Staff Paper

Evolution of Dairy Grazing in the 1990's

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by
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Why This Paper?

As I looked around New England and in the North Central U.S. in the mid-1980's, pasturing appeared to be a lost art. I was concerned that farmers younger than me had retained little of the knowledge my grandfather's generation had used to manage pasture. In other developed countries of the world, such as Ireland, England and New Zealand, especially in climatic zones where forage crops grew nearly year around, rotational grazing was the preferred harvesting alternative. One of my goals for spending a sabbatic leave in England in 1988 was to learn about rotational grazing and see how it might be applied in Michigan.

During that leave, I wrote "Lessons for Michigan from the U.K.'s Dairy Pastures." [1] [1]
It was a literature review with a lot of history. It ended with an outline of the status of rotational grazing in the Northern U.S. with ideas on how to expand the future use of this management tool. Upon return, I discovered the rebirth of grazing as a tool of choice was already underway in Michigan.

This paper, written 15 years later, reviews the evidence that management intensive grazing (MIG) is a sound management practice that has reestablished itself as a profitable alternative in the dairy industry of the Great Lakes. There are sections on 1) Using Pasture, 2) The Technology of MIG, 3) Great Lakes People, 4) Economics of MIG, 5) Private Sector Response, 6) Public Sector Response, 7) Agricultural Experiment Station Response, 8) Conjugated Linoleic Acid, 9) a Disclaimer, and 10) Future Directions for MIG Research. The past 15 years have seen a lot of articles that document how pasturing in the U.S. has utilized current knowledge. A few of them are cited. I am no longer concerned about losing this knowledge about an alternative way to profitably feed dairy animals.

Using Pasture for Dairy Cows Is Alive and Well

A significant number of dairy farmers in the Great Lakes States are graziers. They use management intensive grazing with their lactating cows to harvest roughage. Other terms include intensive grazing, rotational grazing, and intensive rotational grazing. For a dairy herd, it is intensive if the cows get to graze a fresh paddock after every milking. It is the opposite of set stocking, where a set number of animals are turned into one big paddock for the pasturing season. For beef cows, it is intensive if they are moved to a fresh paddock every 4 days. A dairy farmer whose cows are consuming

[1] Numbers in brackets refer to Bibliography at the end of this paper.

over half their roughage dry matter from grazing during the pasture's growing season fulfills most definitions of MIG.

The actual number of dairies using MIG has not been accurately established. Although significant in number, graziers are a minority when compared to all dairy farms. The 1997 Agricultural Census showed Michigan with 820,405 acres of pastureland. This is 8.3 percent of the total land in farms. In addition, 151,171 acres of woodland were pastured. [2] The census does not show what species used the pasture. The total acres grazed are understated in the census, because hay land is often mechanically harvested for stored feed in one cutting, and then regrowth is grazed later in the same growing season. The 1999 Michigan dairy farm survey showed the average farm used 665 total acres, of which 45.2 acres were pasture. See p. 9, Table 20. [3]

In the year 2000, the Michigan dairy type of farm report included 150 farms. [4] At least 12 of these, or 8%, used MIG. In Michigan, the servicing agents had to know the farm was a grazier; the farmers were not asked. A similar study in New York, for 2000 showed 65 of 294 dairy farms, or 22%, used MIG. [5] In New York, all the farmers were asked. The farm was classed as practicing intensive grazing if "the dairy herd was on pasture for three months or more and was moved to a new paddock every third day or less and at least 30 percent of the forage was from pasture." See p. 59 and Table 66.

A mail survey done in early 1997 showed less than 4% of dairy farms in Pennsylvania and Virginia, and 11.5% of dairy farms in Vermont used intensive grazing. [6] The authors concluded on p. 841 that "These farms tended to be slightly smaller than average, with slightly lower milk production per cow. Farmers using intensive grazing technology tended to be younger and have more years of formal education. A key finding was that intensive grazing farmers tended to be significantly more satisfied with many aspects of their farm business."

A survey found that MIG increased from 7 % use in 1993 to 23 % use in 1999 on Wisconsin dairy farms. [7]

Research using 35 MIG farms in a retrospective cohort study in Michigan was done to determine differences between MIG and conventional dairy farms in 1994. [8] These 35 farms were less than 1% of the state's 4,300 Grade A operations in 1994. [9] A Nebraska survey in July, 1994 got 423 responses. Of these, 100 farms, or 24%, said pasture provided over half of the forage fed to their milking herd. [10]

Based on the above I'd guess that as we moved in the 21st century, somewhere between 8 and 22 % of the dairy farmers in the Great Lakes States used MIG. [2] *Is this enough to warrant the support of public institutions, like extension? Having devoted a portion of my last 15 years supporting the concept of MIG, I obviously think the answer is "yes!" Is this enough to support private investment in support services? Examples are out there to support another "yes!" Recognize that not all agree on precisely*

[2] At the end of some sections I shall add personal comments and musings without trying to prove them. The italics are to warn the reader of this terrain.

what qualifies as MIG. The previously cited Dartt and Winsten papers use definitions different from what I used at the start of this section, and they differ from what Knoblauch allowed.

The 8 to 22% are proportions of farms, and by default, people. Because MIG farms, on average, have fewer cows than non-MIG farms, the percentage of milk coming from MIG farms is less than 8 to 22%. The MIG system has attracted supporters from a variety of places. Those who like small farms like MIG. Graziers groove with those who think sustainability, and environmental quality. At the end of the 1980's, MIG was new and different. In the last 15 years, the users of MIG have shown that although they may be in the minority, they practice a management concept that works and is profitable.

The Technology of MIG

Management intensive grazing for lactating dairy cattle currently implies providing as much of the needed roughage as possible from pasture. Ideally, cows are given a fresh strip of paddock after every milking. The opposite approach, called conventional, is to have cows confined with all feed mechanically harvested and stored prior to feeding. The strategy of MIG is often described as needing three parts: 1) Management, 2) Forages, and 3) Livestock. [11] As MIG in the U.S. started to appear in the late 1980's, probably over 95 % of the herds were conventional. People had to learn how to do MIG. If already in the dairy business, old habits had to be set aside and new strategies developed. The attitude towards forages in MIG is how to maximize the harvest of the sun's energy. Cows are used to keep the forages cut relatively short during the growing season so as to assure high quality feed. Paddocks have to be moved through at a variable pace to control this growth during the growing season. Livestock have to be trained to the system while maintaining healthy intake levels. People had to relearn how to judge what are profitable livestock production practices.

Fencing and its use is a major factor in MIG. Pastures have to be within a cow's walking distance of the milking center. A strong, permanent perimeter fence of the land is needed. Within the perimeter, a few large paddocks and lanes may be delineated with permanent fences. Temporary fence, which can be quickly moved up to twice daily, is used to control the paddock where the cows graze. The temporary fence and parts of the permanent fences are charged with electricity.

It's often said the emergence of MIG in the U.S. was made possible by non-barbed high tensile wire plus electric energizers, which are low impedance and high voltage. They can electrify permanent fences up to 50 miles long without losing significant voltage, and produce a very short, 0.003 second, high energy pulse. [12] They are much less apt to short out when touched by wet forage than were the older electric fencer units. Several styles of polywire and netting became available to serve as temporary fencing for the constantly changing paddocks, along with a variety of posts that could be easily moved. This equipment had been developed prior to 1990 and their value proven in New Zealand. They only needed to be imported to the U.S.

Private sector dealers for several brands of fencing and related supplies got into the business. As is often the case, dealers had to help educate the graziers on how to plan, build, and manage their paddocks with the equipment available. Two dealers that served Michigan were Don Neville of Clare,

[13] and Gary Wright of Reading. [14] An example catalog and prices of fencing supplies on the internet as of May 2003, was at www.kencove.com. These names are offered with the usual disclaimer about the university not endorsing them. Others could be mentioned, but these are examples of how the private sector has helped the Michigan dairy industry adopt MIG.

A sound business management strategy is to minimize one's investment in productive capital assets. Practitioners of MIG seem to pay special attention to this strategy. This has led several to adopt the New Zealand style of milking parlors, called "swing-overs" or "swing" parlors. Swing parlors are typically herringbone in style, but with only one line of milking machines top suspended so they can be swung from one side of the pit to the other. [15] They are often housed in home made minimal buildings. [16] Palmer stated "Graziers and other producers who want to milk cows fast with a low investment per animal generally choose swing parlors." p. 27 [17] Of course, grazed cows can be milked in any type of facility.

The provision of water beyond the buildings is one of the factors that differentiates MIG from conventional dairy farming. As MIG adoption advanced in the late 1980's there was some debate on whether or not shade and water should be provided in every paddock, as opposed to a big water trough at the end of the lane. Bartlett summarized a sound management position for the Upper Midwestern U.S. when he said the lack of shade in all paddocks can be safely dealt with. [18] However, for lactating cows, "an ideal grazing site has water in every paddock." p. 797 [19] How to do this in a practical and effective manner was presented in a 1999 bulletin. [20]

Forage management is very different in MIG when compared to confinement dairying where all feed is mechanically harvested and put in storage prior to being fed. The grazier keeps plant height in paddocks relatively short, as the best quality feed in growing plants tends to be between the heights of 3 and 12 inches. If the plant is never allowed to reach seed stage, it keeps on growing thus producing more feed for the next pass through by the cows. A paddock may be grazed several times a season. Each plant species has its seasonal growth cycles. Grasses tend to grow rapidly in the spring, grow more slowly in the dry season of late summer, and then grow faster again in the wetter, cooler days of autumn. A typical graphical presentation of resulting seasonal feed availability is given by Garcia. [21] A grazier with a fixed amount of land and a fixed number of cows will likely be unable to either keep the spring growth below 12 inches, or will not have enough growth to support the herd in times of dry weather.

There are management strategies the grazier must learn to handle seasonal growth cycles. [22] Annuals like brassicas can be planted in the spring to provide dry or late season feed. [23] Timing of fertilizer applications can encourage growth rates in the dry season. A conventional dairy will let the hay crop get nearly mature before cutting, thus maximizing plant growth. Two or three cuttings a year can be taken. In the Great Lakes Region, several months of stored feed must be available to carry a herd through the winter season, so mechanically harvesting likely exists, even on an MIG farm. A grazier may harvest the extra spring growth to store for winter. Or, plans have to be made to purchase cold weather roughage needs.

The basics of feeding dairy cows for optimum production are the same whether using MIG or conventional strategies. Grazed roughages have a much higher moisture content when eaten then do most stored feeds. This has to be allowed for in meeting nutrient requirements, which is often done by supplementing only with dry feeds. The end result in MIG is often less milk produced per cow during a year. However, total profit per farm can be as great, or greater, than conventional herds at higher milk production levels in the Great Lakes States.

Cows have to be trained to respect the fences. If they have never grazed, they may have to learn to do so, preferably before they have their first calf. Some attention may have to be given to bloat control, depending on the plant species used. Parasite control needs attention in an MIG situation.

Seasonal dairying is usually associated with grazing, although it has been argued that conventional herds might profit from it, also [24]. This is where the whole herd is dry for a period of time. The cows are bred and culled so they freshen about the same time, and are all dried off at one time. Seasonal dairying is used in most of New Zealand that produces for their export market. As farmers in the Great Lakes States looked to New Zealand to learn MIG, they also noted the seasonal aspect. Having a vacation from milking was attractive. A few U.S. graziers also have experience with seasonal dairying. Three of the 12 Michigan panel farms I have data on are seasonal. For some individuals it certainly has been profitable. [25] Articles are available listing the pros and cons of seasonal strategies. [26] [27] Kriegl has found that MIG farms that are also seasonal are not as profitable as those who sell milk the year around. p.14-15 [28] However, their satisfaction levels may be comparable.

It has taken management oriented people to combine the pieces of MIG into successful farms. Some say that those with little previous dairy experience learned MIG easier. Anyone converting from traditional confinement operations certainly had several new things to learn, plus they often had to leave some of their fixed capital investments under utilized. In the past 15 years in Michigan one can find farm families who moved to MIG from positions of strength on a traditional farm, to others who tried MIG as a successful last gasp effort to stave off bankruptcy.

Paddock management was totally new to everybody, unless they had a grandparent around to brief them. The management of growing plants in MIG is easier to write about than it is to do! It is an art that has to be learned. Fortunately, one can get well grounded in 2 or 3 years. It helps, of course, if the manager likes doing it. I'm told a good grass manager walks the fields every day, looking at plant growth, thinking about how much area the cows will be allowed next time the fence is moved. And they have to think about when the sward being grazed today will next need to be grazed to maintain its peak quality during the whole season. Walking in a quiet field is a marked contrast to riding on noisy equipment. One of the most effective adult group education techniques for MIG practitioners is called the "pasture walk" where the eyes of the expert can help focus the eyes of the novice.

Great Lakes Public Sector People

It is my personal, private opinion that there are 3 people who performed great public service in doing research on, and educating dairy farmers to adopt, MIG. A lot of people made a difference; these

3 made a big difference in the last 15 years. I offer them to you alphabetically by last name: Benjamin B. Barlett, Darrell L. Emmick, and David L. Zartman.

Benjamin B. Bartlett is currently a District Extension Dairy and Livestock Agent with Michigan State University Extension in Chatham, Michigan. He has applied a wide range of knowledge to his work with Northern Michigan's livestock industry, but spent a major piece of his career fostering MIG on dairy farms. He may have been about the first extension person in the Great Lakes to recognize its potential to reemerge as a viable management strategy. His writings on the subject start at least as early as 1986. [11] On February 13, 2001, his extension career efforts earned him Michigan State University's Distinguished Academic Staff Award.

Ben used a variety of adult education methods from demonstration farms, to small group participatory workshops, to large group lectures to get farmers to adopt MIG. He motivated other extension and research workers to get involved. He traveled to New Zealand and brought back understanding of how MIG was done. He networked with others throughout the world and helped them share with farmers by starting the Michigan Grazing Conferences, the first one being held in 1993. They have been yearly events, eventually becoming the Great Lakes International Grazing Conference that serves several states and Canadian provinces. [29] His promotion of MIG could serve as a case study of how a cooperative extension agent can change people's outlook and get an innovation adopted.

Darrell L. Emmick is currently a State Grasslands Specialist with the USDA's Natural Resources Conservation Service (NRCS) in Cortland, New York. His scholarly capabilities, plus depth and breadth of knowledge are illustrated in a recent publication. [30] He studied Irish experience, a country that uses grazing much like New Zealand does. [31] One can find mention of his research and teaching in extension publications and industry magazines by 1992. [32] [33] In October, 1998, Darrell was presented with an appreciation award in honor of his dedication and tireless efforts on behalf of improved grazing management in New York by a group of New York graziers.[34]

The U.S. Farm Bill of 1996, Section 386, had a new initiative titled 'Conservation of Private Grazing Land.' [35] Among other things, it earmarked funds for maintaining and improving private grazing land and its management. This initiative was continued in the 2002 Farm Bill [36] and codified in the Federal Register in November, 2002. [37] In Michigan, this resulted in a full time professional position titled 'State Grasslands/Forage Specialist' currently held by Kevin Ogles. It is alleged that Darrell, with others, helped successfully educate the Federal Congress on the need to create Section 386 of the 1996 Farm Bill and earmark NRCS funds for use in grazing initiatives.

Darrell participated in regional groups including the Northeast Pasture Research and Extension Consortium started in July 1995, and the Great Lakes Grazing Network, a 3-year project funded by the W.K. Kellogg Foundation. In this latter group I grew to respect his leadership capabilities. He has been a sought after MIG speaker far beyond New York State. I have witnessed the high caliber of his teaching skills in farmer workshops. His fostering of MIG could serve as a case study of how to get an innovation adopted working from within a federal governmental agency.

David L. Zartman is currently a Professor of Animal Science, The Ohio State University. He earned his place on my list by carrying out the 5 year Mahoning Farm Dairy Program at Canfield, Ohio while he was Chair of the Department of Dairy Science. [38] The project was a demonstration farm with about 30 cows, half Holsteins, half Jerseys, operated as a seasonal dairy with MIG. Dave used what he learned during a year in New Zealand to show how it could be done in the Appalachian foothills. The full story was also on the internet at http://ohioline.osu.edu/rb1190/ as of May, 2003. The Mahoning project formed the basic case study for a vocational agriculture teaching manual. [39]

The Mahoning Farm Dairy Program did well in getting information out to farmers about the activities and results. I organized a trip there on July 14, 1989 taking 10 extension agents to participate in one of the several scheduled field days. The agents were able to get a lot of photos and video tape of material they used later to teach MIG in Michigan and get pasture walks started. Dave currently teaches a course on MIG on The Ohio State campus and is in demand as a speaker at grazing conferences. He could serve as the subject of a case study on how a research scientist can lease resources to carry out a farm research and demonstration project.

I'm chagrined to admit that when I went to England in early 1988, I was unaware of Ben Bartlett's work with MIG. In studying the dates while writing this paper, all 3 of the above men must have had MIG related projects underway by the early to mid-1980's. Dates on the publications also indicate a lot of material was being printed by the early 1990's, especially in the popular press and in extension bulletins.

When I returned from England in late1988, I started a microcomputer database of interesting MIG materials that passed through my hands which I thought might have future use. Without the database, I wouldn't have tried to write this paper! In this section, I have given only a few sample references by or about the 3 men. In my 15 year accumulation on the MIG topic, the software found I had 55 items for Bartlett, 8 for Emmick and 17 for Zartman. If you want to find more about them, put their name into an internet search engine.

Economics of MIG

Dairy farm families can make as much profit using MIG as they can with any other managerial approach. Following is evidence with the most recent discussed first.

As MIG was rediscovered in the U.S., the preceding statement may have been believed by the few farmers who were doing it, but the rest of the dairy industry was septically looking for proof. The best economic proof to date is becoming available from the Great Lakes Grazing Network Dairy project funded by a $253,000 USDA Integrated Food and Agricultural Systems grant. It was written by William Bivens of Michigan and Tom Kriegl of Wisconsin. The project includes extension and research workers from 10 states and Ontario Province. Major goals are to "have standardized data handling procedures and combined actual farm financial data and a more limited amount of production data to provide financial benchmarks to help farm families and their communities become successful and sustainable." p.

101 [40] The final report for the year 2000 is being developed. It will include the averages of 92 farms across the region and show the average net farm income from operations (NFIFO) was $33,098 for dairy farms using MIG. NFIFO represents the returns to unpaid labor, management, and equity capital invested in the business, but excludes income from unusual capital item sales. The farms averaged 90 cows per herd and sold 16,836 lbs. of milk per cow.

During 2000 in New York 65 grazing farms made an average net farm income with appreciation of $43,413. p. 17 [41] They averaged 93 cows and sold 17,107 lbs. of milk per cow. During 2000, a report of 33 grazing farms from Indiana, Michigan, Ohio and Wisconsin showed an average net farm income of $55,228 per farm. [42] This was calculated by the Finpack system using market value asset values, not cost basis asset values. They averaged 84 cows and sold 15,309 lbs. of milk per cow. Michigan, New York and Wisconsin all have similar reports on grazing farms for each of their states for 1999 and 1998. My first one summarized 1995 financial performance. [43] Kriegl has closely monitored the financial success of a panel of 23 dairy farms using MIG from 1995 through 1999. [44]

Most of the farms in the above mentioned studies by Conneman and Nott are the same farms submitted to the Great Lakes Project report. Given the inherent variability in whole farm financial data, the regional project is probably better due to its larger sample size. All of the above reports would be called panel studies taken from accounting summary projects, as opposed to random sample surveys. All of the reports in the above two paragraphs support my opening sentence of this section that farm families can make profit using MIG. This is true for the average. As is true of any sample of farms, the average hides the fact that some individuals may have lost money while others made a large profit during the year. The Great Lakes Project is also better because the data are defined and the reports calculated in the same way. Although all the above mentioned states basically follow the recommendations of the Farm Financial Standards Task Force when doing their reports, there are state by state reporting differences which the Great Lakes Project has reduced. This further enhances the efficacy of the regional report.

Before the accounting panels of graziers got large enough to report, surveys were used to monitor MIG. A 1989 survey of 15 New York farms showed the average annual cost savings for grazing farms was $153 per cow. [33] A 1989 survey of 79 Pennsylvania farms showed the average pastured herd had $78 per cow less annual operating expenses than did the average confined herd. [45] This latter study was typical of the prevailing mind set that dairies using MIG had to be compared to confinement farms if the study was to have value. A Wisconsin study followed confinement and pasture-based dairies over the 3 years of 1990-1992. The same 9 confinement farms were followed over 3 years; the 20 pasture observations had 7 farms for 2 years and 2 farms for the 3 years. The conclusion was that pasture-based farms have comparable net returns when compared to confinement-based systems. [46] A master's thesis study included financial surveys of 35 MIG and 18 conventionally managed dairies in 1994. "In univariate analysis, no difference was found in profitability or efficiency between Michigan MIG and conventionally managed dairy farms. However, multivariate regression results indicated that MIG farms tended to have higher economic profit and higher asset efficiency, and were significantly more operating and labor efficient." p. 92 [79] Dartt also got into non-economic benefits from grazing. I tried a comparison of 11 Michigan grazing farms compared to a comparably sized group of conventional dairies. [47] The graziers' annual net farm income averaged about $12,000 less.

Budgeting and simulation were used to analyze MIG. Perhaps the most elegant was the work of Alan Rotz with his DAYFOSIM model. His Pennsylvania based paper indicated MIG would reduce feed costs from $0.86 to $1.00 per cwt. of milk produced. [48] His Michigan analysis indicated MIG would increase the annual net return by $146 per cow or $58 per acre compared to confined feeding. [49]

Case studies were also used to publicize the benefits of MIG. Some were published in journals. [50] Most were in the popular press. [51] It led one researcher to say "Individuals interested in pasture should be wary of farmer testimonials. The economic evaluation in these statements is usually done incorrectly ... " p. 4 [52]

As MIG reemerged in the Great Lakes Region, its proponents had a tough time finding sound economic proof that it was viable. The progression from case studies, to budgeting studies, to simulation, to cohort analysis, to group averages from surveys and accounting panels seems reasonable.

Today, I believe MIG is a profitable way to manage a dairy farm. It is not the only way. But, I don't feel the need to compare the results of MIG versus conventional ways. They are different, and in the hands of a good manager either system will work. I do understand that because MIG farms are fewer in number, lenders may view them with trepidation. Financial inventories of MIG farms will likely look different, with fewer dollars of assets tied up in machinery, and in feed inventories. Milk sold per cow may be lower on MIG farms. Graziers hoping to borrow money usually have to sell their ability to generate cash flow while controlling costs, instead of showing they have lots of assets. Fortunately, that is not hard to do!

Private Sector Response

Voisin's book [53] is an historical reference that was among the first to spell out the principles of MIG. Voisin's work was applied by Murphy to conditions in Vermont using dairy heifers. Murphy, an agronomist with international experience, then published his own book [54] in 1987. It is an easy to read manual on MIG technology. Another book often cited was published in 1986 and drew on international experience with MIG. [55] It covered the whole range of MIG technology from goal setting to managing forages, although it was oriented more towards beef than dairy production.

A monthly newspaper, "The Stockman Grass Farmer," published in Ridgeland, MS, by editor H. Alan Nation, has served MIG practitioners for several years. [56] The current subscription price is $28.00 per year. It includes advertising for all facets of the technology used by MIG. The bookshelf section sells books, video tapes and audio tapes on a variety of topics about MIG. Mr. Nation's long editorials are a series of exhortations extolling the benefits of MIG, among other topics. Over the course of a year, the publication mentions just about every animal that can be grazed, but beef has been the primary focus. The first issue aimed primarily towards dairy was in 1991; [57] since then a few issues per year have emphasized dairy.

The mainline national dairy magazines had occasional articles about MIG. "Hoard's Dairyman" ran several columns about Dave Forgey's [58] experiences as he converted from conventional to MIG on his Indiana dairy farm. "Successful Farming" had articles both for [59] and against [60] MIG. "Dairy Herd Management" reported MIG success stories. [61] Regional publications in the Great Lakes region also covered MIG. [62]

There are probably many more private sector efforts and publications I should have mentioned. The ones mentioned in this section are only the ones I've read. I've only cited a few of the articles from my database to illustrate the possibilities. The fact that books have been written on MIG, and that magazines have devoted articles to MIG, are strong indicators that MIG is a successful and economically viable alternative.

Public Sector Response

The MIG efforts by three individuals in the public sector have previously been described. Cooperative extension services in the Great Lakes States have contributed to the adoption of MIG in several ways, and so have other governmental agencies at various levels.

By 1989, Michigan State University Extension (MSUE) had a core of staff doing applied research and educating on why and how to do MIG. Glenn Kole, a District Extension Farm Management Agent in the North Region of the lower peninsular, wrote a staff paper [63] It was the base for a videotape with the same title which was distributed by the AEE Resource Center. Jerry Lindquist, extension agent in Osceola County, sponsored a dairy meeting on March 16, 1989, which included a panel of 3 Michigan graziers with Kole as moderator. On April 20, 1989, Bartlett sponsored a fencing demonstration at Clare County Community College. He did another fencing session at pasture day on the East Lansing campus on August 26. They were two of many he sponsored throughout the region. An ad hoc grazing committee of people within extension came together including Waldemar Moline, Ben Bartlett, Sherrill Nott, Rod Cortwright, Glenn Kole and John Middleton. Materials and programming were coordinated. After meetings on June 5 and July 7, 1989, their efforts resulted in another videotape titled "Principles of Controlled Grazing." [64] On July 6, 1989, a van load of 10 Michigan field agents visited the Mahoning Farm field day in Ohio to learn more about MIG. Cortwright had done a case study and plot demonstration on a grazing farm during 1988 which was published in 1989. [65] A case study was developed for agent training during fall conference. [66] Kole laid the groundwork for a MECP (LLE) $10,000 grant which resulted in a 1990 study of 4 Michigan farms using MIG. [67] The final 1992 project summary was made available nationally. [68]

Michigan researchers looked into the best crops to support MIG. In 1985, Richard Leep was writing on plants useful to graziers. [69] Moline published an extension bulletin on pasture species in 1991. [70] Leep helped find crops to extend the grazing season. [71]

In the early 1990's, the Animal Science Department of Michigan State University was publishing a regular extension oriented paper titled *Animal Science Newsletter*. Several of the editions from 1992 through 1995 carried a column called "The Salad Bar" which discussed MIG topics. [72]

Multiple day annual conferences aimed at farmers using MIG were initiated in the spring of 1993 by Bartlett and others. The first three were Michigan sponsored. Except for some Kellogg funds and support the first year for the publicity and basic start up costs, the conferences have been self supporting. Fees were paid by attendees and by the trade show sponsors. Written proceedings were available. Starting in 1996, the conferences were jointly led by the extension services in Indiana, Michigan and Ohio. The most recent was called the 'Great Lakes International Grazing Conference 2002' and benefitted from the leadership of Bill Bivens of Michigan, and Tom Noyes of Ohio, among others.

Information on MIG was made available on the internet. The following addresses were valid as of May 31, 2003. Jackson County, Michigan maintained a web page button on 'dairy and grazing' information with links to several items about pasture. It was at: www.msue.msu.edu/jackson/ List servers for those seeking to communicate with others using MIG can be found at Graze_L with an e-mail address of majordomo@traranacki.ac.nz for information. A similar discussion group was at http://groups.yahoo.com/group/grazersedge American Farmland Trust sponsors http://grassfarmer.com which is a site on grass based farming systems. Another pasture management website is at http://www.umaine.edu/grazingguide/ It is a cooperative effort among USDA-ARS, USDA-NRCS, and Extension through several land grant universities that extend well beyond the northeast US. An entry of "graze" on any of the internet search engines should yield several other addresses of potential interest.

In this section I have given only a sampling of the extension efforts that were invested in Michigan to learn and promote the use of MIG. There were lots of other people involved, both in Michigan and in the other Great Lakes States, who played important roles. I plead lack of space for not including them here, and beg their forgiveness.

By 1989, it appears a critical mass of applied research and extension teaching was underway on the topic of MIG. It continues today. Those farmers who seek alternatives to conventional dairying can find lots of information to help them get started with MIG.

Agricultural Experiment Station Response

Formal research by Agricultural Experiment Stations within the United States' Land Grant university system, as well as governments in other countries, have supported MIG in recent years. In reaching this conclusion I looked at articles only in the American Dairy Science Association's (ADSA) Journal of Dairy Science. In May, 2002, I used the ADSA's on-line key word search engine to find the phrases "pastur" and "graz". The searches found titles (hits) from January, 1995 through April, 2002. It is likely that sources prior to 1995 were not available on-line.

Fifty two different titles were found. I classified 35 of them as being related to nutrition and milk output, 7 as genetics and reproduction, 3 as BST and 7 as profit measures or other topics. In the United States, 7 were developed in Pennsylvania, 6 in Wisconsin, 4 in Virginia, 3 in North Carolina, 2 each in Louisiana and New York, plus one each in Arkansas, Indiana, Missouri and Minnesota. Nearly half the 52 were from outside the United States. Ten were developed in New Zealand, 4 in Argentina, 3 in Australia, 2 in England, plus one each in Canada, Chile, Ireland, Italy, and Sweden.

My own database had additional grazing oriented articles from 1990 through 1994 published in the ADSA's *Journal of Dairy Science*. Locations of authors included Louisiana, Pennsylvania, Virginia, and Wisconsin.

Scientists have done more than the above mentioned work that is of use to graziers. In the search mentioned above, only two phrases were used. Probably there are other titles with implications for grazing dairy cows which did not have those two key words. Also, this was the only journal I searched. Other publications such as the Journal of Animal Science would have grazing titles of interest. Journals reporting on plant species and their management have titles useful to graziers. There are probably veterinary based titles on management of pasture based parasites.

In my review 15 years ago, [1] I noted that considerable research on pasturing had been done in several states of the U.S. However, most of it came to a halt in the early 1940's. After 1950 research tended more towards stored feed and confined animals. It was nice to see research interest in MIG start to get increasingly published by peer reviewed journals after 1990.

Although I believe graziers are currently receiving their share of research attention, it has taken awhile to build momentum. Field workers in the late 1980's and early 1990's were often frustrated by lack of help in making ration recommendations to dairy graziers. There was, and is, a measurement problem. It is somewhere between difficult and impossible to measure the quantity of dry matter (and its nutrient density) that a grazing cow is consuming! Without this measure, nutritionists were frustrated in what to recommend for the rest of the diet. Without this measure, economists couldn't say what the land was yielding in terms of crops, leaving little ability to argue with nay sayers who ridiculed the comparative profitability of MIG systems. American researchers still have a ways to go to solve this measurement problem.

Conjugated Linoleic Acid

The term conjugated linoleic acid (CLA) covers a group of compounds with a mix of isomers of linoleic acid. The CLA isomer found in dairy products and meat is the isomer that reduces the risk of mammary cancer in rats. "Of the large number of compounds found in foods with putative anti-cancer activity CLA is unique because it 1) is derived from an animal product and 2) is effective at concentrations close to human consumption levels." p. 137 [73] It may also decrease atherosclerosis, improve glucose tolerance, and enhance immune status. Graziers are currently trying to use this information to increase their sales of milk and meat.

"Cows have the ability to extract anticarcinogenic components from pasture and feed and transfer them to milk. Use of genetic engineering and other techniques to increase the range and level of anticarcinogens in pasture and supplements may increase the anticancer potential of milk." p. 1339 [74] That is from a JDS review article. Another article the same year said "Cows grazing permanent natural pasture had 500% more CLA compared with cows fed total mixed rations containing conserved forage and grain in a 50:50 ratio. Feeding pasture grass in dry form as hay did not influence milk CLA content.

Feeding fish meal increased CLA content of milk by a small margin." p. 2155 [75] A more recent article "suggested that fish oil increased the production of CLA and transvaccenic acid from other dietary sources of linoleic acid such as extruded soybeans." p. 624 [76]

Beaulieu cited a study that showed the meat from steers fed all pasture had 1.5 times more CLA than did another group fed cracked corn plus pasture. p. 139 [73] Feeding fresh pasture will cause the CLA to increase in milk within 4 to 5 days regardless of prior diet. However, once fed grain, steers do not thereafter appear to be able to increase the CLA content of their meat. p. 5 [77]

Crop varieties being grazed will influence the amount of CLA in milk. Red clover has been found to be associated with exceptionally high CLA content in milk. p. 95 [78] Other research showed grazed white clover produced 15 % more CLA in meat than did alfalfa. p. 6 [77]

The benefits of CLA as a cancer fighter, among other things, has been documented by researchers using animals. Whether it will prove as beneficial in humans has yet to be conclusively proven. If it does prove to helpful, then providing products containing human useable forms of CLA should be of high economic value in the market. Graziers appear to be in a position to cash in on these potentially higher prices for milk and meat. However, scientists are scrambling to discover how to provide CLA effectively in a pill form. The above mentioned research on feeding fish meal and other products are attempts to get high CLA levels in milk produced in confinement, not just in MIG.

My guess is that graziers who market their products directly to consumers may stand to gain from enhanced CLA levels in the products they sell. It will take consumer education. When CLA is finally proven beneficial to humans, the economic stakes will be so high that the whole dairy industry and the total meat industry will find ways to profit. Any profit edge to graziers will likely be short lived.

Disclaimer

This paper is aimed towards dairy graziers. Any species of animals that eat forage can be grazed. Some of the references cited above also deal with horses, sheep, goats, beef, poultry and deer. Certainly there are niche markets using goats for brush clearing, and sheep for keeping power line rights of ways cleared, in addition to their historical production of fiber, meat, milk and cheese. My career assignment has been dairy, hence my attention to the bovine side of grazing.

Future Directions for MIG Research

We need better measurements in the United States of how much forage crop is being produced and eaten by grazing cows reported on a per acre basis. These will be of major interest to both researchers and farmers. It would allow more accurate assessment of how MIG competes with other production systems, and enhance feeding recommendations at the farm level.

In northern U.S. areas like the Great Lakes States, grazing is usually limited to plants' growing season. There is increasing interest in 'stockpiling,' a term describing the practicing of letting paddocks

grow without harvesting the latter part of the growing season. In the winter or following spring, animals work down through the snow and graze the standing, frost dried material. Apparently, this is better quality feed than most people currently realize. Stockpiling needs better research, both from the nutritional and economic points of view.

The use of MIG should be monitored by state and federal statistical services. We need to know the numbers of farms involved and the level of output. Annual economic results of graziers need to be pooled, published, and monitored. These will allow policy makers to make better decisions about how to allocate support among research and outreach educational activities.

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