanchion barns typically milk twice a day. Newer barn designs for confinement dairies housing significant numbers of cows are widely accepted as providing better conditions for confined cows, and being less time consuming for staff to manage. They have more integrated systems for managing bedding and manure, for lighting and heating in winter, and for cooling in summer.

"If I built a brand new facility today, and I milked these exact same cows, I'd be willing to bet in 10 months, even 6 months, that I'd get 10 lbs more [milk per day], just because the cow comfort level would be so much better. The better air, the better mats, beds where the cows lay. We've learned so much over the last 10-15 years about making cows comfortable and how much that really affects milk production."
Dale Bogart – Diamond Dairy

"We go by pounds per cow per day, and its running at 69/lbs/cow right now, but we are pushing to get up to 74 –75, that's what we are hoping the remodeling is going to help."
Personal communication - Farmer

Compared to older barns for confinement dairies these investments are seen as worthwhile for the improvements in cow comfort with resulting boosts in milk production and the reduction of disease problems such as mastitis and Johne's disease.

"The most significant change is our calf barn, the building right out there by the road. Previously our young calves were raised in the same barn as the milking cows, and because of disease control and disease spread we found it necessary to house them in a separate building, with better lighting, better fresh air, just better growing conditions to raise healthier animals that grow faster, and reach the milking herd faster.

Our average age of 1st calf heffers is now 23 months old, 4 years ago before that building existed, we were at 26-27 months old. Now, that 4 months is big time savings."
Richard Olson - Olson farm

While modernizing farm buildings has clear advantages, it does not in itself imply growth in herd size. However, the economics of financing a new milking parlor and confinement barn with accompanying manure storage pit does push farmers in that direction.

Financial returns and debt burdens drive ongoing decisions

Farmers that have made the significant financial investment in modern free-stall barns often feel that they have to maximize the use and hence return on that capital investment, and hence design the farm operations around maximizing the use of their milking equipment. The confinement farms interviewed with medium to large milking herds, run their milking parlors close to 24 hours a day with three shifts of workers doing the milking.

"When we moved here we were at 150 cows. For the first 6 or 7 years there wasn't a year that we didn't buy cows and grow here. We just realized that we had to maximize this facility to pay for it. And I have to get as many cows milked through it. So right now we're milking about 21 hours a day, going 3 times.
.... It's just like any other machine, if it's not operating it can't generate you any income, and that's the way farming has become. Over the years, the profit per cow has gone down so dramatically that you simply end up owning more cows and, its the best way to stay profitable."
Dale Bogart – Diamond Dairy

The need to generate a regular return to manage debt payments on new facilities has changed farming behavior and reduced the traditional autonomy of individual farmers to vary production according to market conditions.

"We've got a lot of debt because we built a $3m facility. Our dairy is run like a business, we do budgets and contract milk to take out some of the lows and highs in milk prices."
Dennis Schopf – Schopf's Hilltop Dairy

By contrast the farms with less investment in their milking equipment are generally much less labor intensive and milk only a few hours a day.

Increasingly the autonomy of farmers is being eroded and their farming and business decisions are determined in consultation with and many times at the behest of their banker. While there have always been financial trade-offs made in farming, the closeness of the relationship and level of involvement of the agricultural banking sector has probably never been higher. Banks help farmers decide how to expand and what they can afford. For example, comparing the expected costs of different manure management strategies and the maximum number of milking stalls that can be added. However, the banks' reliance on a 'debt per cow' ratio in assessing credit directly drives the move to larger herd sizes to cover the debt on modernized or newly purchased facilities. Increasingly even short-term economic considerations appear to trump all others, and are determining many of the changes in farming practices.

"Because you get in a game with the bank where they look at numbers. How many cows do you own? Cause they look at assets, so sometimes you keep a cow that you wouldn't keep if you had heifers to replace them, because you know the banker wants to see so many cows."
Personal communication - Farmer

"So who does the [Manure] hauling?
We haven't decided that yet. We never had liquid [manure] before, and we thought we were going to hire it out, but the banker told us 'you can do it cheaper yourself'. We've got a semi-tractor, we've got big tractors, all you need is the tanks and just do it. We didn't want to spend money on big tanks, because that's a lot of money too, but he said it's still cheaper than hiring it, so that's probably what we'll do.
So you said you hadn't had the liquids before, so?
Well I shouldn't say never, because we had them before, but small, small tanks.
O.k. so it's just the scale that's different?
Yeah. We didn't like the manure liquid back then, but when you get bigger, that's the only way with manure.
Right.
Eventually I want to put a separating system in, to separate out. Then we can just pump the water out, and irrigate the water, then haul the dry solids out, or compost them.
So you think that's down the line?
Down the line, yeah. We thought we were going to do it right at the beginning, but the price tag on all that equipment was too much, we can't do that yet."
Personal communication - Farmer

Economies of Scale and Quality of life

There are additional benefits to growing the size of the farm, that were raised by the farmers.

"Economies of scale give one competitive productive advantages. The consumer in our country spends about 10% of their per capita income on food, it's the lowest in the world, so our boss the American consumer is telling us: look you need to have very low cost, highly efficient operations. And we're responding to that."
Karl Klessig – Saxon Homestead Farm

More flexibility to take time off

This appears to be a function of both increasing in size, and certain technology improvements. The move from a single family to a two-family ownership allows either family to take time off when needed, and the chance to plan holidays away from the farm. For farms with single family ownership, getting larger means more full-time staff, and this in turn makes the on-farm presence of the farm owners less critical.

"I'm usually up here at 7 o'clock in the morning and lots of nights its 10 o'clock. Granted you take off, you go to the kids ball games, you do that y'know. We can do that because we've got people that can run it."
Dennis Schopf – Schopf's hilltop dairy

Typically on farms with more than 150 cows, the milking is now done by recent immigrants. Among the farms interviewed these staff were predominantly migrant workers from Mexico and Central America, a relatively recent shift in the agricultural labor market. In addition to the milking staff, larger farms have a full-time herdsman and employ a wide range of specialist consultants. These include a feed nutritionist, an agronomist for soils testing, milking parlor technicians, veterinarians and financial assessors and advisors.

Some of the major technological innovations such as moving to free stall barns and total mixed ration (TMR) mixers, have allowed a simplification of milking and feed preparation. The now widespread use of TMR mixers makes the task of balancing feed proportions much less dependent on the knowledge and experience of the farmer, allowing part-time or full-time staff to take over this responsibility.

"With the freestall barn and the parlor we've been able to take [time] off easier. Because you can give a guy a recipe and he can mix feed up, it isn't a big deal."
Dean Fischer – D&R Fischer Farm

IV. Are Wisconsin's dairy farms economically efficient?

Efficiency is a somewhat broad term, as it must be defined in some context before it can be measured. If we measure production efficiency in terms of production cost per hundredweight of milk, or milk production per cow, then the general trend throughout the dairy industry has been towards increased efficiency. Annual output per cow has been steadily rising due to a combination of research on optimal feeding, optimal breeding, and improvements in cow comfort and milking equipment.

"So what would you say were the main changes [to the farm in the last 5-10 years]?
Mainly getting more efficient. Lots of little things.
So little things like?
Less tillage. We've been doing that, and that's a big thing. Instead of working the fields 5-6 times, we're working then just what they need. 2 times, 3 times, less waste of fuel, less erosion, a big thing."
Personal communication - Farmer

In the abstract efficiency is commonly viewed as a ratio of output per unit of input. In that sense we can look at signs of efficiency in the management practices and behavior of dairy farmers. Their output is milk and their variable inputs are feed, water, and labor with more 'fixed' inputs of animal housing, milking equipment, power and land. There are side inputs that go into crop production like manure, fertilizer, pesticides, labor and machinery also.

In terms of a focus on efficiency, farmers appear to be paying close attention to their input/output ratio. The confinement farmers interviewed were monitoring the moisture and nutritional content of their feed on a weekly basis with professional laboratory testing, and employing professional nutritionists to advise on feed balance in their total mixed rations. The milk output is tested daily for quality on multiple criteria including somatic cell count, butterfat content, protein and other solids. The 2004 Dairy Producer survey for Wisconsin found that 75% of farms now use professional feed nutritionists, 43% have a formal business plan and 27% have tried hedging or forward contracting on milk and, or feed in the last 5 years {WASS, 2004 #22}.

Nutritionally balanced diets and monitored feeding strategies

Feeding strategy appears to be linked to the level of fixed capital investment made on the farm. The farms with modern milking parlors appear to be paying the most attention to, and money for, their feed. Using carefully monitored and balanced feed rations to maintain and increase milk production.

"We test every day for moisture. Just to keep your quantity right for your groups, but you're testing for your acidity, your protein content, your energy, all the qualities that make a good forage. This we test at least once a week now, as we change [the feed]."
Rod Kinnard – Kinnard Farms, Inc.

"When we built these new facilities, they're called cow comfort. They built them so that they're comfort for the cows so that the cows last longer, and they're finding out that cows aren't lasting longer. And I think the reason they're not is: number one we're pushing them more. If we only got 50 lbs of milk out of them cows a day instead of 90 they would last a lot longer. I think the technology changed so fast, I think the feeding is becoming so much more hi-tech. The way we feed the cows now, we're balancing enzymes in their stomachs, we're balancing lactic acid. Y'know were not just balancing the protein and the minerals anymore, you're balancing all of these other minute things y'know what I mean, in these cows to make them last longer and that's how you're getting more milk out of them, because you're keeping that pH in that stomach exactly the same."
Dennis Schopf – Schopf's Hilltop Dairy

Widespread Growth Hormone use

The use of Monsanto's 'Posilac' rBST growth hormone appears to be widespread amongst confinement dairies. However, during the interview period Posilac production had ceased due to quality control concerns, and several farmers expressed an interest in stopping using it.

"Truthfully, I think if I could, I wish I didn't have to use Posilac. Because, I think a cow's got so many lbs of milk in her, and either you get it out of her in 3 years, or you get it out of her in 5 years. And whether you wear her out faster to get the milk..., so I think to me Posilac is like a magnifying glass, it makes everything you do better, it makes everything you do bad worse. So it's an accelerator is what it is.
So I mean, you think that, you'd like to not use it, but you also think that it [not using Posilac] will be successful? I'm just trying to equate...
Yeah, if nobody used it, we'd all be better off. Because there's more of an acceptance of it now, but there's still some stigma to it. Nobody likes to have to use a synthetic artificial substance, and I think people are still leery of drinking something from a cow that is that. And I think it would give a fresh face to dairy if all at once there's no more BST, there's less to, I can't say you have nothing to worry about, but you have less to worry about. So that would be a good thing. If BST went away that would be a good thing, I think."
Personal communication – Farmer (current Posilac user)

There were some interesting reflections on how the various factors that influence milk production affect the health and well-being of the cows. There was common agreement that modern barns were more comfortable for cows. However, there was also concern that the ongoing pressure to increase milk production was wearing the cows out faster. This is partially borne-out in the average herd age data, although these numbers are skewed towards stable herds, as farms that have been recently expanding understandably have a younger average milking cow age (see Figure 12). These comments on a potential trade-off between cow milk production and milking lifespan also suggest that dairy farmers are beginning to approach limits to milk production per cow.

When looking at our small sample of interviewed farms, it is not altogether clear that the trend towards larger farms and greater milk production go together (see Figure 11). Certainly, the largest farms appear to have the highest milk production, but smaller scale farms appear to be able to stay within a similar range when they pursue similar milk output maximizing feed and management strategies. There is a clearer distinction between the confinement and the grazing herds, with the organic and intensive grazing farms showing the lowest milk production per cow, although still above the average for all Dairy Gateway dairy farms as recently as 1999. It should be noted that with such a small sample Figure 11 and 12 are only illustrative of possible trends. In comparison the 2004 state survey shows that milk production in the aggregate is highly correlated to herd size (see Figure 13).

Figure 11: Milk production per cow by herd size

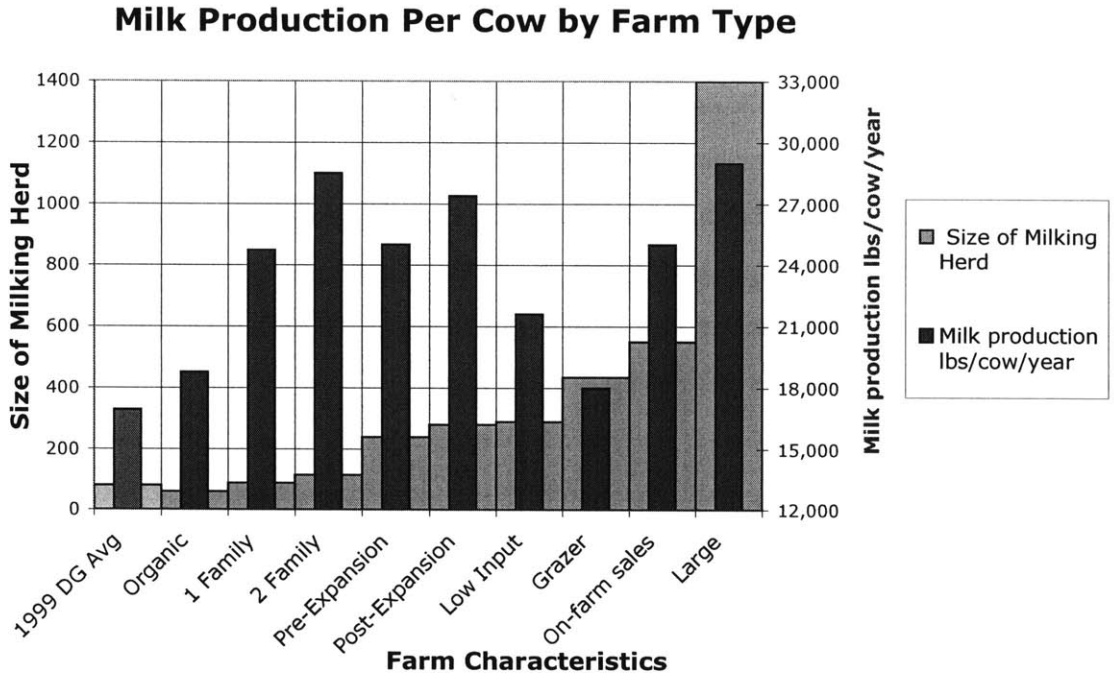


Figure 12: Average age of milking herd and milk production per cow

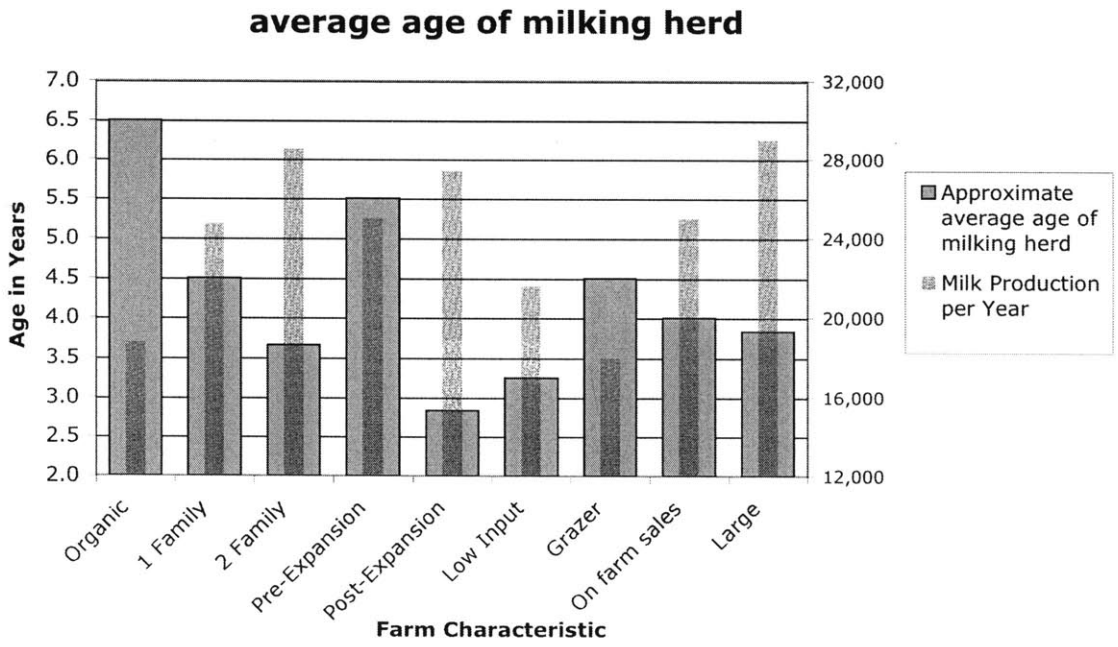
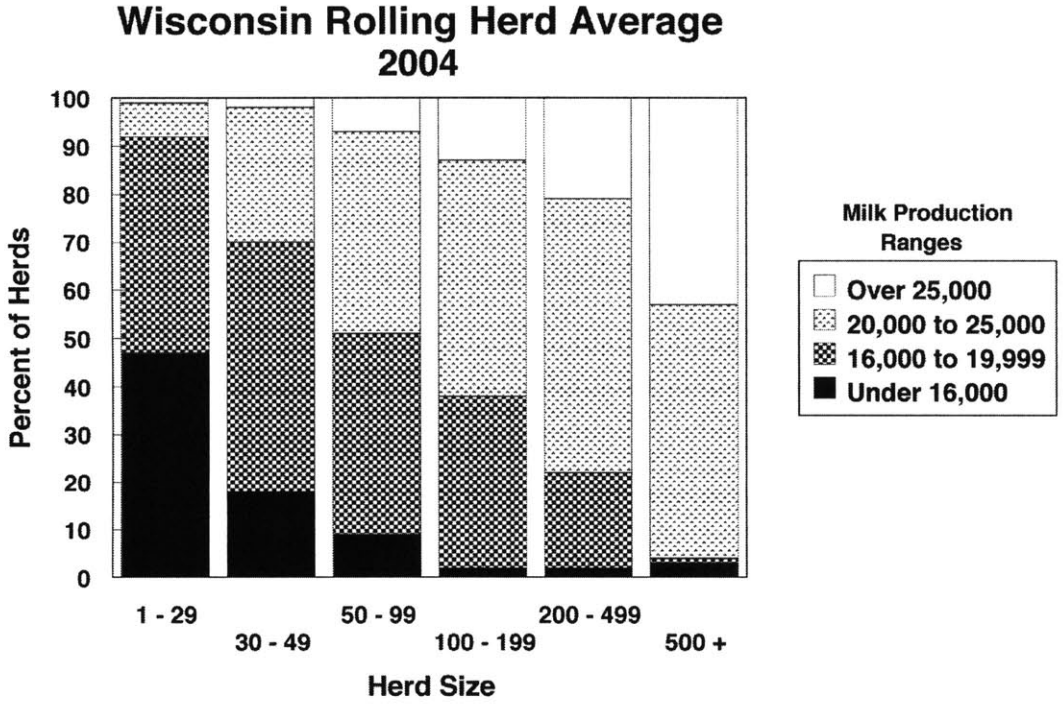


Figure 13: Average annual milk production per cow by herd size
{WASS, 2004 #22}



Adopting Industry Best Practices

In terms of sharing best practices there are numerous magazines, newspapers and online newsletters on everything from the broad changes in the dairy sector to the specifics of herd management, and rotational grazing. All the farmers interviewed read several of these news sources and shared them with their staff, in order to stay updated on new innovations in technology and management techniques.

"Yeah, one thing I learned about was what they call long-day lighting. Where we installed lights in our barn. Our cows are kept inside the barn in winter except for about 2 hours per day when they go outside for exercise. We put lights in the barn over the feed alley, where they eat, and we keep those lights on for 18 hours a day to increase the pituitary glands response to light, which causes them to eat more, which causes them to milk more. And it worked. And I first learned about it in one of the magazines."
Richard Olson, Olson farms.

The confinement dairies with modern milking parlors stated that they are utilizing those facilities close to 24 hours a day. The farmers themselves work long hours and employ motivated and hard working immigrant workers to maximize the efficiency of labor relative

to its cost. Farms also mentioned utilizing their land-base for feed cropping with carefully planned crop rotations, nutrient management plans based on soils testing and consultation with agronomists. Grazing operations have moved to intensive rotational grazing methods developed in New Zealand to maximize the productivity of their land, and both the grazing farms interviewed had recently sent a family member on a trip to New Zealand to visit farms there. Farmers' comments corroborated survey data that milk production per cow has been increasing rapidly as a result of this combination of strategies over the past several decades {USDA WASS, 2004 #29}. A couple of farmers felt that in their facilities milk production may be leveling off, leading to a shift to focus on reducing their input costs until they can afford to modernize their barns and milking equipment. Two of the larger farmers also mentioned using market futures on various feed crops to help make their decisions on feed strategy.

"I spend a lot of time on risk management. All of our production is risk managed. I do a lot with futures and spend a lot of time working the markets in milk, feeder steers, corn, soybean meal, and cotton seed, Like any other business we very carefully review our cost of production. I work with a technical analyst as well as a broker. Risk management is part of our business."
Karl Klessig

Some farms and farmers are more economically efficient producers than others but in general the farmers interviewed in the Dairy Gateway appeared to be skilled and savvy managers focused on improving their production efficiency and responsive to feedback from their testing, and monitoring of their dairy herds. In terms of the factors that farmers have control over they appear to be operating efficiently. There are still issues of scale, land value, and geography that are largely outside their control.

V. Alternatives to Herd expansion – Focusing on Price not Quantity

Better Supply Management

There have been ongoing calls from farmers to institute greater producer control over the quantity of milk supplied to the US national and regional markets. There are historical and international examples of this, with milk production quotas being widely used in Europe

and neighboring Canada. In addition, the large Organic coop 'Organic Valley' maintains a quota system on its farm members {Personal Communication, Mosgaller 2004}.

Eventually, following sustained low milk prices in 2003 a program to buy-out herds to control the milk supply at the margin was implemented by the major milk cooperatives, in the absence of a significant federal program.

"Also there's a program called CWT – Cooperatives Working Together. All cooperatives, each farm put in $0.05 per hundred-weight, that they use to buy out herds to take their production off the market. And that has also helped supply management.
Do you think that arose partly in response to the low prices?
Yes, directly in response to low prices. I think everybody has always kind of wanted to do something as a consolidated group, but I think farmers are the hardest group of people to try and unify, of any, because we're so independent. You know you are there and you are working for yourself day in and day out, and then you should all come together for a common cause. Well there's so many different viewpoints that it's hard to nail down."
Richard Olson

In its first year, through September 2004, the Cooperatives Working Together program is reported to have removed 33,000 cows and 1.2 billion pounds of milk from the market, which is calculated to have increased the all milk price by an average of 59 cents per hundredweight {Dumas, 2004 #21}.

Grazing as a viable alternative to Confinement Dairying

While most of the confinement farmers claimed limited interest in management intensive rotational grazing, they were all aware that grazing was a viable alternative approach to dairying in Wisconsin. Where it was mentioned, it was acknowledged that grazing had advantages in terms of the logistics of cropping and manure handling and this was also linked to the risk of concerns from neighbors over expansion plans. These issues were highlighted by several of the confinement farmers when asked what the main points of discussion were in the farming community.

"At least in this area, and I would think it's all over [the country]. It's manure and expansions y'know. The townships letting them expand or not letting them expand. I would say those are the number one issues."
Dennis Schopf

"With the grazers, it seems less stressful. I'm sure they have stress of their own kind, but it's not the stress of getting crops off. You don't have all the money tied up in the equipment, the repairs and all of that.
...And I think the big farmers are going to run into the environmental roadblock, that's going to be their worst nightmare. Because I know of people that live next door to bigger farmers, and every time they got the tractor out and got one drop of mud on the road she's on the phone calling the sheriffs department. You don't have to do much, but we don't have that problem here.
...Like I said before, you don't know who's going to move into your neighborhood. The people that tolerated all these years they might be fine. But you get people from town move out here, they aren't going to put up with some of that stuff. In 20 years it could be completely different. In ten years, it doesn't take ten years, you can see it already."
Dean and Renee Fischer – D&R Fischer farm

The grazers for their part, claimed a better quality of life and greater job satisfaction from their choice of management practices.

"And, well it's 9 years, and it's going wonderful. I mean the grazing does good, the stress on the animals and us and everything is I think a lot better."
Gary Mosgaller – Sunny Slope farm

"We like the opportunity to have our cows outside. We think it's more fun than conventional farming. I'm not sure if that's true, but that's probably all in the minds of the operators."
Karl Klessig – Saxon homestead farm

These comments support the policy of the Center for Integrated Agricultural Systems at the University of Wisconsin which has been advocating that farmers, especially new farmers getting started in dairying adopt the managed grazing approach {CIAS, 2004 #30}{CIAS, 2004 #31}.

VI. How do they see the future?

In discussing the likely future of dairy farming in the Dairy Gateway region there was a split in opinions between the interviewees. The majority of the farmers expect to see the current trends of farm expansion and consolidation continue, and for smaller, older farms to continue to go out of business. However, several farmers expressed doubts that large confinement dairies would be successful, over the longer term. In Door county in particular; where land prices are currently the highest in the Dairy Gateway, and dairy

farmers have a lower representation in town government, there was the expectation that available farmland will continue to shrink.

"The trend will be to larger farms. The 500-1000 cow dairy. Mainly because of the scales of efficiency where they just seem to run per cow and per hundred-weight more efficiently than say our 100 cow barn. They can milk more cows faster, turn out more milk per hour and when you go to get money from a bank to do something like that, they are going to want somebody that's going to turn a profit. Hopefully turn a profit and get a better return on their money than will the traditional farm setup like we have."
Richard Olson

"No it's[land in dairy] getting smaller. People are building houses and putting trees in, and people are selling it off and some of it you can rent back, some of it they don't want farmed y'know. So I'm sure it's not going to get bigger, it's going to keep shrinking."
Dennis Schopf, Door County

"It's like our banker tells me. Everything works and nothing works. So I don't really see definitive trends to go one way or the other. I see groups of people that desire to do one thing or the other. I think organics are growing, and I also think larger confinement operations are growing.
Karl Klessig

Passing on the farm – a critical goal

In discussing the future most farmers mentioned their concerns over passing on their farm to the next generation. In several cases, farmers don't expect their children to continue farming, but would still like to see their land stay in agriculture. The cases where farmers were most confident that the farm would continue were the largest farms and the organic farm.

"And I never expected my kids to have any interest in farming. I just didn't. And they both have indicated that... and I really do want them both to go to college and get a degree, but they are serious about looking at this as an option for a living, and I can't. Y'know I just did not even think that that was something to think about. Cause, I mean the land's getting too expensive to farm here."
Gary Mosgaller

VII. What precipitates change - Necessity as the mother of innovation.

In many of the anecdotes that described changes, the initial impetus to rethink and revisit the existing practices was some fairly immediate crisis. Examples include:

1. The Cooperatives Working Together (CWT) program for milk supply management didn't happen until milk prices fell to $9 per hundredweight.

2. The Olson's didn't build a new improved calf barn until they had 10% incidence of Johne's disease in the herd.

What led to.. [the calf barn change]?
We had found an incidence, a presence of Johne's in our herd. At the time that we had tested about a 10% incidence in the milking herd of Johne's. It was our goal at that time to reduce the amount of Johne's, and it's spread within our own herd. And so the best way to do that and the most.. the easiest way for Johne's to spread is through young baby calves. That's when they're most susceptible to pick it up through manure and whatever, so getting them away from,... and they can only get it from infected cows, because it's cows that shed it. So the best way to control it is the calves away from the cows. So we built a separate facility. Now our calves are born, Day one, as soon as they're, sometimes they're not even dried off yet, they're over in the calf barn isolated away from mature animals, so that they can't pick up the disease.
And now since May of 2003 we have not had a positive Johne's cow tested, so it worked."
Richard Olson, Olson farm

3. Gary Mosgaller was a conventional crop farmer until disaster struck in his sunflower seeds. He was then a conventional dairy farmer until herbicides nearly blinded him and pesticide spraying made him sick.

"I went the real conventional route at the beginning, like pretty much standard, but I had a lot of problems, different stuff. I mean some of the herbicides that I used I got some real bad reactions. I broke out in a rash and swelled up. And I almost went blind twice because opening a container it vacuum splashed back on me. And I honestly couldn't see, and if I didn't have somebody find me there and get water on me I don't think I'd have my eyes. So I started to realize what am I doing and why? Plus, I was still active in some of the larger canning crops, and they were spraying and we were picking stones and we all got sick from it. And I asked them why they were doing it, because it was like a 20 something mile an hour wind. And I realized when it came to harvest, the area, because I did talk them into stopping at that point. The area that they sprayed was worse than the area they didn't spray. So I said this is just stupid, they're just doing it on prescription, nobody's thinking,

it's just going the wrong way, so I started to just stop and look into I guess at that point sustainable agriculture and that whole concept, and organics sort of led in with that."
Gary Mosgaller, Sunny Slope Farm

4. Continuing to try and pay 22% interest on loans until the 1989 drought forced a farmer into bankruptcy.

"That was in '84. We had that [Farm] until '89. The year of the drought broke my back. That was back when I paid too much for the farm and then the high interest rates. The Farm credit determined I was a high risk so I was paying 22% interest. It was nuts! So I gave up that farm back to farm credit, and kept my cows and my machinery and went back on shares on another farm, and then we moved up here. So, it's been a rocky road, but losing that farm cost me a forture. Set me back probably a good 5-7 years."

5. The Kinnards talk about their darkest days trying to manage a large milking herd before hiring their first Hispanic staff.

"We were doing all the milking ourselves when we switched to 3 times a day. That was back in 2000, and my wife and I had one shift. My mother and brother were doing another shift, we were milking approximately 350 cows at that time. It was a very intense time. We knew we were expanding, we'd just moved into the new facilities and we suddenly realized we can't keep this pace up, and run a business at the same time. And frankly it was going to kill us. It was 24 hours a day of intense labor and nobody was running the business. And that's when we actually started to hire full-time people..."
Rod Kinnard

6. A farmer talks about how his current farm came up for sale.

"This was an operating farm when I moved here. They weren't milking many cows, they had went into herd buy-out, so they were only milking I think 30 cows. Because they had just waited, I think there was a 2-year waiting period or something, on that herd buyout or something like that. And they had just started milking cows again, but the guy was in financially pretty bad shape, and so the banks had basically told him to put it up for sale or you're going to end up losing it, so he put it up for sale."

7. Lloyd and Jeremy Heim had a barn fire which lead to a dramatic overhaul in the way they farmed.

"We milked in the stanchion barn before the fire, and switched to the free-stall parlor. We had to go with the 590 nutrient management plan, so that changed a lot of things about how we do cropping, handle manure and everything. About the single biggest change, there's been so many I wouldn't know what to say."

Sustainability of Dairy farming – balancing cows and land.

Many of the farmers interviewed made explicit reference to the balance between cows and land that still exists in the Wisconsin farming model. While relatively cheap commodity food inputs can be bought and brought in by the truckload from outside the region, the same is not true for manure outputs.

So you didn't pick large-scale dairy as something that you thought would be successful. Can I ask you about that?
Yeah. I just feel we don't have the right land here for that. To me for a large-scale dairy you need a vast expanse of land in order to have enough crops, in order to have enough place to put manure from a large dairy. And Door county is just not the right place for a large dairy. Even though there are, I think there's only two over 500 in the county. ...And they're doing it, but they're doing it under some scrutiny. And I don't think it's any fun to have to work with people looking over your shoulder, so to me it's just not the right locale for it.
Richard Olson, Olson farms

Do you think that the land around here will stay in Dairy farming?
It's going to have to because the people that are getting so big are going to need a land base to support the manure and getting their crops off.
Carl Hagenow – Retired farmer

"So of these different styles[of farming], which of them do you think will be the most successful in this area in the longer term?
Longest term, I really think the organic guys will be.
I really do, because I really feel, and I get some of my information, which doesn't mean it's always correct from my neighbor here with the chickens. A lot of the chicken companies all through the Eastern United States, signed on to have only so many birds a square foot, a cage etc. You're going to end up with the same thing with dairy down the road. And that's going to be the Achilles heel of the dairy industry, is the confined production of milk. You already have it in other countries, where they have to have so much space per whatever animal and so much available pasture land or whatever. See and the organic guys are way ahead on that one already. They aren't going to get that nightmare. Where as my niece isn't gonna go with a rally to protest an organic dairy, but she will go with a rally to protest a mega-farm. Just on the emotions of being young and college kids."
Dean Fischer

Right now I have no problem getting rid of the manure.
With the 2,000 acres we only need about 1,000 acres (550 milking cows), but now where the problem comes in is that some of that I'm hauling 8-10 miles. So that's where this digester and separation comes in. If we can compact the nutrients into a more solid product, now we can afford to haul that 10 miles. Instead of putting 18,000 gallons on, you

might only put a 1000 or 2000 to the acre on. That's where the key comes in. You're not hauling that water.
Dennis Schopf

However, while manure and land-use issues are of concern to farmers, perhaps a larger concern with consequences for the sustainability of the dairy sector is the erosion of the family farming base.

"There are a lot of different people that have moved in[to the area]. *Probably five years ago or ten years ago, you probably would have known more* [farmers]. *Now we've had a number of them* [farmers] *retire, die, leave the area, and they're not being replaced with their children. Their children are not coming back."*
Maureen Kinnard, Kinnard Farms, Inc.

Summary

In summary, the interviews with a broad range of farmers in the Dairy Gateway revealed a number of differing farming approaches and perspectives. Some common themes did emerge.

1. The farmers give a strong impression of being astute and committed managers of their businesses.
2. There is a general belief that dairy farming will continue to be a significant part of the Dairy Gateway region.
3. Nonetheless, there is broad concern about the ability to keep land and people in agriculture to maintain their farms into the future.
4. In a related point there is concern about the compatibility of farms and the increasing numbers of new residents in the region.
5. There is broad agreement that the technology used and farming practices employed will continue to change, driven by economic realities and the need to find ongoing gains in efficiency.

However, there isn't a consensus over whether large-scale confinement dairy is the most suitable or achievable path for these future changes in farming in the Dairy Gateway.

Chapter 5 – Economic theory and Dairy practice

The relatively slow transition of Wisconsin's dairy farmers towards larger farming units does appear to be gradually speeding up. This is to be expected, as the majority of small dairy farmers from the 1960's and 70's are no longer in the business, and those that remain appear to be very pragmatic about what it takes to stay viable. That said, the survey interviews; which disproportionately sampled large and stable farms, still revealed significant opposition to the implications of larger and more intensified farms. This suggests that many of the farmers that are moving in this direction are doing so due to economic pressure rather than by choice. This reluctance could perhaps be dismissed as human nature and resistance to change if it were not for the scale of the impact on the dairy farming community. The fact that the vast majority of the dairy farms of a generation ago are no longer in business, despite a persisting desire to live off the land, suggests that something more fundamental or structural is happening here. This raises three possibilities, discussed below:

1. Are Wisconsin's dairy farmers inefficient managers?

If the economic theory is valid, then the decline of the dairy farming community in Wisconsin and the Dairy Gateway could be due to the farmers being relatively poor economic actors. Yet, as explored previously, Wisconsin's remaining dairy farmers appear to be responsive to changing technology and actively seeking to improve their economic efficiency. They are aware of new technological developments and farming practices through multiple farming publications, and have shown a willingness to adapt, and grow incrementally. In particular, they appear highly responsive to the on-farm feedback that they receive from currently measured parameters such as feed and milk quality.

2. Has Wisconsin lost its comparative advantage?

Wisconsin is perhaps uncompetitive due to structural disadvantages that are outside the local control of its dairy farmers. This argument seems more plausible than the first. The

trends across the industry as a whole continue to show a rise in large-scale confinement dairying, suggesting that it is the most economically efficient production model in the present institutional climate. Wisconsin's dairy strategy appears to be to try and play 'catch up', but as a state they are continuing to fall behind. Particularly in the Dairy Gateway, there is a limited availability and high relative cost of land, which makes expansion to a Californian scale a largely unviable option. In addition, the longer and more severe winter in the Midwest increases confinement housing costs relative to the warmer Western states. If the scale of operations is ultimately what matters, then at best a small fraction of Wisconsin's remaining farmers can compete with the big farms out West by growing to a similar scale. The Western States are already producing milk on farms an order of magnitude greater than Wisconsin and there is no indication that they will remain static, rather than to continue to grow and consolidate.

From the point of view of market economics the current industry trends represent continued progress towards efficiently functioning markets. If larger scales of production are more economically efficient; or are needed to maintain a livable income, then producers will and should move in that direction, and the smallest farms will and should get out of the business and retrain for something else. While market theory doesn't present itself as normative economics, taken at face value, it leads to a normative position that intervention to protect small farmers is futile in the long run, and the State should instead be promoting an acceleration of expansion by those farms that have the potential to do so. Under this approach, government involvement with most farmers would be justified only in terms of lessening the pain of transition out of the dairy sector.

3. Is the Economic theory flawed?

Another possibility is that the underlying economic theory inadequately describes the reality of the dairy industry, and is a poor measure of desired development, due to the lack of inclusion of social, political and environmental dimensions. Arguably Wisconsin's dairy farms are really more valuable to the State than the recent economic trends suggest, but are losing market share due to an over-emphasis on market-based institutions and short-term growth rather than long-term development.

The dominance of neo-classical economics

The primacy of market economic theory can be seen to be critically important here, because it influences the underlying policy approach and outlook of the dairy industry in the region. While the reality is always more complex than the theoretical models, the models essentially frame the mindset of policy makers and the farmers themselves and influence their choices and actions accordingly. Given the apparent misgivings of both the farming and non-farming sector, the validity of privileging market economics above social and environmental concerns in Wisconsin's dairy sector is worth exploring, as are their implications for the future of this sector and the appropriate public policy response.

Perfect Competition in the Dairy Industry?

Certain features of the dairy industry fit well with the perfect competition market paradigm.

a) There are many independent producers in the market, although these numbers continue to decline.
b) Dairy products are highly homogenous, and branding is minimal. However, in recent years the attempts at product differentiation have increased. Now in addition to different milk fat percentages, there are distinctions between organic and non-organic milk and despite legal constraints[1], some hormone free labels.
c) While there are many independent consumers of dairy products, the intermediary actors along the supply chain in the form of processors, distributors and retailers increasingly resemble oligopoly markets.
d) Many farmers talked about the milk price as being essentially set by the economics of supply and demand. Others felt that the government and large processors had the largest influence on milk prices. Milk pricing regulations are

[1] Monsanto sued Oakhurst dairy in Maine to stop them labeling their milk as 'hormone free', and several states have banned rBST labeling. Some cheese and ice-cream products still use an FDA qualified hormone free label.

complex and evolving and are set by a combination of market forces and state and federal regulations and interventions {Manchester, 2001 #80}.

e) Farmers appear to focus primarily on acting as individuals in the marketplace and boosting their own efficiency and productivity rather than acting collectively to control supply. There are signs that this has begun to change too, with the supply-side intervention of Cooperatives Working Together (CWT) as a result of the low milk prices in the summer of 2003. This producer driven and financed initiative is partly in response to the falling level of federal intervention through milk marketing orders. CWT is continuing to take milk off the market, through herd retirement and export assistance policies for a second year, despite historic highs in milk prices during the summer of 2004 {CWT, 2004 #32}. The organic dairy cooperatives have a longer history of acting to control supply from their members and structure economic incentives to encourage stable milk production levels throughout the year. The rest of the dairy industry can see how well this is working, and two of the non-organic farmers interviewed commented on the advantages of this price and volume control at the cooperative level.

In summary, while on the surface there are several features of the dairy industry that resemble perfect competition, further scrutiny suggests that this is not the case. Furthermore, the present trends in the industry appear to be all moving away from the perfect competition ideal as price competition continues to increase pressure on dairy farmers.

Explaining the success of large-scale expansion - escaping perfect competition?

It is undeniable that the large modern dairies have reshaped the market and farms classified as CAFO's now account for a major and growing share of the nation's milk production {USDA NASS, 2002 #84}. In the rapid intensification and dramatic jump in scale of modern dairy farms there appear to be parallels to the development of large managerial firms in the 20th century. This development phenomenon was described by Alfred Chandler Jr. as a shift away from free market capitalism to a new economics of

'managerial capitalism' guided by what Chandler termed the 'visible hand' {Chandler, 1977 #33}. Amsden summarizes this analysis, agreeing with Chandler that successful production firms in this transition followed a three-pronged approach of

a) Large-scale capital-intensive mass production technologies.
b) Mass distribution networks through stable markets gained and maintained by oligopoly and monopoly power.
c) Professional skilled management.

Many enduring global brands rose to their present prominence in this way {Amsden, 2001 #34}. Examples include GM and Ford in automobiles, Dunlop and Michelin in tires, Coke and Pepsi in soft drinks, Boeing, General Electric, IBM and many others. This is akin to the direction now being pursued by the large agricultural producers and processors. There is now an emerging oligopoly of large pig and poultry producers. Dairy farming is more management intensive due to the regularity of milking, and as a result has been slower to move in this direction. Nevertheless, the scale of the largest dairy CAFO's is now in the range of 10-20,000 cows milking herds. Increasingly big farms own multiple herds, and choose to spread ownership among family members for tax purposes {Looker, 1998 #35}. Market stabilization is being sought through closer ties and long-term contracts with cheese and other dairy processors and retailers. In addition, upstream costs and risks have been mitigated by significant political lobbying, to maintain access to subsidized water, energy and animal feed. The professional skilled management comes in the form of dedicated herd and milking staff and a slew of consultants to advise on technical matters and financial planning.

"You rely on such a circle of people around you. You try to find good people to answer questions. We use a nutritionist, a veterinarian, an agronomist, a milk quality specialist, a washing specialist, and we do a lot with consultants. We did something with them before, but we probably do even more with them now."
Rod and Maureen Kinnard, Kinnard Farms, Inc.

Large dairy coops continue to invest in expanding and stabilizing the market for dairy distribution. Recent examples of this include working with Pizza Hut and McDonalds to increase their use of dairy products.

"But you go and ask the average person, they have no idea the research that was put in that was promoted to get the Pizza Hut to get the stuffed crust pizza, and how much more cheese that took. Or the big promotion done with McDonalds to get to put the milk chugs in there y'know, and to put the [Milk] chugs in there instead of the [Juice] cartons"
Dennis Schopf – Schopf's Hilltop Dairy

Political intervention, Milk pricing and the US Farm bill

Another incongruity with assumptions of a free market at work in the dairy sector is raised by the government intervention in the form of the US farm bill and milk price setting mechanisms. Dairy farms sell their raw milk to cooperatives and other milk processors at the going price. However, raw milk is a complex commodity due to its daily production and limited shelf life. Raw milk can be converted into pasteurized or ultra-pasteurized fluid milk and cream products which have the highest value, but due to daily and seasonal fluctuations in demand relative to supply a large portion of grade A milk is instead made into cheese, butter and other dairy products. Balancing the milk market is complex and dairy cooperatives, states and the federal government have been involved in regulating the milk market since the great depression.

In the post-war period, the 1949 Agricultural Act provided permanent price supports until the 1996 Farm Act led to the reduction and phasing out of permanent price supports and export subsidies. The 1996 reform has been characterized as a move to a more market-oriented pricing system, but milk pricing still a heavily regulated and opaque process. There are federally administered regional milk marketing orders, dairy futures markets, and California, Pennsylvania and the North East States have their own additional pricing systems, all designed to stabilize milk prices {Manchester, 2001 #80}. Regional price differentials have fallen as cooperatives have grown to national scale and milk increasingly travels across state lines, but the overall volatility of milk prices has increased since the 1996 Farm Act effectively reduced the level of federal price support.

The survey data on farmers' opinions appears to show that there is only so much market 'competition' that dairy communities can take. The current compromise appears to be a largely political one, in the shape of agricultural subsidies through the U.S. farm bill, and various state measures to support agricultural land use. The stated goals of this legislated assistance are to support rural farming communities, and could thus be defended as having desirable redistribution effects theoretically justified by the second welfare theorem of market economics. But, to many observers the history of the Farm bill suggests that it is always prone to favor the large and politically connected farmers at the expense of smaller farming operations. Dairy farmers are by choice not overtly political people, and several interviewees displayed distain and concern about the political process. They value their production of a good quality healthy product, at a fair price, and the politics of subsidy runs counter to this sentiment. Furthermore, political intervention to mitigate economic pain amounts to a treatment of the symptoms rather than tackling the root causes of the problem.

Competing with CAFOs and Managed Capitalism

Wisconsin's historical competitive advantage lay in its ecological services of ample precipitation and good soils for both grazing and cropping. These were and remain largely 'free' services, and appear to have diminished in importance, as confinement dairying has become more capital intensive. For organic and grazing operations these factors are still paramount and it is instructive to see that they are able to remain viable and competitive despite lower capitalization and significantly lower milk production per cow. Some recent grazing literature even argues that grazing pigs on cornfields can be more efficient and profitable than conventional machine harvesting {Gerrish, 2004 #10}. This suggests that there is something of value in the ecosystem services that grazing producers are tapping into, but which is missed by the neo-classical market analysis.

Are Confinement dairies less dependent on natural resources?

For the majority of confinement dairies business plans are geared towards maximizing the return on expensive milking equipment, barns and cows. Farmers wishing to invest in modernizing their facilities find banks looking at their debt to cow ratio, as this is treated as a crude indicator of their expected returns on the capital investment. With new milking parlors and the requisite manure storage facilities costing several million dollars, herd expansions are seen as the only feasible way to stay in business and stay competitive. This has been partly facilitated by the availability of affordable and dedicated labor in the form of migrant workers.

The increasing economic pressure on the dairy industry is in effect shifting farming practices towards the greater use of manufactured capital and labor relative to natural resources. This is because the primary relevant natural resources come in the form of land, and land availability is limited making it much more costly and difficult to scale up. Assuming that natural resources can be substituted for by more efficient machines, and more intensive practices, is something that traditional farmers would likely question. However, with the increasing influence and oversight of banks and financial consultants in farm decision-making, there is an increasing potential for natural resource burdens and constraints to be overlooked. Modern dairy farming is increasingly about efficiently managing capital-intensive milking parlors, so as to produce enough milk to support the debt load of the parlor and manure storage facilities, and the cost of animal feed.

"I've got in my manure system probably $1million already just for the manure end of it. And I'll have easily another million in it. And what value, unless you go to a bank and you can show that its going to make you money they say 'no way', y'know what I mean. So it's a challenge on that side of it. And I was actually on [the phone] with them [manure digester company] and I was on [the phone] with the bank this morning too."
Dennis Schopf – Schopf's hilltop dairy

That is not to say that environmental constraints have gone away. The increased knowledge of ecological systems and the relative success of the clean air and water act

regulations on industrial point source pollution has led to greater concern over point and non-point sources in the agricultural sector. In addition to pesticide and herbicide impacts, many farming areas have seen the effects of nitrates and phosphorus leaching into groundwater and well-water, due to persistent or unbalanced manure and commercial fertilizer use. Rising awareness of the potential risks has led to states adopting regulations such as requirements for manure storage, nutrient management plans, and the permitting process for CAFOs. However, as economic theory argues, regulation is a poor substitute for successfully economically incentivized behavior. While dairy sector farmers have been pulled by financial incentives to increase milk output per cow, and maximize the use of milking equipment, they are being pushed into greater environmental sensitivity by new regulatory burdens and public concern over their practices. This approach presents environmental issues as binding constraints, where poor behavior is penalized but superior performance is not rewarded. While the Wisconsin small-scale production model has traditionally internalized the environmental limits of manure nutrient content, and not over-burdened the local water availability, this is no longer assured as economic margins decline, and cannot be safely assumed of newer large-scale confinement farms that are expressly designed for economic efficiency. California's larger, specialized CAFOs typically buy-in their bulk feed on subsidized grain markets, and draw their extensive water needs from shrinking and unsustainable aquifers. That developments of this sort lead to social and environmental concerns is less than surprising.

Critiques of the current market economic theory

Within some disciplines of academia, flaws with the pervasive market economic doctrine have long been acknowledged. When applied to the modernizing dairy sector they are arguably becoming starkly apparent. Market economics initially assumes a lack of environmental externalities for instance, because they are not adequately or accurately represented by the market price. This is typically as deep as economic critiques run, and the standard response is to look for ways to reduce the impact of accepted externalities by creating new markets that value in monetary terms what previously had been overlooked. This could be achieved with a cap and trade program to create a market in waste or

nutrients, which would help to mitigate this specific problem. This solution would likely face resistance from farmers as it could potentially increase their costs, unless the cap is too low to cause meaningful change. This policy also institutes a right to pollute, and does nothing to alter the mindset of producers to view anything other than profit-maximizing as important.

The Social Critique

There is also a more fundamental set of assumptions required for the axioms of market economics to hold. These include an underlying utilitarian philosophy of rational self-interested actors acting as individuals rather than as a community. While in some respects this resembles the behavior of dairy farmers, it also appears to miss crucial aspects of the farming community as observed in the Dairy Gateway and by logical extension, prevalent in many agricultural communities worldwide.

There are numerous examples of solidarity with other farmers; sharing equipment and man-power at times of need, and preferring to keep land in crops when alternative development uses would be more financially rewarding.

"They've always, if I had trouble, they were there to help. And I'd like to think that if they had trouble, I could help too, but sometimes you feel like a bad neighbor yourself. But they've been good people.
We do whatever we can. If something or somebody needs help with something or a piece of equipment, or something that they don't have, we always help."
Rod and Maureen Kinnard, Kinnard Farms, Inc.

The farming community also creates an environment in which children can grow into young farmers and gain first-hand training in the way farms are run. All the farmers interviewed in this study had close relatives who were dairy farmers, and the vast majority grew up on a dairy farm. In contrast, few had any formal academic agricultural education. The value of community receives scant attention in economics, as models based; as they are, on assumptions of self-interest and individualistic behavior find the valuation of communal actions largely intractable {Marglin, 2003 #36}. As a result of

this, the decline of the number of working farms in the region is not regarded as a significant cause for concern, since milk production remains high and cow and farm productivity are rising. Counting any social costs to Wisconsin's rural communities is a fuzzy and imprecise task and requires subjective normative judgments to be made. Perhaps because of this impression, such assessments are largely avoided in the mainstream economic analysis, but it is starkly apparent to the farmers.

"Outside the farm, what would you say are the main changes in the last 5-10 years?
Losing our neighbors. That's a huge one.
We've seen the growing area become a lot more suburban than we expected.
Faster than we expected. We've seen social change out here."
Rod and Maureen Kinnard, Kinnard Farms, Inc.

The Ecological critique

On the environmental side, there appears to be an even more damaging critique of the axioms of the mainstream market model. The dairy industry like all agricultural sectors is critically dependent on natural resources, yet the mainstream economic theory of production ignores this almost totally. This shortcoming in production theory was notably highlighted by the economist Nicholas Georgescu-Roegen as long ago as the 1970's. In 1979 he explicitly criticized the production functions of Nobel prize winning economists Robert Solow and Joseph Stiglitz {Daly, 1999 #37}. Georgescu-Roegen argued that their formulation of the factors of production amounted to no more than a conjuring trick to include natural resources in their equations while ignoring any implications of the laws of physics once physical matter and energy are included in their otherwise abstract models.

"Solow and Stiglitz could not have come out with their conjuring trick had they borne in mind, first, that any material process consists in the transformation of some materials into others (the flow elements) by some agents (the fund elements), and second, that natural resources are the very sap of the economic process. They are not just like any other production factor. A change in capital or labor can only diminish the amount of waste in the production of a commodity: no agent can create the material on which it works. Nor can capital create the stuff out of which it is made. In some cases it may also be that the same service can be provided by a design that requires less matter or energy. But even in this direction there exists a limit, unless we believe that the ultimate fate of the economic process is an earthly Garden of Eden."
{Georgescu-Roegen, 1979 #38}

It is worth elaborating on Georgescu-Roegen's points and applying their implications, as they are sufficiently basic as to have had their relevance largely overlooked by a generation of economists. Dairy farming as practiced in Wisconsin's Dairy Gateway for generations requires significant amounts of land on which to raise crops and to cycle manure nutrients. Even modern CAFOs that buy in the majority of their feed must source that feed from land somewhere, and similarly must dispose of their manure on land, air or water, even if it is external to the farm. Similarly, the cropping of farmland for dairy feed is dependent on the ecological services of water and nutrient cycles, for maintaining the health and balance of the soils and growing conditions. All of these production activities are critically dependent upon solar and embodied energy sources. Unfortunately neo-classical economic theory currently ignores this elementary science and abstractly treats land as a perfectly substitutable resource, that can be replaced with more capital or labor. The commonly used Cobb-Douglas production function is of the form:

$$Y = A\, L^{\alpha}, K^{\beta}, N^{\gamma} = f(L,K,N) \qquad \text{where } \alpha, \beta, \gamma > 0$$

Where Y denotes the quantity of output, A is a constant denoting available technology, L the quantity of labor, K the quantity of physical capital, and N the quantity of natural resources. So the level of output is a function of Labor, Capital and Natural Resources. The current trends in the Dairy sector imply that there are flat or increasing returns to scale, and so in this case $\alpha + \beta + \gamma \geq 1$.

Natural resources are included in the equation, but a mathematical function of this type implicitly assumes that increasing L or K while holding N constant at any size allows for an indefinite increase in Output, Y. Essentially L, K and N are assumed to be substitutes rather than complements, and a small quantity of N can be compensated for with more L and K.

The empirical evidence from the physical sciences, and specifically the laws of thermodynamics to which Georgescu-Roegen was referring, indicate that Natural resources, N and Energy, E, are not substitutes. Instead they are required complements

for the use of manufactured capital, K, and Labor, L, in the transformation of raw materials into output, Y. This is a strong statement, but an eminently defendable one. The first law of thermodynamics is an application of the principle of conservation of mass and energy in a closed system, to heat and thermodynamic processes such as those used in any production process. The second law of thermodynamics states that entropy increases in a closed system, and entropy can be defined as 'a measure of the amount of energy that is unavailable to do work'. By contrast, in physics energy can be defined as 'the capacity to do work', again suggesting it's fundamental role in any production process. What these two laws of thermodynamics tells us about the world is that external sources of mass and or energy; typically both, are required to maintain or add anything with structure (embodied energy) in a closed system. In other words, natural resources and energy, are required inputs in any production process. Energy and material efficiency can be improved by making improvements in technology, which in the Cobb-Douglas equation is represented by the constant, A, up to finite limits of thermodynamic efficiency. However, this does nothing to answer the critique of theoretically positing that K and L are substitutes for N.

Is the Dairy Gateway constrained by limits?

The economic theory implicit in the current institutional set-up assumes an unbounded possibility for growth in production, yet farmers suggest that their cows and their fields are approaching their limits. In this case it seems reasonable to side with the farmers, and their empirical evidence because natural resource inputs like land and energy sources, or systems like the water and soil nutrient cycles are finite in scale and not growing.

That is not to say that thermodynamic limits are currently constraining the amount of cows or the amount of milk you can produce in a confinement dairy. The existing land can certainly be farmed unsustainably for many years in this fashion. However, increasing the intensity of milking does increase the need for mass and energy inputs. Twenty-four hour parlor lighting and maximizing the amount of feed cows eat, are clear examples of additional energy and resource inputs required to complement additional manufactured capital and labor investments. These additional natural resource inputs

have finite limits, and their costs eventually lead to diminishing returns as some farmers are finding with their feed bill. While thermodynamics doesn't totally constrain production it does serve as a useful and clear indicator of environmental sustainability. Energy and resource use is only one aspect of sustainability, but it can be measured with a reasonable degree of accuracy and is comparable across different production methods, as Odum's work on EMergy has shown {Odum, 1996 #82}.

If we conclude that there are finite limits to the sustainable production of milk related to natural resources, then we can justifiably challenge the argument that Wisconsin no longer has a comparative advantage in dairying. Rather than California having a sustainable comparative advantage in dairy production, we are faced with the more troubling conclusion that both states are currently producing unsustainably due to short-term market pressures. The apparent comparative disadvantage of Wisconsin arises only as a result of farmers becoming aware of and approaching some of those finite limits sooner.

If the long-term goals for Wisconsin's dairy sector are sustainability and development rather than merely short-term growth, then the mindset of what is an appropriate policy response changes. Trying to compete with Western states in exploiting their natural resources faster can be seen as a shortsighted strategy. Unfettered growth looks to be inconsistent with the long-term goal of a model of production that stays within the sustainable scale suggested by those finite natural resources and ecological services on which it is dependant. This does not mean that dairy modernization and farm expansion are bad. It only implies that the current financial incentives and subsidies to the industry are based on overly narrow and misguided economic assumptions. We should continue to seek technical and managerial improvements; as dairy farmers have a commendable track record of doing, but we should reconsider what is important to optimize, by synthesizing what we understand from the physical sciences with our application of economics.

The ecological economics approach would be to say that the dairy industry as a primary production sector much more closely resembles the fishing sector than say the computer

software sector. As such it is heavily dependent on natural resources inputs, albeit largely renewable resources like animal feed and the manure nutrient cycle. Just as there are finite limits on how many fish you can stock a pond with before you start to overwhelm the ecosystem and poison the water, there are similar constraints on how many cows an acre of land can support over time. The critical factor in both cases appears to be waste management as feed is more easily brought in from outside.

None of this directly addresses the social concerns of the farming community. However, by showing the theoretical weaknesses of the neo-classical economics model, ecological economics opens up space for that debate. It is also more plausible that ecological and social sustainability would be mutually supportive, as they both represent a pluralistic alternative. The current market paradigm is reductionist in that it assumes that a price can be assigned to all significant variables and any competing trade-offs can be decided by the implicit cost-benefit of profit maximization. In other words, aggregate gains due to growth will outweigh cumulative individual losses. Ecological economics cannot fall back on unlimited growth as a panacea as was pointed out from its outset.

"If economic growth is sustainable indefinitely by technology then all environmental problems can (in theory at least) be fixed technologically. Issues of equity and distribution (between subgroups and generations of our species and between our species and others) are also issues of limits. We do not have to worry so much about how an expanding pie is divided, but a constant or shrinking pie presents real problems. Finally, dealing with uncertainty about limits is the fundamental issue."
{Costanza, 1989 #87}

Ecological factors can thus provide greater justification for a policy approach that considers social and distributional issues. In the case of Wisconsin's dairy sector this could result in maintaining more farms at their present or incrementally growing scale, and placing finite limits of farming intensity based on long-term goals. By contrast, neo-classical market logic suggests a rapid consolidation of farms and scaling up of herd sizes and farming intensity to compete in the short-term.

Chapter 6 – Policy implications for the Dairy Gateway

The importance of natural resource inputs and ongoing ecological services to dairy and other agriculture suggests that the emerging field of ecological economics provides a superior explanatory model to that of neo-classical market economic theory. By treating natural inputs as prerequisites that are substitutable only at the margin, ecological economics illustrates the dependence on finite resource limits and sustainable scale that we see in the dairy industry and suggests different policy implications for achieving the sustainable long-term development of agriculture. This is relevant to the dairy sector in the Dairy Gateway of Wisconsin for several reasons.

- Farmland is finite and increasingly constrained by alternative development pressures.
- The existing density of cows on the agricultural land in Manitowoc and Kewaunee counties is among the highest in the state.
- Environmental concerns around potential externalities from unsustainable scale farming are high due to the importance of leisure and recreation to the local economy.

Nonetheless, it is not immediately apparent how acknowledging the importance of ecological services and natural resources will lead to changes in practice and policy that support the dairy farmers in Wisconsin. It is clear from the farmer interviews, that often it takes a minor crisis to trigger a change in any individual farm's practices, and that is not a desirable way to guide environmental innovation.

Farmers are already aware of environmental limits on their land and their cows, but the addition of environmental regulations only adds another impediment to their potential competitiveness. The Wisconsin department of natural resources (DNR) and the department of agriculture, trade and consumer protection (DATCP) have already phased in a requirement for nutrient management plans for dairy farms. They left the smallest

scale farms until last, acknowledging that meeting new regulatory requirements is perhaps hardest for the small single-family operations. Successful implementation of any new environmental regulations has to take account of varying farm capacities, without resulting in overly lax constraints or overly onerous requirements. It is also clear that Wisconsin needs to improve its competitiveness in the national milk market if it is to sustain its dairy sector. Improving awareness of, and responding to the implications of ecological economics would only help Wisconsin compete if there was some economic and social benefit to dairy farmers that resulted from improved environmental performance.

For the majority of confinement dairies the key long-term environmental issue looks likely to be nutrient management. Performance in this area can likely be improved by a better knowledge of soil processes, consistently applying best practices in manure handling, and also greater attention to feed nutrition to achieve mass balance in nitrogen, phosphorus and other nutrients {Knowlton, 1998 #56}. This is perhaps easiest for larger farms to monitor as they are more likely to have sophisticated feed monitoring systems in place, and they can defray fixed costs over a larger revenue stream. Nonetheless, improvements in environmental performance are unlikely to be achieved without the broad support of the dairy farmers, and that suggests that there must be economic and social rewards tied to any change in practices. Farmers like any other group of people are more likely to innovate when they perceive a tangible problem, and can measure their progress towards a more rewarding alternative.

Four critical factors then are:

1. Tangible environmental problems to tackle
2. Measurable and monitored performance to show credible results
3. Flexibility to allow different levels of performance according to farm capacity
4. Economic and social rewards for superior environmental performance

1. 1 Dairy farmers perspective on environmental issues

It is important to note that the size of a dairy farm is not in itself an indication of any ecological balance problems, and the large dairies should not be scape-goated on environmental issues when they have led the adoption of many of the recent improvements in manure handling and nutrient balancing. The majority of interviewed confinement farmers see potential environmental benefits, rather than concerns, coming from the modernization of their farming practices. In the last couple of decades many farmers have witnessed tangible improvements in environmental performance due to better measurement and hence management of soils in particular.

"I like living out in the country, I enjoy nature very much. I guess I don't mind seeing the sandhils [cranes] as long as they're not in the cornfields. Now we have [wild] turkeys coming, it's very enjoyable watching a tom turkey out here parading around a bunch of females, it's just unbelievable. Y'know from not growing up with that to having it now it's kind of neat."
Dean Fischer – D&R Fischer Farm

They are now using lower quantities of pesticides, herbicides, and commercial fertilizer, and are more evenly spreading their manure because they can more accurately predict and measure the desired quantities.

"We take Soil tests every 3 years. We apply Chemicals and fertilizer as needed according to recommendations of our agronomist. And are careful not to over-apply or under-apply, because if you under-apply you're spending money and still not getting the result that you want. If you over-apply you'll get the result, but you spend too much to get it. So accuracy is important."
Richard Olson, Olson Farm

They are increasingly adopting practices such reduced soil tillage and other erosion control measures because it saves them money and helps them build up quality soils.

"The [Soils] test, yes it costs money, everything costs money, but I don't know how we'd do without it, I really don't. I mean you just can't go off and say well this land looks like it needs manure.

The 590 [nutrient management] plan says you do it, but I mean we were doing it before that. It was just a moneymaker for us. And you know, you have to have knowledge before you can take action, and that's generally the way we try to do it."
Rod Kinnard – Kinnard Farms, Inc.

Instead their concerns over the increasing economic pressures on their industry appear to be focused largely on the sustainability of their lifestyle and rural community.

Renee: "Well even in our own neighborhood since we've been married, we are, well there's us and another one. There's only two of us left now.
Ian: And before, ten years ago, how many farms?
Dean: 15. I mean there's still a few but not very many [farms]."
Renee and Dean Fischer – D&R Fischer Farm

So in the last 5-10 years how many farms do you think have closed down?
Almost half of the farms probably in the county. Close to half, maybe not half. Yup, significant.
Richard Olson

"The whole thing is that the farm continues, whatever the farm needs to continue, if we take care of it, it will take care of us."
Maureen Kinnard, Kinnard Farms, Inc.

1.2 Is there a real Environmental issue?

"Prospects for continued industrialization of milk production clearly exist, but they are not limitless. Environmental concerns about large numbers of animals on potentially small acreages are increasing, as are the waste management issues associated with those animals. Several key milk-producing areas are in environmentally sensitive areas, particularly with respect to water quality. Environmental issues are not only large farm issues; small farms can have the same types of problems." {Short, 2004 #52}

While farm size is not a direct cause of environmental concern, what is a relevant indicator of the potential for nutrient management problems in the density of animals per acre on a farm, and this density is often highest on the larger confinement dairies. More specifically the ratio typically measured is the number of manured acres per animal unit (MAs/AU). This ratio is a good first approximation of the ecological pressure being exerted on the farmland. In the case of dairy farming a mature holstein milk cow is

approximately 1.4 animal units, whereas smaller grazing breeds such as a Jersey cows are closer to 1 unit. An increasing amount of research is being done on linking animal density to nutrient mass balance, in recognition of the environmental risks of nutrient overloading. The Wisconsin Integrated Cropping Systems Trial Project interviewed 28 farms in Southern Wisconsin of which 11 were dairy farms. They found:

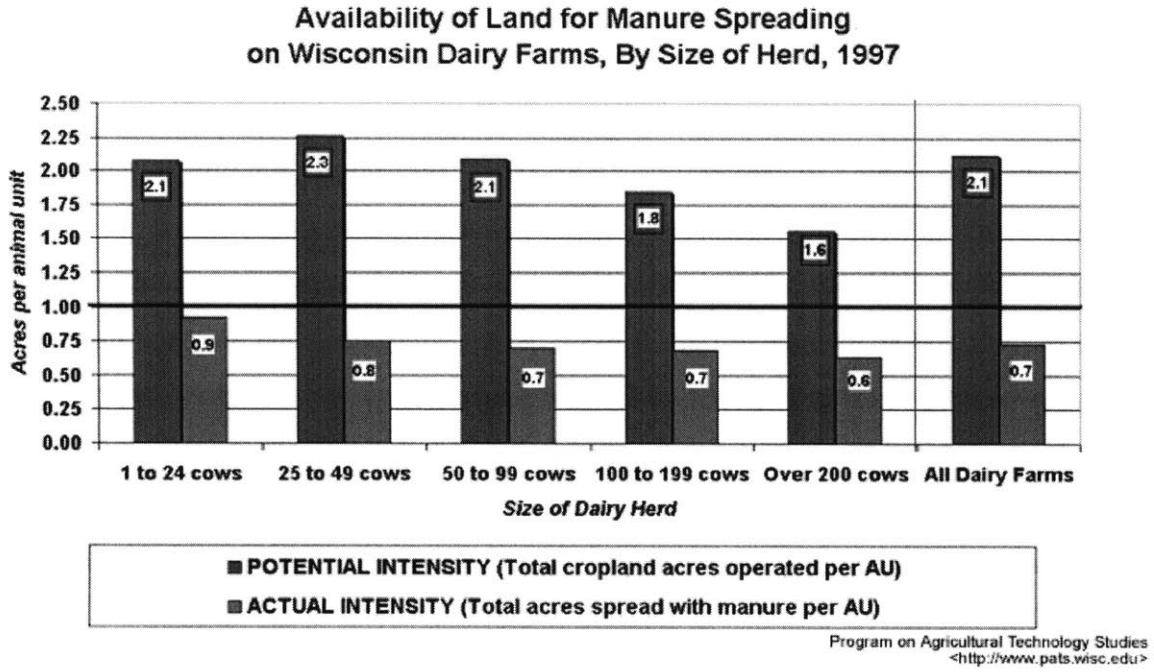
"a weak correlation (R-Squared = 0.49) between stocking rate and soil test build-up (see Figure 5). Through crop rotation, fertilizer management, ration management and production level, farmers are able to manage different numbers of animals with the same land base. However, in this sample, when stocking rates were below 2.0 MAs/AU, changes in soil test P levels were always positive." {Fisher, 1996 #39}

In this 1996 study, a ratio of greater than 2.0 MAs/AU suggests a safe limit, and below that ratio careful nutrient management would be needed to maintain a balance in Phosphorus (P) in particular. A more recent 2002 study of 98 representative dairy farms in Wisconsin found an average of only 1.56 MAs/AU, suggesting that there are many farms approaching or exceeding sustainable soil nutrient limits {Powell, 2002 #72}. A forthcoming paper on this topic from the USDA Agricultural research service suggests that at present the majority of Wisconsin's farms do not meet either nitrogen or phosphorus manure spreading standards {H Saam, 2004 #71} (see maps in appendices). These recent findings suggest that in addition to the social costs to the farming community of increased consolidation and intensification in dairy farming, there are serious and potentially chronic environmental issues looming on the horizon. A nutrient balancing approach has been adopted in the Netherlands and Denmark, two countries known to be leaders in environmental performance, but also facing problems that come with very intensive dairy agriculture. {Danish EPA, 1999 #62}.

One reason why soil nutrient levels might be higher than necessary is that in the past farmers have not always been acting to maximize their use of manure. Research by the Program on Agricultural Technology Studies (PATS) from 1997 (see Figure 14) illustrates this well by showing that farmers were not using their full tillable land-base for spreading manure. Figure 14 also illustrates how the number of cows per acre tends to increase as herd sizes increase. The recent introduction of nutrient management plans is

expected to lead to the utilization of more land for manure spreading, largely because farmers will be measuring their soils more regularly.

Figure 14: Differences in Land available and used for manure spreading {UWISC PATS, 1997 #75}



1.3 Other environmental issues – Water

The primary environmental concern linked to the dairy sector in Wisconsin is the potential risk of groundwater pollution. This is particularly of concern in regions like the Dairy Gateway given the nature of its soils and fractured bedrock. While there is substantial discussion around manure management, there is little current concern about water usage. Indeed, none of the farms interviewed track their water usage. This suggests that water supply has yet to become a limiting factor, but if it continues to go unmonitored then this resource cannot be well managed. It may well be in the interests of Wisconsin's farms to begin tracking their water use. It is a critical ecological service, and is increasingly a cause for concern in competing states such as California.

2. Measurement and Monitoring to ensure credible implementation

In order to succeed, any new environmental policy would need to have broad farmer support and active participation. Over the past several decades farmers have been asked to straddle the mixed economic and policy messages of the market and local actors, and have been unfairly criticized for failing the impossible task of succeeding on both fronts. If farmers are to participate in the implementation of any significant policy, it will greatly benefit from economic incentives for farmers and a credible and transparent yardstick for measurement and performance monitoring.

One related case that highlights the importance of measurement for compliance with production standards is from the buffalo mozzarella cheese industry in southwest Italy.

"As a result of this monitoring process and the sanctions associated with it, the numbers of adulterated samples among member firms has decreased significantly – from 23% in 1993 (before the Consorzio acquired the DOC) to 7% in 1997. (See Table 5)*"*

Table 5: Monitoring and its Consequences for Consorzio Members
{Locke, 2001 #69}

Year	Number of Samples Analysed	% of Positive (adulterated) results	Expulsions from Consorzio
1993	**No monitoring**	**23%**	
1994	**165**	**15%**	
1995	**194**	**10%**	**2**
1996	**214**	**11%**	**6**
1997	**199**	**7%**	**2**

As can be seen from the data, prior to imposing an effective monitoring scheme on its cheese producing members, a large proportion of buffalo mozzarella farms were tempted to not comply with the official production quality standards. 23 percent of the cheese tested the year prior to introducing random testing by the consortium was found to contain cheaper cows milk. However, once a credible and transparent testing program began the consortium members improved their compliance to 93 percent in only 4 years, thus protecting the quality status of their product label. This example illustrates the importance of giving skilled managers a credible feedback measure of their performance, something that Dairy Gateway farmers have shown that they respond to. In planning

future policy initiatives, this suggests that clear and credible measurement of performance is a critical part of successful implementation.

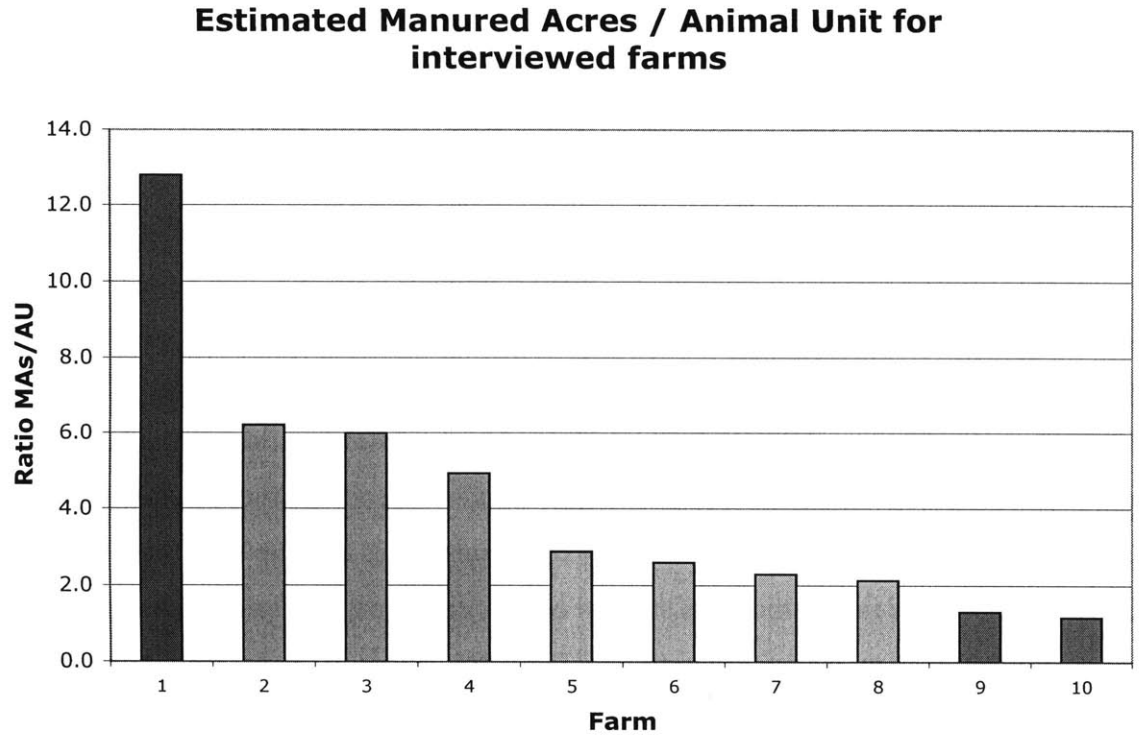
3. Tiered regulation according to animal density

Another implementation problem is ensuring that new standards are feasible for the participants to meet. The phasing in of nutrient management plans reflected the reality of different capacities for different scales of farm. The flexibility of Wisconsin's Environmental Results act would likely allow a tiered program that would allow farms with benign environmental practices simplified paperwork to stay in compliance, while also giving more technically sophisticated dairy farms the chance to maximize their operations by providing more detailed data on nutrient balance.

If further research suggests that farms with a ratio of 1-2 acres per animal unit are staying within safe limit for nitrogen and phosphorus balancing, then farms at this ratio or higher could be permitted a less demanding nutrient management plan. This would help ease the regulatory burden on the considerable number of small and traditional dairy operations that have not yet increased the intensity of their farming to that extent. It would also apply to many grazing and organic dairy farms.

For the farms that do have a ratio below a comfortably safe threshold of acres per animal unit, a stricter nutrient management plan would be appropriate. This would apply mostly to confinement farmers with good management practices, and allow them to continue to maximize the intensity of their farming while staying within safe and monitored limits. Because of their more complex management systems, they are better placed to meet the data and monitoring requirements of a stricter nutrient management plan. An approximate illustration of the MAs/AU for the ten farms interviewed is presented in Figure 15.

Figure 15: Approximate Nutrient Management ratio for sample farms



While there were two farms with ratios of less that two, the majority of farms appear to have a comfortable ratio of land to cows. In particular one farm had a ratio of over 12. This farm is part of a family business that has previously focused on its large cropping business, and their dairying has been slower to expand. The dairy recently became a separately managed concern and is in the process of expanding, but due to family connection has agreements with the larger cropping operation to spread manure and share hauling costs. This agreement gives the dairy operation plenty of room to grow without facing land constraints to its nutrient management.

This farm's high MAs/AU ratio illustrates one proposed solution to the problem of nutrient loading. Where local crop and livestock farms can be matched together to share their land-base for manure spreading, there can be benefits to both farms {Wagner, 2002 #76}. The crop farms gain cheap access to fertilizer, and the dairy farms gain additional land on which to safely recycle their manure nutrients. Barriers to implementing this

include the costs of manure hauling, local opposition to manure trucks on roads, and finding well matched crop and dairy farmers. Placing more of a spotlight on environmental performance, while showcasing potential solutions will hopefully further the implementation of this and other existing policies to protect farmland and tackle nutrient management issues.

4. Incentives for Environmental Performance

In order to add an economic incentive to promote superior environmental performance, a degree of product differentiation in needed. This need not necessarily be a tangible difference in the final product, it could also be a product differentiation on the basis of production practices. The growing consumer awareness of social issues related to agricultural livelihoods has allowed socially conscious labels like the 'Fair Trade' certification to grow in commodities such as coffee, chocolate and bananas that are not necessarily better or worse quality products. The same is true of 'sweat free' labels on clothing not produced in sweatshops. While the dairy industry is quite different from these examples, the milk marketing board and the state of Wisconsin could consider creating a labeling program with similarities to both social labels and to organic certification. The present organic label seeks to differentiate its products based on a set of farming practices and use this product differentiation to capture a price premium in the market. While the organic label considers chemical use and genetic engineering, it does not at present consider physical limits and sustainable scale in the way that ecological economics would suggest is appropriate. Many organic producers already operate at a sustainable scale in terms of nutrient balance in the soil, and perhaps water use, so it may be possible to lobby for the explicit inclusion of these criteria in the organic standard.

4.1 Dairy labeling for product differentiation

Dairy producers have in recent years begun successfully using 'rBST synthetic hormone free' and 'Certified Organic' labeling to differentiate their milk, and gain significant price premiums as shown in Figure 16.

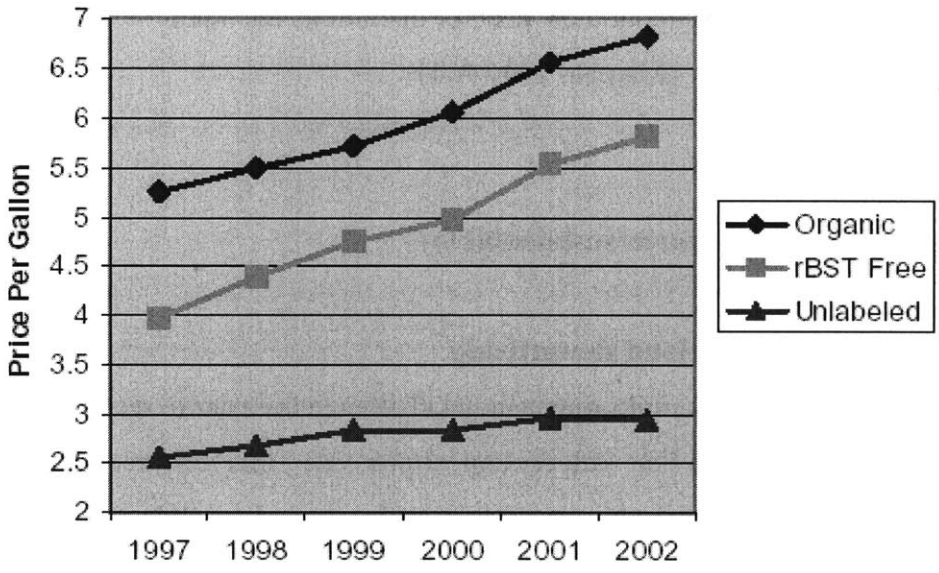


Figure 16: Price premiums for Organic and rBST free Milk

Farms and cooperatives also use labels as a way to make the consumer feel more connected to the farm, with idyllic descriptions of the family farmers and their cows in the fields. Since 1997 Wisconsin has quickly become the number one state for organic milk production, and the Wisconsin based Organic Valley cooperative has established itself as a major national brand. Organic dairying has also recently received State support, with Governor Jim Doyle incorporating organic farming in his 'Grow Wisconsin' economic development plan in October 2003. On the other hand, only 2-4% of Wisconsin's dairy farmers are presently certified organic, and it is a difficult step to take for farmers who do not own the majority of their land-base.

Instead, it may make sense for Wisconsin and other similar dairy states to institute a new and overlapping label based on 'sustainable scale'. This approach could add a positive price incentive to good environmental performance in nutrient management and water use. It could also allow the majority of Wisconsin's farms to benefit from their ecological advantages over the large CAFOs in the Western states. This would reduce the incentive for Wisconsin farmers to grow indefinitely, and would rebuild support for farmers as good land stewards by playing to their natural advantages. In contrast in California the

large farms face increasing concerns about their scale of operations and their unsustainable use of water resources {Mamen, 2004 #64}.

Reframing policy and practice towards sustainability

Promoting Grazing as sustainable land stewardship

For grazers and organic farmers, this multi-dimensional challenge is easier to reconcile, as their practices are already more in line with ecological processes, and it is precisely by taking advantage of Wisconsin's geographic strengths that they have been able to remain competitive. The implications of the ecological economic model are that these farming methods are relatively ecologically sustainable due to their dependence on ecological services. This suggests that state and federal intervention in the market through the farm bill or otherwise should be doing more to encourage and facilitate the adoption of grazing farming methods for those farmers willing to try it.

Grazing takes advantage of Wisconsin's ecological services and provides what many non-farming neighbors want to see; cows in the fields and fewer manure trailers on the roads. It is also arguably more profitable on a per cow basis to use grazing rather than confinement feeding practices {Kriegl, 2001 #58}. While the majority of grazing operations are currently small, they could potentially increase in size incrementally and stay financially viable, whilst confinement dairies with higher overheads may require greater increases in herd size to stay in business. Grass fed milk has been shown to contain conjugated linoleic acids (CLA's). These are essential omega six fatty acids that the human body needs to obtain from the diet. They are also found in vegetable oils and seeds. This could be used as the basis for product differentiation for milk from grazing cows, and is already considered important in some specialty cheeses.

Measuring sustainability using eMergy analysis

Empirical survey work based on the thermodynamics of entropy/energy flows and termed 'eMergy', can be used to estimate the relative ecological efficiency of different processes

{Odum, 1996 #82}. This approach could be used allow a comparison of grazing operations relative to confinement dairies of a similar size. Similarly this approach can be used to assess the environmental sustainability of the whole region or state, as has been done in parts of Italy, most recently in Venice {Bastianoni, 2005 #81}. The results of this or similar research could justify a reallocation of farming subsidies and the inclusion of sustainability criteria in state and federal allocations. Several policies and research programs that support grazing practices are in place, however, their relative share of funding remains marginal relative to subsidies and research to assist confinement dairy operations.

Protecting agricultural land

Likewise, in dealing with increasing pressures on land availability for agriculture, intervention to regulate land-use for agriculture is better supported by ecological economic theory than market economics, and has been widely adopted. Exclusive agricultural zoning ordinances (EAZs) were introduced at the county level but required local town and city adoption to become significant given the relative strength of local government. By 2000 some 283 local town governments had adopted their county EAZ ordinance and a further 119 had developed separate EAZ ordinances. 17 villages and 19 cities also had adopted EAZ districts {Jackson-Smith, 2002 #83}. This process and other zoning and land-use regulations are important in keeping agricultural land available. The nature of local government in Wisconsin makes this a rather fragmented process, and more regional coordination may be required to retain land for dairy farming.

Conclusion

While the actions of farmers and town communities appears to be generally supportive of the value and necessity of ecological services, state and federal incentives are bifurcated. On one side the financial sector, the majority of economists and public policy researchers, and much of the rationale of the US farm bill comes from the perspective of neo-classical market economics. On the other hand, the actions of farmers and their neighbors, the department of natural resources and agricultural researchers at the University of

Wisconsin and elsewhere implicitly prioritize natural resource constraints over market efficiency. These two diverging perspectives lead to very different approaches, leading some analysts to present dual but opposing options for future policies {LaDue, 2003 #48}.

Measuring the ratio of MAs/AU and using this crude yardstick as the basis for a tiered but strict nutrient management plan is just one example of a policy approach that could align environmental performance with economic rewards. It is beyond the scope of this brief study to assess the viability of this or any other policy proposals, but it is hoped that it will further stimulate the discussion over the importance of ecological factors to the long-term health of the dairy community. Understanding the flaws in the neo-classical economic model, and how they apply to the dairy sector will hopefully serve to strengthen the resolve and support of innovative farmers and policy makers to move at all levels towards a more ecologically sustainable outlook.

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Wisconsin Dairy Gateway Questionnaire: Summer 2004

This survey is not a large statistical survey. It is a small series of case studies to try and understand how different types of dairy farms and farmers work and what they think the future will hold for farms like them.

Permission to record the interview: Yes | No

Part 1. About the Farmer(s):

Name	Age	Education	Other
Farming Background			

Family Members	Occupation	Age	Education

How many hours a week do you work on the farm?
Do you take vacation, if so how much?

Do you get most of your income from dairy farming? How much of it (%) comes from other off-farm work?

Part 2. About the Farm:

Is this your first farm?

Name	Years farmed	Location and Acreage
a) Farm History b) Livestock- Breeds c) Cow #'s and age d) Milk production average per cow e) type of sales – dairy milk other		

Who buys your milk? What price do you get for it?

What do you feed to your cows? How does feed and milk vary from season to season?

feed – Spring (date)	Summer	Fall	Winter
Production – Spring	Summer	Fall	Winter

2.4 How do you manage your manure ?
2.5 How much energy do you typically use in a month/year and has this increased or decreased in the last 5-10 years?
2.6 How much water do you typically use in a month/year and has this increased or decreased in the last 5-10 years?
2.7 What do you do to maintain healthy crops/pasture and soils?

Part 3. Past and Recent changes

3.1 Have you changed anything about the way that you farm in the last 5-10 years. If so, what and how have you changed it?

3.2 What do you think are the main changes that have taken place in this area in the last 5-10 years in general. How have they affected dairy farming?

3.3 What is it that you like most about dairy farming? Has that improved or gotten worse in the last 5-10 years?

3.4 What is it that you least like about dairy farming? Has that improved or gotten worse in the last 5-10 years?

3.5 What equipment changes or new investments have you made in the farm in the last 5-10 years? E.g. new equipment, new feed, new cows, side business etc.

3.6 Are there any changes that you would like to make, or practices that you would like to continue, but can't because of financial constraints?

Part 4. Farming Community

4.1 Do you know a lot of the other farmers in the area? What area, how many roughly?

4.2 Are you a member of any farming related organizations, or community organizations? Do you attend meetings?

4.3 Do you know any processors or manufacturers personally?

4.4 Do you know any state employees in Agriculture or DEP personally?

4.5 Do you read any farming related magazines or newsletters?

4.6 What would you say are the main issues being discussed in the dairy community?

4.7 Who do you think of as your main competitors?

4.8 Who or what organization has the biggest influence in dairy farming practices?

4.9 What or who has the biggest influence on the price of milk?

4.9 Is debt or depression something that you think is widespread in the dairy farming community?

Part 5. Different Farming Approaches

Farming Style	Know other farmers		Your Farm	
	Considering it	Doing it	Considering it	Doing it
1. rBST / rBGH free (no Posilac)				
2. Organic dairy (no antibiotics etc)				
3. Large scale dairy - More than 500 cows				
4. Direct sales & or on farm dairy production				
5. Intensive Rotational Grazing				
6. Seasonal Dairying				
7. Anaerobic digesters or Biomass waste mgmt.				
8. Other interesting practices				

5.9 Which of these practices do you think will have the most success in this area/county? Why?

Part 6. Current and Future Plans

6.1 Are you planning to make any more changes to the farm, and what would they be?

6.2 Do you expect your family to continue farming for the next 20 years?

6.3 Are you worried about environmental issues in this area? If so, what concerns do you have?

6.4 When do you plan to retire from dairy farming?

6.5 Are there better options for dairy farmers like you these days, and if so what are they?

6.6 Do you think the land around here will stay in dairy farming for the next 20 years?

6.7 What do you think the future of dairy farming in Wisconsin will look like?

6.8 Is there anything else that I haven't raised in the questions so far that you think is important to mention?

Permission to Use Audio-Recorded Interviews

You were asked to participate in a research study conducted by Ian J. Finlayson, Master in City Planning Candidate, from the Department of Urban Studies and Planning at the Massachusetts Institute of Technology (M.I.T.). This study will explore dairy farming practices in the Dairy Gateway counties of Wisconsin and consider the sustainability of the dairy sector in light of broader trends in the industry. Specifically, the study will consider recent farm and farming changes and expectations for the future. The goal of this work is to inform planning practice and policy regarding dairy farming and agricultural land-use.

Interviews were conducted with the understanding that:

- Your participation was completely voluntary.
- You could decline to answer any or all questions during the interview.
- You could decline further participation, at any time, without adverse consequences.
- You could request that audio-recording cease at any time during the interview.
- You have the right to review recordings.
- You will receive no payment for your participation.
- Unless you give permission to be quoted below, the transcripts and subsequent written materials will only contain general information about your farm and farming practices, and no quotes will be attributed to you personally.
- Audio recordings will be stored in a private, secure location.
- Audio recordings will be deleted if you request them to be at the completion of the research (Feb 2005).

My/our understanding was similar to the above information and I / we agree to the use of my/our interview.

(Please check one)

I ☐ **agree** **to be quoted in final documents.**

☐ **disagree**

(Please check the box if you would like the following:)

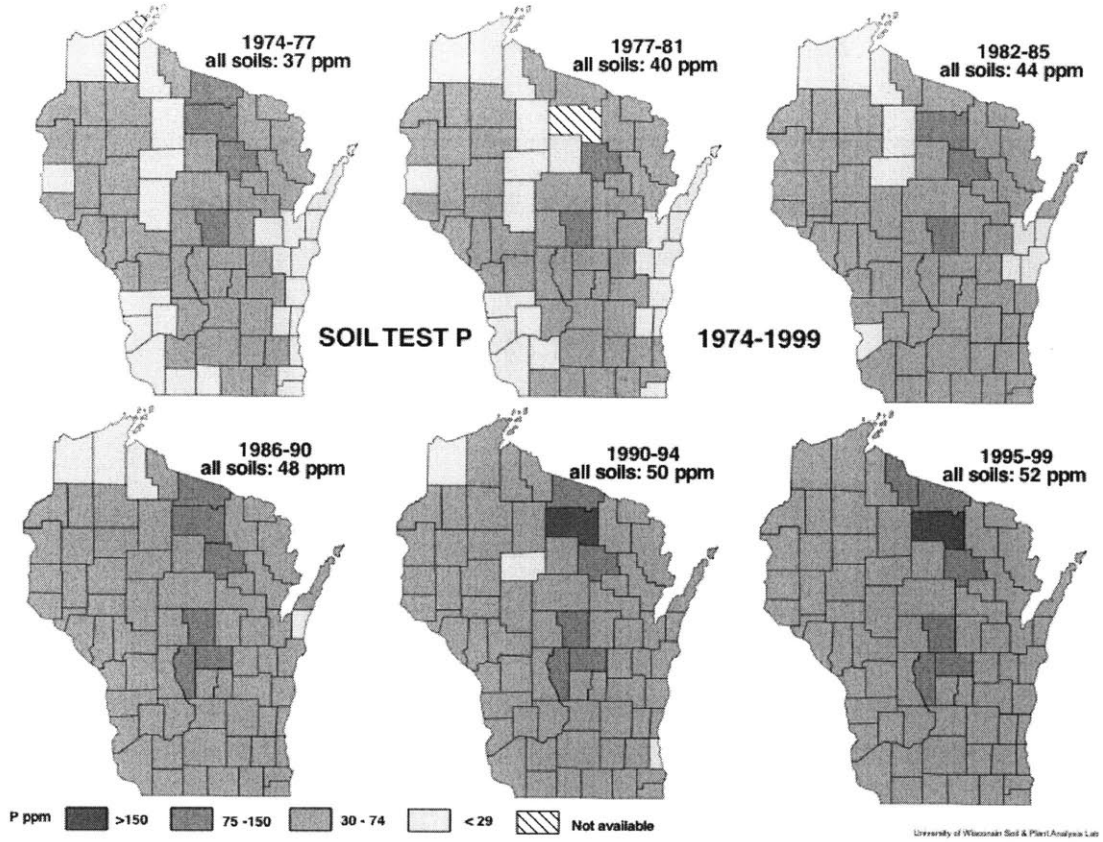
☐ **I would like my interview recordings to be erased at the end of the project (Feb 2005).**

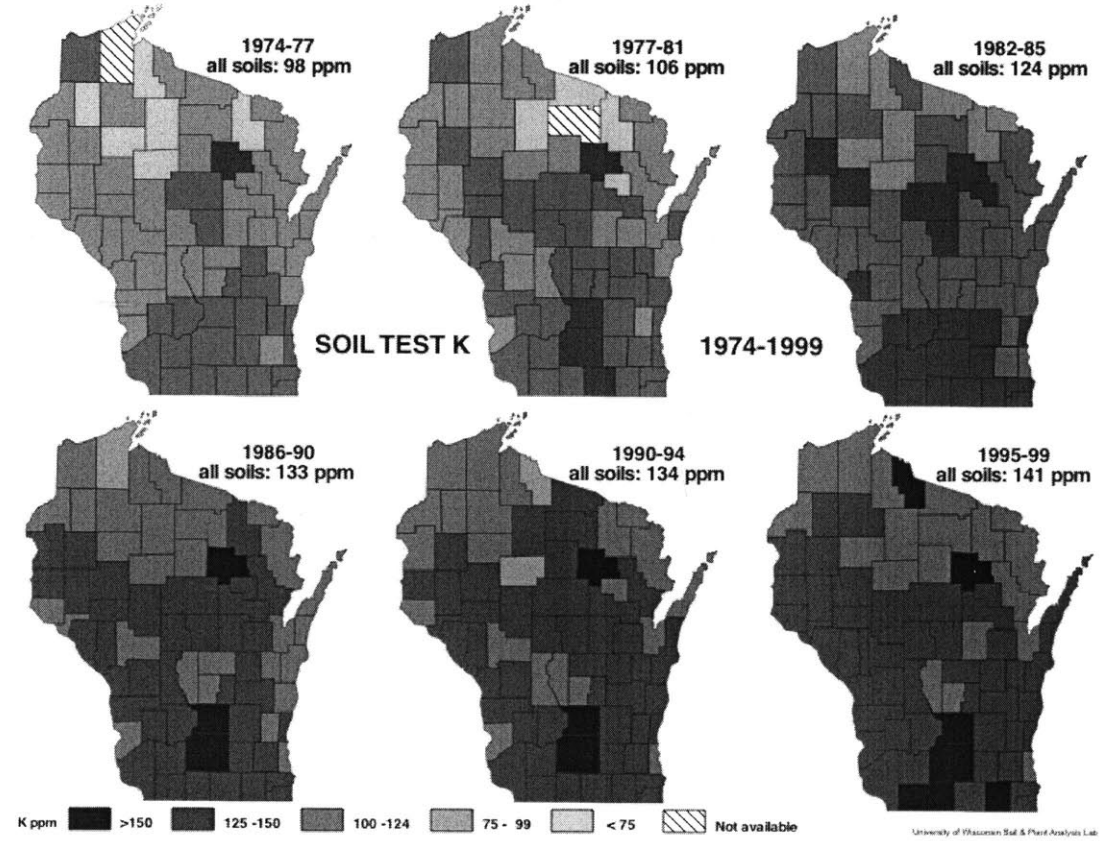
☐ **I would like a copy of the final report (Masters thesis) sent by email.**

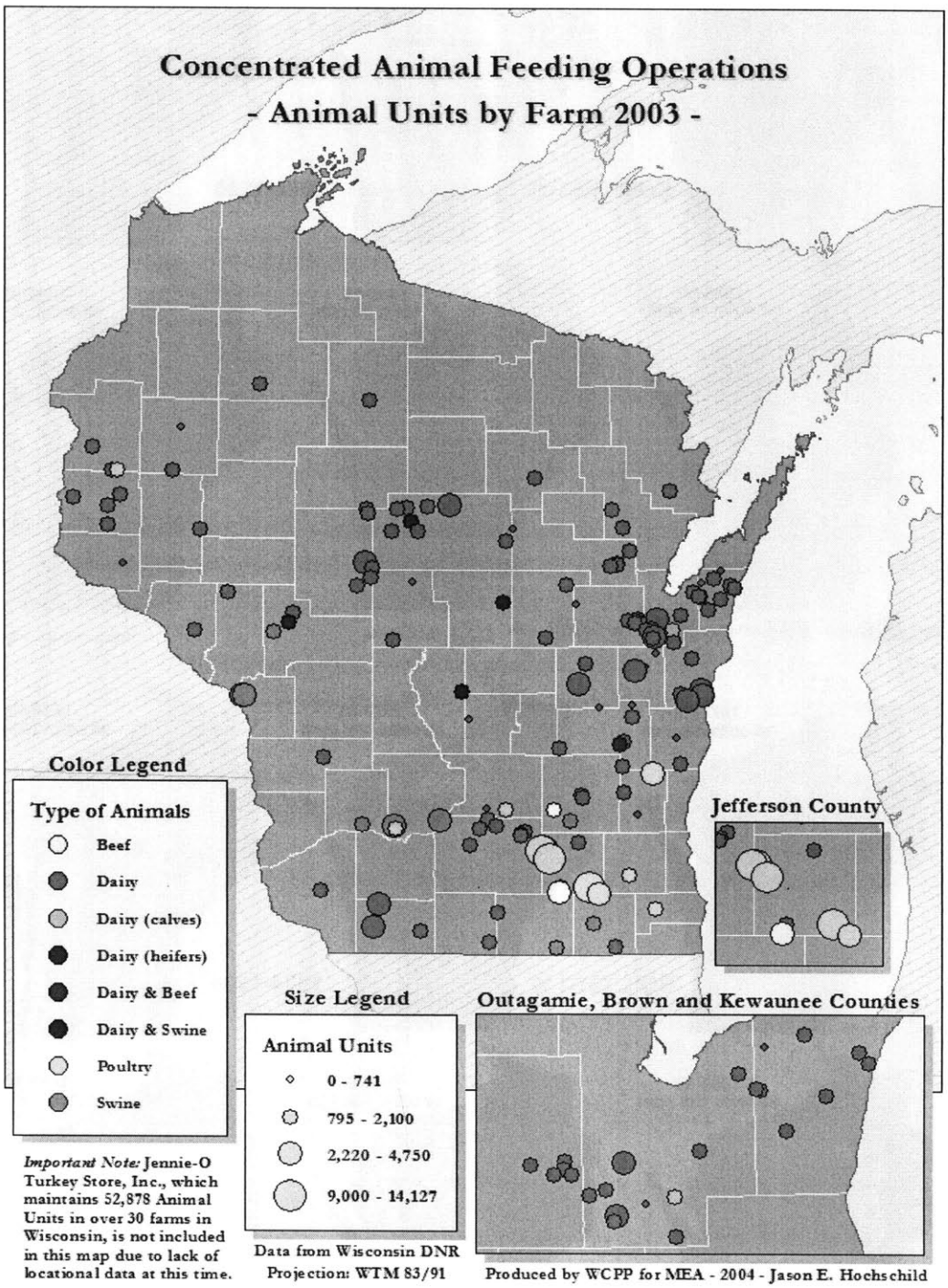
Participant's Signature (s) **Date**

Participant's Name (s) (Please Print)

Contact Information of Primary Investigator: Ian Finlayson
Phone: 617 718-7126 (H) 857 222-4008 (M) Email: ianf@mit.edu


1974-77
all soils: 37 ppm
1977-81
all soils: 40 ppm
1982-85
all soils: 44 ppm
SOIL TEST P
1974-1999
1986-90
all soils: 48 ppm
1990-94
all soils: 50 ppm
1995-99
all soils: 52 ppm
P ppm
>150
75 -150
30 - 74
< 29
Not available
University of Wisconsin Soil & Plant Analysis Lab


1974-77
all soils: 98 ppm
1977-81
all soils: 106 ppm
1982-85
all soils: 124 ppm
SOIL TEST K
1974-1999
1986-90
all soils: 133 ppm
1990-94
all soils: 134 ppm
1995-99
all soils: 141 ppm
K ppm
>150
125 -150
100 -124
75 - 99
< 75
Not available
University of Wisconsin Soil & Plant Analysis Lab


Concentrated Animal Feeding Operations
- Animal Units by Farm 2003 -
Color Legend
Type of Animals
Beef
Dairy
Dairy (calves)
Dairy (heifers)
Dairy & Beef
Dairy & Swine
Poultry
Swine
Jefferson County
Size Legend
Animal Units
0 - 741
795 - 2,100
2,220 - 4,750
9,000 - 14,127
Outagamie, Brown and Kewaunee Counties
Important Note: Jennie-O Turkey Store, Inc., which maintains 52,878 Animal Units in over 30 farms in Wisconsin, is not included in this map due to lack of locational data at this time.
Data from Wisconsin DNR
Projection: WTM 83/91
Produced by WCPP for MEA - 2004 - Jason E. Hochschild