Opportunities in Grazing Dairy Farms:

Assessing Future Options

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by

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Executive Summary

Overview

Dairy farming has long been a stronghold of Michigan agriculture and of Michigan's rural communities. At 21% of 2002 farm gate receipts, dairy is the largest single agricultural commodity in the state; one in 18 farms in Michigan is a dairy farm. Seventy-three percent of Michigan's dairies milk between 10 and 200 cows, but the future of these mid-sized farms is far from certain. While milk production in the state has remained relatively constant, the number of mid-sized dairy farms is in rapid decline. This has significant implications for the diversity of Michigan's dairy industry, the ability of new dairy farmers to enter farming, the existence of a rural entrepreneurial middle class, and the overall vitality of rural communities.

Our review of the literature suggests that proven alternative dairy production methods, if supported, could help maintain the scale diversity of Michigan's dairy industry, help preserve the mid-sized dairy farm, and present opportunities for much needed rural economic development. An investigation of research from Michigan, the Midwest and throughout the country provides a sound basis for concluding that low-capital managed grazing dairy production offers a viable management option for small- and medium-sized farms.

Summary of Findings

- Small- and medium-sized dairy farms in Michigan continue to decline in number.
- Dairy farmers are an aging population. New farmers will be needed to maintain dairy farm numbers in the next 20 years.
- Grazing dairies require less capital investment per cow than confinement operations, and often have higher returns to assets and equity.
- Grazing dairies have greater net income per cow and per hundred weight of milk than confinement dairies. A grazing dairy can provide a livable family income on a scale that can be operated and managed primarily by farm family labor.
- With reduced costs, lower capital investments and viable net incomes, grazing dairies may present more accessible start-up opportunities for beginning farmers.
- Opportunities exist for differentiated, niche, or value-added products to add to profitability, but do not appear necessary to achieve satisfactory net incomes.
- Socially and economically, rural communities with relatively large numbers of medium-sized farms tend to score better in various measures of well-being than do communities with small numbers of larger scale farms. These measures include, for example, lower poverty and unemployment rates, and greater civic engagement.
- Dairy operations that rely more heavily on managed perennial pastures can provide enhanced ecosystem services, including reduced soil erosion, reduced phosphorus losses, and increased soil carbon sequestration potential.
- Other states are working to the decline of their state's dairy farms and foster scale diversity through long-term planning, industry diversification, strategic financial assistance, and individualized technical assistance.

Introduction

Animal agriculture currently accounts for well over half of total farm gate receipts in Michigan. However, we should not assume that this will remain true in the future, nor that current farm gate receipts imply a reasonable standard of living for the average farmer; nor that the farm's management demands and economic prospects encourage the next generation to remain on the farm. Agriculture in Michigan and across the country is facing a massive challenge. The 2002 Census of Agriculture indicates approximately a 10% decrease in farms of 50-1000 acres across the north central region for the preceding five years. Some argue that these "farms of the middle" constitute the bedrock of American agriculture and a basis for the land scale necessary for the continued viability of animal production family farms[1]. Projections for Michigan indicate a probable 71% loss of farms between 50-500 acres by 2040[2].

According to 2002 Census of Agriculture data, the most current available, dairy is the largest single agricultural commodity in the state, with 21% of farm gate receipts; one in 18 farms in Michigan is a dairy farm [3]. Dairy farms are a vital part of Michigan's agricultural economy and landscape; producing food, paying taxes, providing jobs and income, and maintaining open land. Yet, according to the 2002 Census of Agriculture, the total number of dairy farms in Michigan declined from 4226 to 3013 between 1997 and 2002 [4]. Only the largest farms showed increased numbers: the number of farms with 200 or greater cows increased from 247 to 295 over this time period [5]. Meanwhile, the number of farms with less than 200 cows declined by 34%, from 3979 to 2718 farms [6]. These trends have likely continued from 2002 to the present.

Still, medium-sized dairy farms remain the dominant form in Michigan; the median herd size in 2002 was somewhere between 50 and 99 cows. Seventy-three percent of all Michigan dairy farms had between 10 and 199 cows – exactly the farm sizes that are in rapid decline. This decline of "agriculture of the middle" parallels trends seen nationwide in all commodity types. Kirschenmann *et al* warn of the loss of public good that accompanies the disappearance of mid-scale farms [1]. There are many good farmers who are forced by external factors, not lack of management ability, to exit farming. Given the continuing trend of declining farm numbers, it is important that struggling farms have alternatives beyond getting larger or going out of business.

In addition, more than one-third of Michigan dairy operators are 55 years old or greater; more than two-thirds are 45 or greater [7]. In the next twenty years, many of these farmers will likely be retiring. Some of their land and assets will no doubt be acquired by existing farms, but in order to maintain a stable agricultural base in Michigan, new cohorts of young farmers will be needed.

In this context we ask the following questions: What can be done to foster diversity of scale in Michigan's dairy industry? What strategies can be utilized to improve the economic viability of small- and medium-sized dairy farms today and reasonably assure that viability for future generations of farmers? What impact will these farms have on the environment, rural communities and the state's economy?

This report discusses the future potential of Michigan dairy farming from the standpoint of two possible systems or paradigms: a managed grazing or pasture-based system; and a grain-based, confinement feeding system. Managed grazing and modern confinement are two alternatives to what researchers from Wisconsin's Center for Dairy Viability [8] call "traditional confinement": relatively high capital, high input small to medium scale farms which are likely the least viable in today's economic and regulatory environment. Below is a brief and simplified description of the managed grazing and modern confinement systems. The goal of this comparative report is to discuss the relative viability of alternatives for mid-scale production, and the importance of nourishing those alternatives in order to maintain a healthy agricultural future for Michigan. It should be noted that, in practice, a continuum of production methods exist, with each farmer attempting to identify the methods that best suit available resources, farm location, management style, and personal and business goals. Still, most dairy farms will fall into either a generally pasture-based or a grain-based, confinement management paradigm.

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In the pasture-based system, the cows harvest the majority of their own feed from grass and legume pastures during the late spring, summer and fall. Conserved forages (hay, silage) are supplemented through the winter, and concentrated feeds (corn grain, for example) are also supplemented to meet management goals. Typically, some form of management intensive rotational grazing (MIRG) is employed. MIRG involves moving cows to fresh pasture (often daily) in order to maximize pasture growth and nutrition. Generally speaking, pasture-based dairies are smaller farms with relatively fewer cows (typically under 200 cows, but examples of pasture-based dairies with up to 2,000 exist in the U.S.) Typical production levels are 10,000 to 17,000 pounds of milk per cow per year, depending primarily on grain supplementation levels. Cows often produce over a longer lifespan in this system so it could be expected that cull rates will be lower[9].

In a confinement feeding system cows are housed in buildings, where they are brought a nutritionally balanced, mixed ration of corn, soybeans, alfalfa and other feed. Farms often grow a significant amount of their own feed. Barns, crop planting and harvesting equipment, feed mixing and handling equipment, and manure storage and handling equipment all add to the capitalization needs of these operations. Confinement operations increasingly operate with very large numbers of cows (1000+) and generally produce more milk per cow than the pasture-based system (average milk production in Michigan is around 21,000 pounds of milk per cow per year [10]). Confinement dairies typically stagger the breeding of their cows so there will be staggered

levels of milk production among cows, allowing for continuous, stable milk production year-round. Most Michigan milk is currently produced in this way.

This report summarizes results of studies from Michigan and throughout the U.S. to inform the following questions: How do the dairy production models described above compare in start-up costs and income generation? What are the implications for job creation and community economic growth? What are the environmental implications of these production systems? How have other states supported agricultural development in order to address declining dairy farm numbers? It should be noted at the onset that few comprehensive, side-by-side system comparisons of the profitability, capital needs, energy use or environmental performance have been conducted.

The sections below present comparisons of the economic and environmental performance of pasture-based and grain-based dairies. Evidence to the importance of farm diversity in the social and economic well-being of agriculturally influenced communities is then discussed. We consider the consumer demand for differentiated animal products, and then discuss the approaches taken by a number of states to address the decline of small- and mid-sized dairy farms.

On-farm Economics: Capitalization and Returns

"Regardless of one's biases, most people would agree that for a given number of cows, a state of the art grazing operation should require less investment/cow…"

Managing debt loads can be crucial to the success of both beginning and existing dairy farms. Data from several studies suggest that grazing dairies require less capital investment per cow than confinement dairies. Data from Missouri comparing investment for a 250 cow grazing dairy (2005 data) and a 1,000 cow confinement operation (2000 data) indicate that per cow investment for facilities, machinery and equipment (not land or cows) is $671 per cow for grazing and $1,895 per cow for confinement [11-13]. Joe Horner, an extension economist from Missouri, estimates current total per cow capital investment costs (including land and cows) at about $5,500 per cow for a confinement operation, and about $4,000 per cow for grazing [14]. A study from Kansas estimates $5,900 of investment per lactating cow for confinement operations [15]. Wisconsin researcher Tom Kriegl concludes, "Regardless of one's biases, most people would agree that for a given number of cows, a state of the art grazing operation should require less investment/cow (and therefore less debt/cow) than a confinement system, especially a newer one" [16]. Another study in Ontario compares 36 grazing dairy farms with a baseline set of 182 (presumably confinement) farms [17]. Using three years of data, the researchers found grazing farms have less debt per cow and pay less interest (about $100 Canadian less per cow each year) than the baseline farms.

Missouri researchers [12] report grazing dairies have lower ownership costs both per cow ($241 versus $429) and per hundred weight of milk produced ($1.61 versus $1.95, at 15,000 and 22,000 lbs of milk sold, respectively), compared to confinement dairies. Projected 2007 budgets from Missouri list ownership costs per cow at $548 (confinement) versus $330 (grazing).[9] Ownership costs are defined in these studies as tax, interest and insurance on buildings, equipment and land, plus depreciation on buildings and equipment.

Evidence from other states also suggests that grazing is an important management strategy for entering farmers. A Wisconsin study found that beginning farmers were twice as likely to employ grazing as the average dairy farm [18]. Researchers from this study conclude, "A number of the practices widely used by recent entrants – the tendency to minimize the number of acres owned and rented, the tendency to employ existing facilities (especially stanchion barns), and the tendency to employ MIRG – suggest that a key dairy entry strategy is to combine cost minimization and investment minimization"[18].

A number of studies indicate that grazing dairies often have higher returns to equity and assets, reflecting profit earned per dollar invested in the farm business. The manner by which different researchers or projects measure these figures is greatly variable, leading to varying estimations and conclusions. New York data from 1998 [19], 2000 [20], 2002 [21] and 2004 [22] indicate grazing dairies, compared with non-grazing dairies, achieved higher returns to equity capital and all capital in every year studied. These studies also indicate higher net income per cow for grazing farms. Three year data comparing (a) approximately 100 grazing farms in multiple states versus (b) samples of between 581 and 743 Wisconsin dairy operations of all types, find that grazing dairies achieved higher returns in each year studied (2000-2002, inclusive) in both returns to assets and returns to equity measures [23, 24]. Results from the Northeast U.S. [25] show higher (per cow) returns after cash costs and capital replacement for "moderate intensive grazing" dairy farms as opposed to "extensive grazing" or "all farms." 2004 data from Michigan, however, find lower returns for grazing farms[26, 27]. An inconclusive study found no statistical correlation between grazing and returns to assets on New York dairy farms [28].

Profitability and income generation

Dairy farmers sell cheese at the Sweetwater Local Foods Market in Muskegon, MI. Photo courtesy of Chris Bedford.

A report from the USDA Agricultural Research Service showed that, based on several estimates, grazing dairies net $50-100 more per cow annually than confinement [29]. We have identified studies from twelve states (MI [26, 27, 30], WI [23, 24], MO [12], NY [28], MD [31], NE [32], MN [33], IL [34], VA [35, 36], TX [37], FL [38], CT [39]) comparing grazing and confinement feeding dairies. In all but one (TX [37]), grazing dairies earned greater net income per cow than confinement dairies. Data from Michigan, Wisconsin, Connecticut and New York were collected on-farm, and therefore may be considered most reliable. Table 1 provides an overview of pertinent results from these studies. In the MI, NY and WI studies, grazing dairies had greater net income per cow. The graziers in

the WI study also had greater net income per hundred weight of milk produced, on average, for every year of the study. A summary report from Wisconsin[8], utilizing on-farm data over nine years, confirms these results: compared to large confinement operations, grazing dairies incur less costs and earn more net income per cwt equivalent over each year of the study (1996-2004). In general, grazing dairies are competitive due to cost savings. A number of observers believe grazing dairies are better able to survive low milk prices than confinement feeding dairies due to this cost efficiency.

Table 1. Selected Comparisons of Grazing and Confinement Farms

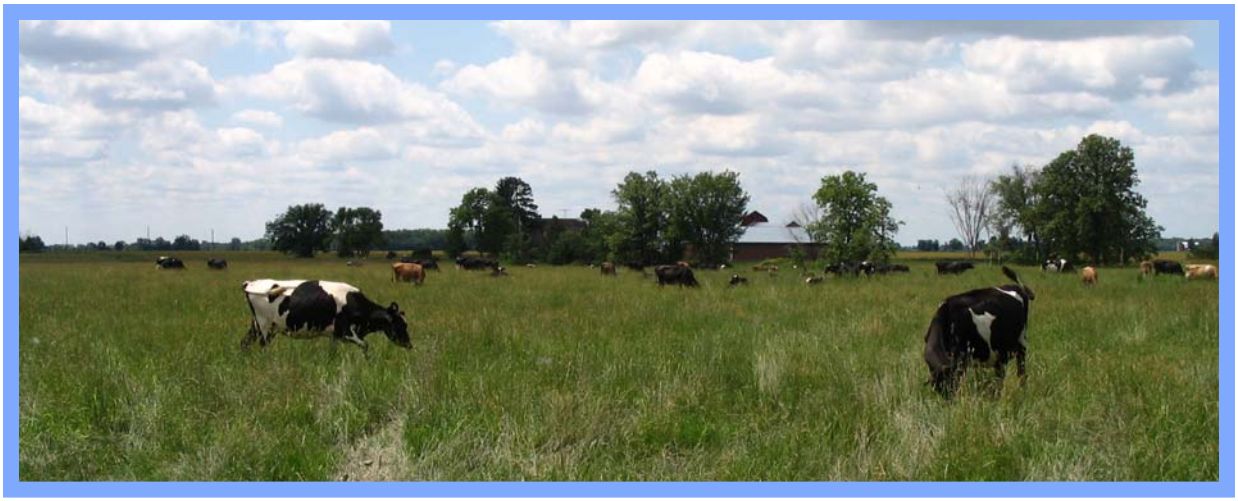
State	Lead Author	Net Income/Cow		Net Income/CWT		Total Cost	
		Grazing	Confine	Grazing	Confine	Grazing	Confine
NY	Gloy	$363	$252	-	-	-	-
WI	Kriegl	$524	$230	$2.53	$0.85	$962 per cwt	$11.30 per cwt
MI	Dartt	$429	$412	-	-	-	-
CT	Foltz	$459	$369	-	-	$2341 per cow	$2737 per cow

With good management, grazing dairies appear able to provide a livable, family income at a farm scale manageable with primarily family labor. In the Michigan study mentioned above, 35 grazing dairies netted, on average, $429/cow [30]. A farm that achieves this with 100, 120 or 150 cows earns incomes of $42,900, $51,480 and $64,350, respectively. These figures compare favorably with Michigan's 2002 median income of $42,715 [40]. Grazing dairies in 4 states, including Michigan, averaged net income of $55,228 per farm in 2000 [41].

Environmental Performance

Farm and land use management strategies can greatly affect the impact that agricultural food and fiber production have on the environment. Soil conservation, nutrient management, surface and subsurface water quality, and soil carbon storage all remain pressing issues faced by rural communities. In anticipation of the need for federal farm bill policies to align with international trade agreements (World Trade Organization and others) the promotion of production practices that maximize these ecological services may better position Michigan farms to receive future stewardship-based federal payments.

Tillage and soil preparation for annual crops such as corn and soybeans tend to leave soil bare and susceptible to wind and rain erosion. Such sediment losses not only degrade soils but potentially contribute to pollution in surface waters. Permanent vegetative covers, such as pasture grasses, help to hold soils in place and prevent soil losses. One study profiling three pasture-based livestock farms in Minnesota found significantly reduced sediment losses from storm events over three years [42]. A particularly severe rain event in this study released 52



pounds of sediment per acre from rotationally grazed dairy lands, whereas a nearby farm on the same soil type and less severe slopes, but planted in corn and soybeans, released 20,000 pounds of eroded soil per acre from plowed fields and 10,000 pounds per acre on fields under conservation tillage. The National Resources Conservation Service (NRCS) recognizes the environmental conservation benefits of rotational grazing by allowing lands managed according to a Prescribed Grazing Plan [43] to participate in the Grassland Reserve Program [44].

Controlling sediment losses also greatly helps in reducing a major agricultural pollutant to surface waters: phosphorus. Phosphorus (P) is taken up by the soil fraction that is most susceptible to runoff. When this sediment-bound P finds its way to streams, rivers and lakes, it contributes to eutrophication [45]. A management strategy based on perennial pastures and management intensive rotational grazing can be an effective way for dairy farms to reduce environmental P losses [46, 47]. For example, rotational grazing is among the management practices being encouraged by the City of New York to control eutrophication in the upstate watersheds that supply the city's water [46]. Permanent vegetative cover helps hold soil and nutrients on the farm, but incorporating rotational grazing can also aid in managing the accumulation of soil P by reducing nutrients imported to the farm (in the form of feed grains) and reducing the need for grain crops [47, 48].

Nitrogen losses from agricultural lands can also become a potential environmental pollutant, particularly in the form of nitrates leached to subsurface aquifers and to tile drains that lead to surface watercourses. Nitrate leaching on rotationally grazed dairy farms is a function of climatic and soil conditions, animal stocking density and the ability of pasture plants to uptake N depositions, among other factors [49, 50]. Some studies suggest significant (>10 mg l^{-1} NO_3^-N) concentrations of nitrates in the leachate beneath intensively grazed pasture at relatively low cumulative seasonal stocking rates (200 animal days, or 1.1 mature dairy cows per hectare over a 180 day grazing season) [49]. Such losses from pastures are characterized by high losses from urine and fecal patches superimposed over lower losses from the pasture as a whole [51] and can therefore be difficult to quantify. Simulation models suggest higher levels of nitrate leaching losses from grazed pastures than from harvested grass silage fields receiving manure slurry [50]. Other modeling studies suggest an economical preference of grass pastures over corn as a means for dairy farms in the Netherlands to comply with nitrate leaching restrictions [52], while whole

farm models implemented under a Pennsylvania scenario show decreased nitrogen leaching with grazing systems compared with confinement systems [53]. There appears to be more discrepancy in the literature on nitrate leaching than in other environmental performance indicator, indicating the need for further research on a variety of Michigan soil types.

Clearly, it is important to regard rotational grazing as a production system rather than a nutrient management system. Nutrient management techniques, best practices, and regulations need to be developed for rotational grazing, just as they need to be developed for other production systems. It is necessary for educational and regulatory bodies to develop both scale-appropriate and production system-appropriate guidelines.

Rotational grazing on grass pastures also can lead to sequestration of significant amounts of atmospheric carbon in soils. Carbon storage in soils is an important strategy in discussions of global warming mitigating activities. A meta-analysis of data from around the world shows a 19% increase in soil carbon stocks after land use changes from crop to pasture [54]. A similar study looking at the *rate* of soil carbon accumulation calculated a mean accumulation rate with conversion from cropland to grassland very similar to the rate with conversion from cropland to forest[55]. Because management intensive rotational grazing can increase grassland forage production relative to extensively (or continuously) grazed areas, there is the potential for this management practice to influence soil carbon levels. A study conducted in Virginia found 22% greater total organic soil carbon levels under management intensive grazing compared to neighboring extensively grazed or hayed pastures [56]. Additional research is needed to address soil carbon dynamics under Michigan pastures.

Such environmental performance measures are important not only for their impact on Michigan's soil and water resources, but also for their relevance in aligning Michigan's farms with global food policy. The ability of farms to provide a variety of services beyond food and fiber production, such as land conservation, ecosystem services, viability of rural areas, and biological diversity, has been termed multifunctional agriculture. Such services are considered non-trade distorting within the World Trade Organization (WTO) Agreement on Agriculture. The ability to provide such services will prove to be increasingly important as national agricultural policy is forced to conform to global trade agreements.

Social and Economic Implications of Farm Size and Structure

Assuming that, as these studies indicate, a grazing dairy is a potentially viable family farm business option, it is important to consider what their increased numbers could mean for the social and economic well-being of Michigan communities. There is an array of studies that measure the impacts of farm size and composition on surrounding rural communities. The prevailing conclusion is that rural communities with greater numbers of small- to medium-sized operator-owned farms score better on a number of measures of

The Shetler family (pictured above) owns a specialized grazing dairy in Kalkaska, MI. Photo taken by Annie Shetler.

community well-being compared to otherwise similar towns characterized by a few large farms that rely on hired labor [57-62]. These measures of community well-being include: more even income distribution, better housing conditions [57]; more civic engagement, measured by church membership and voter participation[62]; lower rates of poverty, unemployment and violent crime, lower incidence of low birth weight babies [62], fewer numbers of food stamp recipients [61]; higher qualities of housing, social services and public education [60]. The presence of an entrepreneurial middle class is seen as a particularly important component of a healthy rural society [59]. Also, small to mid-sized farms are more likely to purchase inputs locally [39, 63-66]. It is important to note that these studies are not limited to dairy farms or Michigan per se, but involve farms that grow a variety of products throughout the country.

Differentiated and Value-added Product: meeting consumer demand

The fall 2005 State of the State Survey, a random, statewide Michigan poll conducted by Michigan State University's Institute for Public Policy and Social Research, included questions concerning consumer perceptions of differentiated animal products. When asked to consider their purchasing of animal products, the majority of respondents stated the following attributes were either very important or somewhat important (percentages of responses as very important or somewhat important in parentheses): humane animal treatment (82%), not produced with antibiotics or hormones (87%), environmentally friendly (93%), raised in Michigan (52%) and raised on a family farm (63%). The top reason given for not purchasing, or not purchasing more, pasture-raised products was lack of availability[67]. In addition, 81% either strongly agreed or somewhat agreed that pasture-raised products are healthier for consumers than products from confined feeding operations. This does not mean that pasture-raised products are necessarily healthier, but that consumers think that they are. In fact, a recent report from the Union of Concerned Scientists reviews the literature on nutritional attributes of pasture based cow-products; identifying the boundaries of accurate messaging[68].

Raw milk Gouda produced by Steve-N-Sons Grassfields Cheese, located in Coopersville, MI. Photo taken by Bonnie Ester.

While the studies cited earlier indicate that pasture-based dairies can be profitable selling to the commodity milk pool, they also are well-positioned to supply differentiated and value-added markets that meet some or all of the polled attributes mentioned above. Other surveys from around the U.S. have found that consumers value attributes of local and pasture-raised animal products and significant percentages are willing to pay a premium [69-72]. Sales of organic milk are growing at an annual rate of 23% while sales of non-organic milk have dropped 8% annually [73]. An internet-based study found that 42% of those Midwest consumers responding to a (non-random) survey were interested or very interested in direct delivery of locally produced milk; 10% of respondents are willing to pay a 30% premium for locally produced milk from grazing dairies [74]. Interpolating these findings to Michigan grazing dairies, this product differentiation could generate about $17 million in extra revenue for grazing dairies, from fluid milk alone, if

supply were available.[1] While these "willingness to pay a premium" findings are promising for grazing dairies, it is important to note that these consumers were responding to hypothetical questions on a survey. More research is needed to discover whether these results accurately predict real market conditions.

Initiatives in Other States to Foster Diversity and Viability in the Dairy Industry

A number of U.S. state governments have taken steps to invigorate scale diversity in their state's agriculture through the establishment of policy frameworks, financing mechanisms, and strategic technical support crafted for small- and mid-sized farms [75]. These government investments, tethered with federal and local financial resources and citizen efforts, have demonstrated significant positive economic and environmental impacts.

Wisconsin, Minnesota and Maine are highlighted here as examples of states that have specifically targeted diversification and development in their dairy industry. In all three cases, strategically coordinated technical assistance-oriented education programs linked with financial investments using federal, state, and local resources are working collectively toward the goals of impacting small dairy farm profitability, growing the state's dairy industry, and providing for land conservation. In general, these programs have included technical assistance and training for pasture-based dairies for all the comparative advantages outlined above.

Wisconsin

- Dairy 2020 Initiative Originally a task force addressing Wisconsin's declining dairy industry, Dairy 2020 is now a Department of Commerce administered grant program to encourage and stimulate the start-up, modernization, and expansion of Wisconsin dairy farms. Grants are awarded to dairy producers as cost-share for professional services such as business plan preparation [76].
- Grazing Lands Conservation Initiative A USDA Natural Resources Conservation Service project aimed at promotion of management intensive grazing (MIG) as a viable option in central Wisconsin. The program provides one-on-one farm planning assistance; education for farmers, agricultural professionals, local bankers and leaders; and MIG curriculum for technical and high school agricultural classes [77].
    - In 4 ½ years, the initiative exceeded its goal of 6750 acres by developing grazing plans for 10,120 acres on 108 farms.
- Grow Wisconsin Dairy Team – a joint venture of the Department of Agriculture, Department of Commerce, University of Wisconsin, UW Extension, and Wisconsin Technical Colleges aimed at coordinating resources for dairy farmers modernizing their businesses and adding value to Wisconsin milk through new marketing opportunities. One program focuses on grazing or organic transition and farmer entry [78]

[1]Following Pirog [63], this assumes: 10% of Michigan's approximately 10 million people paying a 30% premium on a $2.00 gallon of milk, times 24 gallons per person per year (average annual per capita consumption of milk).

Minnesota

- Dairy Profitability and Enhancement Team Grant program was created "to expand the one-on-one educational delivery team system to provide appropriate technologies, including rotational grazing and other sustainable agriculture methods, applicable to small and medium sized dairy farms to enhance the financial success and long-term sustainability of dairy farms in the state." [79] The program provides grant funding for both local teams and to the individual producer to develop comprehensive five-year business plans.
    - For every grant dollar spent in 2004, the Dairy Development Profitability Enhancement Teams produced a $7.30 return in on-farm cost savings and increased profitability. [80]

Maine

- Farms for the Future is a statewide economic development program of the Maine Department of Agriculture, Food and Rural Resources available to all Maine farms. This program s is currently administered by Coastal Enterprises, Inc. (CEI), a non-profit community development corporation. The two-phase program provides selected farms with: individualized business plan development for increasing farm viability (Phase 1), and competitive cost-share grants to implement planned changes (Phase 2) [81].
    - As of November, 2005, 122 farms have been supported through technical assistance grants, placing 17,505 acres in non-development agreements. 17% of these farms were dairy [82].
    - Every dollar of public funds that Farms for the Future has invested has been matched by $4.40 (1:4.4), leveraged through personal loans, in-kind contributions, farmers' personal investments and other sources.
- Maine Grass Farmers Network, a producer trade association, works with dairy producers on the financial and ecological viability of growing grass as a means for supplying higher animal nutritive value and higher market prices for their milk. The network is coordinated and sponsored by USDA NRCS, University of Maine Extension, and the Maine Organic Farm and Gardening Association [83].

All three states share similarities in approaches to promote scale diversity of their dairy industry. According to state spokespersons, local teams, a network of technical assistance providers, and incentive loans and grants to help with business planning and implementation have combined in efforts to improve dairy farm viability, stem the loss of farms, and reinvigorate the states' dairy production as well as value-added processing. The following trends run throughout:

- Finance and technical assistance tools emerged within an articulated mission that framed innovation and diversity in the dairy industry.
- The mission was implemented through a variety of strategies that were interconnected and long range in scope.
- Programs and financial tools maximized federal resources, and state funding was calculated as an investment tool.
- Program flexibility and local development teams have allowed for problem identification, planning and implementation that meet the needs of individual farms, regardless of scale.

- Industry diversification and entrepreneurship, such as value-added processing, market differentiation (e.g., organic), niche marketing, and pasture-based management strategies, have been supported and encouraged as tools for reinvigorating the state's dairy industry and growing the state's economy.

Conclusions

Steve-N-Sons Grassfields Cheese is located in Coopersville, MI. Photo courtesy of Chris Bedford.

The dairy industry in Michigan, as in much of the country, is undergoing a major restructuring. Among the casualties of this restructuring are the mid-sized dairies that have arguably been a backbone of rural communities and the historical bedrock of Michigan milk production. The trend is not inevitable, however. A review of the literature reveals that relatively low capital, high net-income alternatives are available to Michigan dairy farmers in the form of managed rotational grazing. This option appears to be well suited for beginning farmers as well as existing farmers. Maintaining and increasing diversity of farm scale would likely contribute to the social and economic well-being of rural communities. Managed rotational grazing has the potential to provide enhanced ecological services and environmental performance. Finally, pasture-based farms are well positioned to offer differentiated products for value-added markets. While not necessary for grazing dairy profitability, such differentiated product opportunities can add to farm profit and can make significant contributions to economic development in the state.

Other states have combined loan and other cost-sharing programs with individualized, on-farm technical assistance to modernize, diversify and re-grow their dairy industry. In three states exemplified here – Maine, Minnesota, and Wisconsin – managed rotational grazing is playing an important role in reinvigorating their dairy industry by allowing new farmers to get started with manageable debt and existing farmers a reasonable means to modernize without significantly expanding herd size.

Although this report is based on a limited base of research, the findings are fairly consistent. Nonetheless, we encourage further discussion, inquiry and study into the issues outlined here, as well as other implications of different models for dairy production, management and marketing. It is a responsibility for our research institutions to support such research if we are to continuously increase the sustainability of our food and farming systems. We emphasize that to date the focus of most dairy research efforts has been on confinement feeding systems; if research has helped to enhance agricultural production, which we believe it has, then there is still much work that could be done to augment returns in pasture-based systems. While there is increasing interest in pasture-based dairying, it remains under-resourced in terms of research and development efforts. One needed line of inquiry, for e.g., is preferable conditions for transition to grazing, building on recommendations from Wisconsin's Center for Dairy Profitability[16]. We look forward to a broad discussion and to the potential for development activities focused on mid-scale dairy viability.

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