# THE SOCIAL IMPLICATIONS OF MANAGEMENT INTENSIVE ROTATIONAL GRAZING

## AN ANNOTATED BIBLIOGRAPHY

**January 2005**

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King George III of England:
*To what is your climate best adapted?*

Thomas Hutchinson, Governor of Massachusetts:
*To grazing, sir; . . . nothing is more profitable in America than pasture, for labor is very dear.*

# INTRODUCTION

The agricultural movement widely known as management intensive rotational grazing (MIRG) has undergone a unique change in status in the span of a single generation: from a novelty practice introduced into the USA largely by farmers and for the most part ignored by the agricultural establishment, to a movement which now boasts consistent growth in numbers and is increasingly lauded by agricultural scientists and officials. At a time when rising costs of production and stagnant milk prices are expected to slash the number of US dairy farms by a staggering 85% by the year 2020 (LaDue, Gloy, and Cuykendall, 2003), MIRG represents an increasingly attractive option for dairy farmers looking to cut costs and boost profits. To cite one quantitative example, the number of dairy farms practicing grazing in Wisconsin has tripled in less than a decade, rising from 7.3% in 1993 to nearly 22% in 1999 (study #75)[1].

Concomitantly, the academic literature on rotational grazing has gone from a small trickle through the 1980s and early 1990s to a small explosion in the late 1990s and the current decade. As evidence mounts that MIRG is not only an economic, but also an ecological alternative to the trend towards 500+ cow dairies, industrial beef feedlots, and chicken factories, researchers in many branches of the agricultural sciences are increasingly taking notice. This growing acceptance of MIRG as a viable and profitable strategy for livestock farmers, particularly dairy farmers, is evidenced by the spate of recent studies appearing in the dairy industry's flagship scientific journal, the *Journal of Dairy Science*.

Amid the flourishing literature, however, there are two noticeable holes, both of which the following bibliography addresses. First, there are only a small number of works that step back and summarize the literature to date on the subject. What's more, all but one of these gives a review of only one particular section of the literature on grazing, for example the link between grazing and human nutrition (122) or between grazing and water quality (115). One study (109) is a general literature review by a long-time grazing researcher, but it is more of a personal commentary than a formal bibliography.

Second, there is a particular paucity of studies that assess the *social* impacts of rotational grazing. The spate of studies mentioned above have mostly been confined to the economic and agronomic sides of grazing, while the sociological side has scarcely been touched. This is a gap of some concern to social researchers, for MIRG is not only an agricultural practice, but a social movement with cultural and even political connotations (97 & 98). Furthermore, if MIRG does indeed represent a lifeline for struggling livestock farmers, as its proponents contend, then it could ripple out to affect socio-economic status and general quality of life at both the farm and community levels.

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[1] *Unless otherwise indicated, all numbers given in parentheses refer to a numbered study in the annotated bibliography.*

Owing to these two major gaps in the grazing literature, we decided to undertake the preliminary task of creating a comprehensive annotated bibliography that covers the social implications of management intensive rotational grazing. Before we introduce the studies themselves, however, a few words are in order about how we drew the boundaries to determine which studies qualified and which did not.

*Methodology and definitions*

We initially broke all studies or commentaries on grazing into seven basic categories: Economic; Sociological; General Reports; Agronomic; Environmental; Human Health; and "How-To." Our primary goal, remember, is to examine rotational grazing through the lens of the social sciences. Of course, a holistic point of view recognizes that *all* elements are tied up with the social at some level, but for the sake of cohesiveness and manageable length we had to draw boundaries around what was most sociologically relevant. In the end, we reached the following compromise: The first three categories – Economic, Sociological, and General Reports – were deemed the most relevant, and for these we strove for a fully comprehensive review of the literature. This amounts to the first 110 entries in the annotated bibliography. The latter four categories – Agronomic, Environmental, Human Health, and "How-To" – were deemed of secondary relevance to social issues. However, we felt it would be appropriate to provide a limited outline of them, should the reader's interest be piqued enough to want to explore the literature on, say, the agronomy of grazing. The curious reader will find for each of these latter four categories a few keystone articles that open the door to further scholarship on that particular topic.

The authors wish to thank the group of graziers and extension staff that met in November 2004 to review the document, give feedback, and provide additional sources of information on grazing. Their input has been incorporated in the bibliography.

The annotated bibliography is divided into four sections, each of which is further divided into subsections. The next few pages will provide introductory paragraphs to each subsection, in the same order in which they appear in the bibliography:

1. Economic Studies
   - 1a. Financial data from MIRG farms
   - 1b. Economic comparisons between rotational and continuous grazing
   - 1c. Economic comparisons between grazing and non-grazing
   - 1d. Economic comparisons using computer models
   - 1e. Comments on methodology
2. Sociological Studies
   - 2a. General surveys of graziers
   - 2b. Surveys of graziers highlighting economic data
   - 2c. Testimonials by individual graziers
   - 2d. Other socially-oriented studies
3. General Reports on Grazing
   - 3a. Overviews
   - 3b. Pro-grazing musings

4. Secondary Issues
   4a. Agronomy
   4b. Environment
   4c. Nutrition and human health
   4d. "How-to" publications

## 1. Economic Studies

*1a. Financial data from MIRG farms* (#1-9)

No subcategory better represents the recent surge of academic interest in the topic of rotational grazing than this one: consider the fact that all nine studies in this section were published in the last five years. Though sometimes bearing an implicit comparison to non-grazing farms, these studies focus the brunt of their energies on simply laying out the financial characteristics of grazing farms – in all but one case, dairies. The basic aim seems to be to demonstrate through great attention to detail the financial viability of pasture-based dairying. To that end, financial data are presented on the various costs and incomes on grazing farms, and net profitability is assessed. In several cases, intra-group comparisons are made between farms with larger herds and farms with smaller herds; between seasonal operations and non-seasonal ones; and between the most profitable farms and the least profitable ones. Overall, grazing farms are found to be profitable, with net farm incomes ranging from $32,000 to $67,000 depending on the year and the state.

*1b. Economic comparisons between rotational and continuous grazing* (#10-15)

These studies are similar to those in both 1a and 1c, but they differ in one crucial respect. Like the studies in 1a, they look at graziers only and do not address confinement farms; like the studies in 1c, they provide economic comparisons between different farming systems. Their chief difference is that they examine the differences between two intensities of grazing – MIRG on the one hand and the more traditional practice of giving animals free access to an entire pasture with little to no rotations on the other. This latter type goes under many names in the literature, including traditional grazing, extensive grazing, and continuous grazing.

The general trend in these six studies is that rotational grazing is found to be more profitable than continuous grazing due to increased efficiencies and returns to management. For example, study #11 shows a $100 advantage per acre for a rotational grazing cow/calf operation, while #14 shows a per-cow profit advantage of 9% for a rotational grazing dairy. It should be noted, however, that among these studies is also the one that most explicitly counters the claims made by grazing advocates, arguing instead for the superiority of traditional grazing for dairies (10).

*1c. Economic comparisons between grazing and non-grazing* (#16-53)

Here we have far and away the largest subsection of studies, those that offer economic comparisons between grazing dairies and confinement dairies (two are actually for non-dairy operations – one pork [31] and one beef [39]). The studies range geographically from the Northeast to Pennsylvania and Virginia and across the midwest to Wisconsin and Minnesota.

There is not a great deal of consistency among the studies in terms of methodology. Some compare a set of grazing farms to a comparable set of confinement farms, while others

compare grazing farms to all farms taken together. Some break out operating costs into multiple subcategories while others provide only raw net incomes. Some look at one year of data while others examine farms longitudinally. Some use simple arithmetic to calculate net farm income while others offer a regression analysis. Some are based on scientific trials with experimental groups of cows while others are based on financial data from working farms.

Nevertheless, the studies' conclusions are almost universally consistent: Grazing farms on average produce less milk per cow and therefore have lower gross incomes, but they feature significant cost savings which outweigh the reduced incomes and give a higher net profit than confinement operations. A few illustrative examples: New York grazing dairies had total cost advantages over confinement dairies that ranged from $0.20 to $0.82 per hundredweight over the years 1997-2000 (18-21). Costs of production per cow, in those studies in which it was reported, ranged from $0.54 per day (22) to $0.95 per day (49). Net profit advantages per cow, in those studies for which it was calculated, ranged from $50 (46) all the way up to $321 (35). There were also three studies that did not fit the general pattern and found slight profitability advantages for TMR or confinement operations (21, 48, 51).

A final note for the Wisconsin reader: The five studies authored or co-authored by Thomas Kriegl (33-37) feature extensive data on Wisconsin graziers. In particular, his 2004 publication with Gary Frank (37) is one of the most recent and longitudinal studies of its kind and provides some of the best proof yet of the financial advantage enjoyed by grazing dairies.

*1d. Economic comparisons using computer models* (#54-64)

These eleven studies could be considered as a subset of the studies in 1c. All of them contrast one or more grazing systems to confinement systems in terms of their economic returns. The difference is that all the studies in 1c were based on actual data generated by a real herd of cows, whereas the studies in this section are based on computer simulations. Again there is a large amount of variability in terms of the operational parameters being tested, the size of herds, and the length of the comparisons, and again the same trend is revealed: Grazing farms are consistently shown to be as or more profitable than comparable confinement farms. Two studies that computed net profits, for example, found an advantage for graziers of $3867 and $8000 per farm (54 & 56).

*1e. Comments on methodology* (#65-66)

The sheer number and variety of economic studies included in the four previous subsections hints at a lack of consistency among the methodologies used to analyze grazing farms. This is a situation that concerns both authors in this final subsection. Both pieces address the methodological shortcomings of the economic literature on grazing and offer words of advice about making up for these shortcomings and thus rendering the data on MIRG more convincing. It should be noted, though, that the first study is from 1998 and the second is from 1992. Many of the economic studies that have been undertaken since that time have been more in-depth and have featured a more rigorous and consistent methodological approach.

## 2. Sociological Studies

*2a. General surveys of graziers* (#67-70)

Since rotational grazing began to achieve a critical mass in the mid-1990s, a number of general surveys of grazing farmers have been conducted in order to determine the general makeup of the grazier population. The more widely-cited of these studies are the ones that specifically focus on economic characteristics of grazing farms; these are classified under the following section, 2b. The four articles in the present section are those that report the results of a survey with little to no mention of economic data. Instead, they focus on elements such as the factors that motivate dairy farmers to switch over to grazing (67, 70); operational characteristics including herd size, frequency of rotations, and milk yields (68); satisfaction with milk production (69); and the role of Extension outreach in assisting graziers (69).

*2b. Surveys of graziers highlighting economic data* (#71-77)

These are the more substantive surveys mentioned above. At times they resemble the purely economic studies in sections 1a and 1b, though they are also bolstered with enough social and demographic data to be placed in a category separate from economics. Many of these reports deal with the characteristics of farmers themselves – age, level of education, years farming, etc. – and the characteristics of the farm operation – size, number of cows, frequency of rotations, size of paddocks, on-farm labor requirements, etc. In this they are similar to the studies in 2a. What sets them apart is additional information about the economics of the grazing operations: farm profitability, business management, operational costs, milk sales, etc.

Two in particular are among the studies most often cited by other studies in this bibliography, no doubt because of their comprehensiveness. Both were written in 1996, one surveying graziers in Wisconsin (72) and the other in Minnesota (74). In addition, #75 is a 2000 update of the Wisconsin survey data from #72.

*2c. Testimonials by individual graziers* (#78-92)

At 15 publications, this is the second largest subsection in the bibliography (behind only 1c). Many of these works overlap in subject matter with works from other subsections, particularly those on economics. What sets them apart is that their data does not come from an aggregrate number of farms, but from one farm only. In many cases, they are literally a kind of testimonial from one farmer who made the switch from conventional animal rearing to rotational grazing and is eager to report the benefits, both social and economic.

These studies can be broken into two basic types: those that report specifically on the economic advantages of switching to grazing and those that report on some other advantage. The economic testimonials (79, 80, 82, 84, 85, 89, 90) very much resemble those from section 1c. A farmer who used to raise animals conventionally made the switch to rotational grazing, and the economic benefits are displayed for the reader. Examples include reduced costs of $100-600 per animal and increased net profits ranging from $3418 to $18,000. It should be noted that five of these entries are chapters from a single 1995 publication by the Wisconsin Department of Agriculture, Trade, and Consumer Protection.

The non-economic testimonials are more eclectic in their subject matter. Some outline specific on-farm practices (83, 86, 87), some cover benefits gained in on-farm energy use (81, 91), and others address more general issues including quality of life (88, 92).

*2d. Other socially-oriented studies* (#93-104)

If the non-economic testimonials just discussed appear eclectic, this final subcategory is even more so. A number of works, from whole books to book chapters to research briefs, address one social concern or another as related to grazing. In brief, these concerns include: the effects of grazing on rural communities (93); the interplay between gender and labor on dairy farms (94, 103, 104); the institutional relationships between graziers, the academy, and the state (95, 99, 102); and the status of and problems faced by grazing networks in Wisconsin (96-98, 100).

## 3. General Reports on Grazing

*3a. Overviews* (#105-107)

Although generally of a "social" nature, these three reports seemed too generalized to be included in the prior section, 2d. The first (105) gives a historical account of grazing in the Northeastern states and suggests paths for future research. The second and third are general reports put out by sustainable agriculture organizations on raising hogs (106) and poultry (107) on pasture. They include basic production advice, marketing strategies, and the environmental benefits of grassfed livestock rearing. Normally they would have been classified as "How-To" manuals (section 4d), but they also contain information of a more social nature, including grazing's positive benefits for profitability, family, community, and quality of life.

*3b. Pro-grazing musings* (#108-110)

These three pieces were separated from the prior three pieces because, although all six are explicit in their support for rotational grazing, these three are not generalized reports containing data, but rather the musings of one specific individual. #108 is a basic primer on the perceived unsustainability of industrial agriculture and the possibilities for grazing to revive sustainability and regenerate rural communities. #109 is written by a veteran grazing researcher from Michigan who gives his assessment of the progress made in grazing practices and research to date and its potential for the future. #110 is a speech given by an officer with the American Farmland Trust suggesting a specific role for grazing in the farmland preservation movement.

## 4. Secondary Issues

Note: See page 2 for an explanation of why these categories are considered "secondary."

*4a. Agronomy* (#111-114)

Articles on the agronomic element of rotational grazing are plentiful, perhaps even outpacing those on the economics of grazing. They share another similarity to economic articles, too: There was a steady trickle of them through the 1980s and early 1990s, followed by a recent upsurge as more farmers adopted MIRG methods and more agronomists took note. Clearly this is an area of high relevance for anyone wishing to assess the desirability of rotational grazing, but one must bear in mind that social issues are never explicitly addressed in these articles.

The most prominent and widely cited agronomic studies on rotational grazing are those that have made it into the mainstream academic journals in recent years. In particular, the

*Journal of Dairy Science* has featured a number of such articles in the last ten years. These articles parallel economic studies on the topic in that they often contrast the agronomic effects of intensive grazing with continuous grazing and/or confinement feeding. Topics of particular concern include ruminal digestion, milk production, and animal behavior on pasture. The curious reader wishing to learn more on the subject is advised to consult #113 as an excellent starting point, as it is a recent article with a strong bibliography. The proceedings from the annual American Forage and Grassland Council conference (#114), though more difficult to come by, also offer a condensed wealth of information.

*4b. Environment* (#115-121)

The relevance of articles on the environmental effects of grazing was difficult to judge in terms of their inclusion or exclusion from this bibliography. On the one hand, there is a clear connection between grazing's environmental impact and its social desirability. On the other hand, the majority of such articles do not deal with intensive rotational grazing specifically, but rather with grazing in general, and in particular with grazing in the arid West (many of these are found in the *Journal of Range Management*).

Another complicating factor is that an excellent annotated bibliography has already been produced in this area: Driscoll and Vondracek's 2002 *Water, Grass & Livestock: An Annotated Bibliography of Riparian Grazing Publications* (115). This bibliography of over 200 studies focuses specifically on the effects of MIRG on riparian areas and water quality.

For the sake of comprehensiveness, we have also included citations for six articles that specifically address intensive rotational grazing but are not already covered in Driscoll and Vondracek's work. Topics include: soil erosion in pastures after a heavy storm (116); impact of grazing on stream and streambank restoration (117); the prevalence of nesting birds and issues of trampling (118, 119); and nitrogen leaching into groundwater under grazed pastures (121).

*4c. Nutrition and human health* (#122-131)

One of the most trumpeted claims about grassfed livestock is the positive effects that the meat and dairy products from such animals have on human health. In particular, there is growing evidence that meat, milk, cheese, and butter from pastured animals contains higher levels of conjugated linoleic acid (CLA), a proven anti-carcinogen. Here, however, we ran into the same sort of dilemma as that encountered for agronomic and environmental studies. Certainly the nutritional effects and social effects of grazing overlap. However, this immediately leads one down a path of increasing ambiguity and tangentiality. Do we include articles on the CLA content of wild ruminants such as deer and elk? Must we reference the entire literature that demonstrates CLA's anti-carcinogenic properties to begin with? Do we go beyond CLA and examine the vitamin E and omega-3 fatty acid content of grassfed products too?

In the end, the situation looks much like that for the previous section on environmental articles. We list citations for a handful of recent articles that specifically address the link between CLA and grassfed animal products, including an excellent review piece from 2000 that summarizes years of prior research (122). There are also two subsets of studies within this category that address concerns beyond nutrition. First, there is a subset of studies that focus not on the nutritional qualities but on the sensory qualities of pastured products, including smell, texture, and taste (126-128). Second, we found two studies that address the threat to the human respiratory system from dust, gases, and other contaminants found in high concentrations on confinement farms (129 & 130).

Note again that our list is far from exhaustive. The interested reader is advised to visit the Eat Wild website (http://www.eatwild.com/references.html) in order to access a much longer list of scientific articles on the subject, many of which branch out into related concerns not covered here.

*4d. "How-to" publications* (#132-134)

The last category of studies is the least ambiguous. A large portion of the publications on grazing, understandably enough, consists of manuals, checklists, and other "how-to" guides meant for graziers themselves. Many bulletins issued by Extension agents in various states fall under this category, and they are supplemented by a growing list of books, magazines, newsletters, and even instructional videos produced outside the ivory tower. Of particular interest are the periodicals *Graze*, published in Wisconsin and aimed largely at the Upper Midwest (132), and *Stockman Grass Farmer*, aimed at a more national audience (133). A third citation is for a series of proceedings from the annual Great Lakes International Grazing Conference (134). Many of the web sites featured in the "Additional Internet Resources" section at the end of the bibliography are also good examples.

## Future directions for sociological research on grazing

It is safe to say that, although there are a number of articles that deal with some social aspect of grazing simply by virtue of their subject matter or methodology, truly sociological studies of grazing are quite rare at present. The following six suggestions represent gaps in the extant research that would prove particularly germane to sociological analysis. Several of these issues have been addressed lightly but deserve more in-depth treatment, while others were never encountered in the research for this bibliography. To aid in mental organization as well as to highlight the different set of methodological constraints that would have to be taken into account, we have separated the six topics into two categories: on-farm concerns and off-farm concerns. In order to get at the nature of these at times abstract issues, and with the aim towards reaching new knowledge, participatory research should be engaged to ensure relevance for graziers, communities, and policy makers.

**On-farm concerns**

1. *Factors influencing the decision to graze and barriers to switching*
   A number of studies do probe some of the reasons why farmers make the switch from a confinement operation to a grazing system, but they are usually one small part of a larger survey of graziers and do not address the underlying structural issues which compel some farmers down this path and prevent others from doing so. Advanced studies on the topic would give a deeper understanding of which farmers are making the switch, why they are doing so, and how satisfied they are afterwards. Is the decision to switch to MIRG the result of personality type, government policy, structural forces, community pressure? Additionally, what barriers stand in the way of more widespread conversion? Answering such questions would provide a more nuanced portrayal of the entire grazing movement and its future viability, as well as giving Extension agents and other outreach specialists an idea of the particular service needs that are still going unfulfilled for graziers.

2. *Labor requirements and the division of labor in rotational grazing*
   As with the above, a few studies – in particular the grazier surveys – have looked into labor allocation and decision-making on grazing farms, but treatment of the subject has been fairly cursory. In the surveys that have taken place to date, the general trend seems to be that dairy farmers who convert from a traditional system to a rotational grazing system find their on-farm labor requirements reduced, but there are others whose labor demands actually increase. Another avenue of research, then, could be a more systematic investigation of the labor requirements on rotational grazing farms. To begin with, there are the more quantitative questions: Does the amount of required labor increase or decrease with the switch to MIRG? Do labor requirements change as a farmer gains more experience as a grazier? There is also a series of more qualitative questions that arise: Is grazing more or less enjoyable to the farmer than confinement feeding? Do the tasks involve allow more or less participation from other members of the family? Do they allow for a more active role for women? For the farmer's children? For older, semi-retired farmers? In other words, we are interested in both the *quantity* and the *quality* of labor on rotational grazing farms.

3. *Linking rotational grazing to family success and quality of life*

   The questions just posed under issue #2 lead to another set of concerns, also broached but not systematically explored in the present literature: How does the switch to management intensive rotational grazing affect family dynamics on the farm? Part of this investigation would hinge on the economic factor. If raising livestock on pasture brings increased profits, as the majority of economics studies contend, does it also mitigate some of the stress that is a common element in modern farming? Beyond the economic, there are questions of the notoriously difficult to define "quality of life." If it is true, as many advocates claim, that MIRG reduces labor requirements, does this mean an increase in time spent together as a family, or does it simply lead to more off-farm work? If MIRG allows for more on-farm participation on the part of spouses and children, does this get translated as a boost in the quality of family interactions? As with issue #2, we wish to know not only whether rotational grazing gives *more* time together, but also *better* time together for farm families.

**Off-farm dynamics**

4. *The effects of rotational grazing on community dynamics*

   Goldschmidt's famous study of two farming communities in California in the 1940s could serve as the model for a modern-day version in the Midwest: the effects on the local community of a widespread transition to grazing vs. a transition to large-scale confinement dairying. These two paths obviously carry implications for the economic vibrancy, social cohesion, and general quality of life of the surrounding communities. A simultaneous study of two communities would go great lengths towards confirming or denying the various claims made about both rotational grazing and large-scale confinement dairying. Such an avenue of research would encounter a number of significant logistical hurdles, not the least of which would be finding two communities that were truly transitioning to the two livestock systems. One possible way around this problem would be to study communities that are not bounded geographically, but rather organizationally (*e.g.*., a grazier's network).

5. *Mapping rotational grazing's socio-economic networks*

   Almost without exception, social and economic studies of grazing focus on the farm level – on the costs of production, income levels, and quality-of-life issues associated with grazing *for a given farm*. Left unexamined so far are grazing's effects at a wider scale – the local community, the region, even the entire state. What would be the effects on seed dealers, equipment manufacturers, and other links in the agribusiness chain if increasing numbers of farmers transitioned to grazing? How would such a transition affect the idea of a "social contract" existing between rural farm families and the urban consumers who rely on them for food? The study could lay out a number of different scenarios, with parameters such as farm size, intensity of grazing, the growing of hay or other crops, the use of local dairy processing facilities, the use of nutritional supplements, etc. Each scenario could then be mapped out in terms of its socio-economic impacts on other suppliers and receivers of agricultural resources and on the non-farming public, and a net impact on a community could be determined. Like the previous suggestion, such a study

would go a long way towards substantiating or calling into question the socio-economic benefits of grazing which have until now been demonstrated only at the individual farm level.

6. *Key factors in marketing pasture-based products*

While the vast majority of scholarship on rotational grazing has focused on either the agronomic, economic, or social sides, as outlined in the following bibliography, only a tiny handful of studies have focused on efforts to market pasture-based food products. Although the positive health attributes of such foods are increasingly being documented, such information has yet to filter into the larger public consciousness. According to one of the few studies on the topic, pasture-based producers would do better at present to market their products based on flavor or organic status than they would to highlight their pastured origins (CIAS, 2003). This clearly points to the need for more market-oriented studies that investigate consumer knowledge and consumer preferences. How does an emerging food penetrate a market beyond its initial niche? How are health claims best communicated to a public already awash in competing labels? Many links in the marketing chain could be examined, from advertising efforts to distribution networks to retail outlets. In addition, the highly relevant issue of "place" could be brought in as a possible way to enhance the appeal of pasture-based foods to local consumers.

## References


CIAS. 2003. "Flavor, Not Health Claims, Key in Marketing Pasture-Based Cheese." University of Wisconsin-Madison, Center for Integrated Agricultural Systems. Research brief #66. Madison, WI. http://www.cias.wisc.edu/archives/2003/10/01/flavor_not_health_claims_key_in_marketing_pasturebased_cheese/index.php

LaDue, Eddy, Brent Gloy and Charles Cuykendall. 2003. *Future Structure of the Dairy Industry: Historical Trends, Projections and Issues.* Ithaca, NY: Cornell University Department of Applied Economics and Management.

# THE ANNOTATED BIBLIOGRAPHY

Abbreviations used:
AFT: American Farmland Trust
cwt: Hundredweight (a measure of milk produced)
MIRG: Management intensive rotational grazing
TMR: Total Mixed Rations

# 1. Economic Studies

## A: Financial data from MIRG farms

**1**

Gahler, Allen. 2004. "Winter Grazing Equals Profit for Beef Producers." *Amazing Graze News.* Ohio Forage Network, Ohio State University Extension. http://forages.osu.edu/News/Archive/2004/amazegrazemarch04.html.

Several trials are being conducted to determine the profitability of winter grazing of turnips and oats for beef cattle. In one trial, from early November to the end of March there were only 20 days of unsuitable grazing, and costs came to only $0.20/cow/day excluding labor, compared to the normal Ohio range of $1 - over $2.

**2**

Kriegl, Thomas. 2002. "Dairy Grazing Farms Financial Summary. Regional/Multi-State Interpretation of Small Farm Data: First Year Report 2000." University of Wisconsin Center for Dairy Profitability. Madison, WI. http://cdp.wisc.edu/pdf/glgnreport_yr1.pdf.

Detailed financial data are analyzed from 92 grazing dairy farms in several Great Lakes states. Many factors are compared between farms, including milk production, basic costs, allocated costs, and net farmer incomes. Averages are compared between: the most profitable half vs. the least profitable half of farms; those with <100 cows vs. those with >100 cows; and seasonal operations vs. non-seasonal.

**3**

Kriegl, Thomas. 2003. "Dairy Grazing Farms Financial Summary. Regional/Multi-State Interpretation of Small Farm Data: Second Year Report 2001." University of Wisconsin Center for Dairy Profitability. Madison, WI. http://cdp.wisc.edu/pdf/glgnreport_yr2.pdf.

Identitical in form to study #2, but with an additional year's data added. Financial data from 126 grazing dairy farms in several states are analyzed. Detailed financial performance indicators are again compared between: the most profitable half vs. the least profitable half of farms; those with <100 cows vs. those with >100 cows; and seasonal operations vs. non-seasonal. Also added this time are comparisons of grazing farms to confinement farms in

two states, WI and NY. In spite of lower production per cow, graziers in both states were more profitable than their confinement counterparts.

**4**

Kriegl, Thomas. 2004. "Dairy Grazing Farms Financial Summary. Regional/Multi-State Interpretation of Small Farm Data: Third Year Report." University of Wisconsin Center for Dairy Profitability. Madison, WI. http://cdp.wisc.edu/pdf/glgnreport_yr3.pdf.

Identitical in form to study #3, but with an additional year's data added. Financial data from 103 grazing dairy farms in several states are analyzed. Detailed financial performance indicators are again compared between: the most profitable half vs. the least profitable half of grazing farms; those with <100 cows vs. those with >100 cows; seasonal operations vs. non-seasonal; and grazing farms vs. confinement farms in two states only, WI and NY. Graziers on average had higher net income per cow and per cwt. than their confinement counterparts in all three years in both states.

**5**

Nott, Sherrill B. 1999. "Dairy Grazing Farms in Michigan, 1998." Michigan State University, Department of Agricultural Economics. East Lansing, MI. http://agecon.lib.umn.edu/msu/sp99-20.pdf.

This is a pure accounting report, giving column after column of financial data on all aspects of farm operations for 15 grazing farms in Michigan in 1998. Included are data on crops grown, farm income, farm expenses, asset liquidity, etc. In the 2nd half of the report, farms are sorted into <80 cows and >80 cows. Net farm income on all 15 grazing farms in 1998 averaged $66,925.

**6**

Nott, Sherrill B. 2000. "Dairy Grazing Farms in Michigan, 1999." Michigan State University, Department of Agricultural Economics. East Lansing, MI. http://www.msu.edu/user/nott/staff_paper_2000-33_dairy_grazing.pdf.

This is a pure accounting report, giving column after column of financial data on all aspects of farm operations for 12 grazing farms in Michigan in 1999. Included are data on crops grown, farm income, farm expenses, asset liquidity, depreciation, etc. Net farm income on all 12 grazing farms in 1999 averaged $65,974.

**7**

Nott, Sherrill B. 2002. "Dairy Grazing Farms in Michigan, 2001." Michigan State University, Department of Agricultural Economics. East Lansing, MI. http://www.msu.edu/user/nott/Staff_Paper_2002-30.pdf.

This is a pure accounting report, giving column after column of financial data on all aspects of farm operations for 14 grazing farms in Michigan in 2001. Included are data on crops grown, farm income, farm expenses, asset liquidity, depreciation, etc. Net farm income on all 14 grazing farms in 2001 averaged $44,871.

**8**

Nott, Sherrill B. 2002. "Dairy Grazing Finances in 4 Great Lakes States." Michigan State University, Department of Agricultural Economics. East Lansing, MI. http://www.msu.edu/user/nott/Staff_Paper_2002_04.pdf.

The purpose of this report is to demonstrate potentials and problems when merging data sets for multiple states. Basic accounting data are provided for 11 grazing farms in MI, 13 in WI, 8 in OH, and 1 in IN. Includes measures such as costs, expenses, assets, cash flow, etc. Farms are also broken out by <80 cows and >80 cows. On the whole, grazing farms are found to be profitable: average net farm income for all 33 farms = $55,228.

**9**

Nott, Sherrill B., Thomas Kriegl and William M. Bivens. 2000. "Dairy Grazing Finances in Michigan and Wisconsin, 1999." Michigan State University, Department of Agricultural Economics. East Lansing, MI. http://www.msu.edu/user/nott/staff_paper_2000-54_dairy_grazing_finances_in_MI_and_WI.pdf.

The purpose of this report is to demonstrate potentials and problems when merging data sets for multiple states. Basic accounting data are provided for 12 grazing farms in MI and 19 in WI, including costs, expenses, assets, cash flow, etc. Farms are also broken out by <70 cows and >70 cows. On the whole, grazing farms are found to be profitable: average net farm income for all 31 farms = $64,941. The report finishes with a brief discussion of the strengths and weaknesses of the data.

## B: Economic comparisons between rotational and continuous grazing

**10**

Bransby, David I. 1991. "Biological Implications of Rotational and Continuous Grazing: A Case for Continuous Grazing." *Forage and Grassland Conference*. American Forage and Grassland Council.

Author believes that many of the phenomenal claims made about the benefits of rotational grazing have not been verified by sound research. He finds that evidence from well-designed experiments reveals little or no benefit for rotational grazing versus continuous grazing. He argues that the higher carrying capacity per acre under MIRG is cancelled out due to decreased animal performance.

**11**

Bryan, W. B., E. C. Prigge and R. O. Burton, Jr. 1986. "Beef Cow/Calf Production on Conventional and Innovative Systems." *Forage and Grassland Conference*. American Forage and Grassland Council.

The authors compare the net value and production capabilities of a traditional grazing system (a.k.a. continuous grazing) and a MIRG system which involves overseeding of pastures with red clover and rotational grazing with forward grazing of the calves. As a 3-year average, the MIRG system featured returns of over $100 more per acre than the continuous grazing system.

**12**

D'Souza, G.E., et al. 1990. "Economic Impacts of Extended Grazing Systems." *American Journal of Alternative Agriculture* 5(3):120-125.

Several different variations on extended grazing (grazing later into the season rather than harvesting for hay) are tested to improve profitability of cow-calf systems. In general, there is wide variability in the data, reflecting the fluctuating effects of weather, grass species chosen, hay prices, and hay spoilage. However, in general the system featuring the most grazing boosts profitability the most. Note: This article is NOT about rotational grazing.

**13**

Fales, S.L., et al. 1995. "Stocking Rate Affects Production and Profitability in a Rotationally Grazed Pasture System." *Journal of Production Agriculture* 8(1):88-96.

48 cows were grazed at low, medium, and high stocking rates (1, 1.3, 1.6 cows/acre, respectively). Nutritive value of pasture increased with stocking density, and the % of pasture rejected by cows decreased. Milk yield per cow was not affected. A profitability analysis showed that profits per land unit increased with stocking rate, but profits per cow decreased with stocking rate, showing the need for flexibility depending on a farm's particular resources.

**14**

Hanson, Gregory D., et al. 1998. "Increasing Intensity of Pasture Use with Dairy Cattle: An Economic Analysis." *Journal of Production Agriculture* 11(2):175-179.

Financial data was obtained from 53 grazing dairies in NE Pennsylvania. As dairies they showed a return to labor and mgmt. of $129/acre, compared to $20/acre and $58/acre for production of hay and corn, respectively. More intensive grazing showed a 3% drop in milk yields but a 9% increase in profit per cow, relative to less intensive grazing. However, more intensive grazing was also correlated with higher debt loads and negative cash flows, suggesting they may have been the motivating factors to increase grazing intensity.

**15**

Morrow, R. E., et al. 1990. "Economic Comparison of Forage Systems with Three Levels of Grazing Intensity." *Forage and Grassland Conference*. American Forage and Grassland Council.

Three forage systems were grazed with different stocking rates and number of paddocks: low-, medium-, and high-intensity grazing. The three were compared on economic returns over four grazing seasons. Costs, not including labor or land, averaged $41, $46, and $49 per acre, respectively. Net returns averaged $65, $86, and $131 per acre respectively, indicating a clear advantage for the high-intensity (i.e., MIRG) system.

## C: Economic comparisons between grazing and non-grazing

**16**

Butler, L.J. and Gerry Cohn. 1993. "The Economics of New Technologies in Dairying: BGH vs. Rotational Grazing," in William C. Liebhardt (ed.), *The Dairy Debate: Consequences of Bovine Growth Hormone and Rotational Grazing Technologies* (pp. 189-246). Davis, CA: University of California Sustainable Agriculture Research and Education Program.

The authors compare the hypothetical profitability of two dairy technologies, BGH and MIRG. The main point is that in the former, gross revenues rise as do costs, while in the latter milk production falls but so do costs. On a per-cow basis, net revenue is shown to be the same, but on a per-cwt. basis MIRG has a $0.44 advantage. They also explore the effects of changes in milk prices, milk production, interest rates, feed costs, and government policies on the profitability of the two systems.

**17**

Carr, S.B., et al. 1994. "Results of Intensive, Rotational Grazing on a Virginia Dairy Farm." *Journal of Dairy Science* 77(11):3478.

This is an abstract from an ADSA meeting. A dairy farm converted to MIRG. Daily milk production and milk fat content both fell. Herd health increased. Cost of purchased feeds fell by more than half. Net cash income increased by 43%. Even more impressively, net income minus depreciation increased by 70%, and net income adjusted for inventory changes increased by 227%.

**18**

Conneman, George, et al. 1997. "Dairy Farms Business Summary: Intensive Grazing Farms New York 1996." Cornell University. Ithaca, NY. http://nysl.nysed.gov/uhtbin/cgisirsi/7Nu8mNLB4m/186270027/2/6.

A basic comparison of the profitability and the factors that seem to affect it for 30 grazing farms in NY. Factors investigated include percentage of forage coming from pasture, grain fed to cows, and frequency of rotations. Operating cost per cwt. was slightly lower on grazing farms than non-grazing ($11.29 vs. $11.84). Net farm income was much higher on grazing farms ($31,876 vs. $24,607). Report contains extensive data tables.

**19**

Conneman, George, et al. 1998. "Dairy Farms Business Summary: Intensive Grazing Farms New York 1997." Cornell University. Ithaca, NY. http://nysl.nysed.gov/uhtbin/cgisirsi/7Nu8mNLB4m/186270027/2/6.

Identical in form to study #18, but updated for 1998. Economic analysis is carried out on 35 grazing farms in NY. Operating cost per cwt. was slightly lower on grazing farms than non-grazing ($11.08 vs. $11.90). Net farm income was much higher on grazing farms ($19,705 vs. $9,502). Report contains extensive data tables.

**20**

Conneman, George, et al. 1999. "Dairy Farms Business Summary: Intensive Grazing Farms New York 1998." Cornell University. Ithaca, NY. http://nysl.nysed.gov/uhtbin/cgisirsi/7Nu8mNLB4m/186270027/2/6.

A continuation of reports #18 & 19, now updated for 1999. Economic analysis is carried out on 31 grazing farms in NY. Operating cost per cwt. was slightly lower on grazing farms than non-grazing ($10.53 vs. $11.26). Net farm income was much higher on grazing farms ($58,373 vs. $45,390). Report contains extensive data tables.

**21**

Conneman, George, et al. 2000. "Dairy Farms Business Summary: Intensive Grazing Farms New York 1999." Cornell University. Ithaca, NY. http://nysl.nysed.gov/Archimages/6685.PDF.

A continuation of reports #18, 19, & 20, now updated for 2000. Operating cost per cwt. was slightly lower on grazing farms than non-grazing ($10.53 vs. $10.73). Net farm income was lower on grazing farms *for the first time in four years* ($42,858 vs. $43,135). Report contains extensive data tables.

**22**

Hoard's Dairyman. 2003. "Save Money by Grazing Your Heifers." *Hoard's Dairyman* 148(3):96.

144 dairy heifers were split into two grazing groups and two feedlot groups. Grazing heifers gained slightly more weight. More significantly, total costs for grazing heifers was $0.95 per cow per day, versus $1.49 for feedlot heifers - an advantage of $0.54 per head per day.

**23**

Dartt, Barbara and James Lloyd. 1998. *A Comparison of Management-Intensive Grazing and Conventionally Managed Michigan Dairies: Profitability, Economic Efficiencies, Quality of Life, and Management Priorities*. Unpublished thesis. Department of Agricultural Economics, Michigan State University. East Lansing, MI.

This study compared 18 conventional dairies to 35 MIRG farms through surveys. Though asset levels were similar, grazing farms were 7% more profitable and 11% more capital efficient. Furthermore, grazing farms were 26% more "operating efficient" and 32% more "labor efficient." Both groups indicated a similar satisfaction with quality of life, though it was found that spouses from grazing farms took a more active role in the farm.

**24**

Dartt, B.A., et al. 1999. "A comparison of profitability and economic efficiencies between management-intensive grazing and conventionally managed dairies in Michigan." *Journal of Dairy Science* 82:2412-2420.

A comparison of 35 grazing and 18 conventional dairies in MI. Grazing dairies proved to be more profitable than conventional dairies, exhibiting superior asset use, operational practices, and labor efficiencies. However, the confined geographic region of this study makes extrapolation to other regions very tenuous.

**25**

Emmick, Darrell L. and Letitia F. Toomer. 1991. "The Economic Impact of Intensive Grazing Management on Fifteen Dairy Farms in New York State." *Forage and Grassland Conference*. American Forage and Grassland Council.

Based on a study initiated by the Soil Conservation Service in 1989 of fifteen dairy farms in New York, the authors conclude that a more intensive use of pasture on many New York dairy farms could reduce input costs and enhance overall profitability, with the exception of large dairy operations or farms where there is an insufficient amount of pasture. On average, farms in the study which had switched to grazing saved $153 per cow per year compared to their operations prior to conversion.

**26**

Fink, D.S., G.B. Mortimer and E. Truog. 1933. "Three Years Results with an Intensively Managed Pasture." *Journal of the American Society of Agronomy* 25(7):441-453.

This represents one of the earliest formal studies of MIRG. Five paddocks were created in 1929 and given varying amounts of nitrogen fertilizer in order to test both pasture quality and dairy profitability over three years. Numerous data tables are presented. Rotational grazing with heavy nitrogen application is found to both substantially decrease the costs of milk production (35-74% less than confinement feeding) and greatly improve pasture quality.

**27**

Ford, Steve. 1996. "Grazing Looks Better as Dairy Profits Tighten." *Farm Economics*. Cooperative Extension, Pennsylvania State University College of Agricultural Sciences. University Park, PA.

Writing at a time of depressed prices for dairy farmers, the author argues that as feed costs increase and milk prices decline, grazing is a more and more attractive option. He cites several bits of data to illustrate grazing's advantage, including 1) daily ration costs of confinement vs. grazing as grain prices rise and 2) breakeven yields for alfalfa and corn relative to grass pasture.

**28**

Gloy, B.A., L.W. Tauer and W. Knoblauch. 2002. "Profitability of Grazing Versus Mechanical Forage Harvesting on New York Dairy Farms." *Journal of Dairy Science* 85:2215-2222.

Financial data from 237 nongrazing and 57 grazing farms in NY were compared using a regression analysis. Profitability between and among the two systems ranged widely and overlapped, though in general grazing systems were shown to be at least as profitable as nongrazing systems. Three factors have the strongest impact on profitability for graziers: herd size, milk production per cow, and milk prices.

**29**

Hanson, Gregory D. 1995. "Adoption of Intensive Grazing Systems." *Journal of Extension* 33(4).

Production and financial data were obtained from a random stratified sample of 50 grazing farmers in PA. One interesting finding was that these farms were actually practicing moderate intensive grazing, not fully intensive grazing. Because of reduced costs, net returns to grazing were more than double those to a corn silage system and more than six times those to a hay operation. The article concludes by discussing the challenges facing Extension agents in disseminating grazing information to farmers.

**30**

Hanson, Gregory D., et al. 1998. "Profitability of Moderate Intensive Grazing of Dairy Cows in the Northeast." *Journal of Dairy Science* 81:821-829.

Grazing dairies were compared to non- or partially-grazing dairies through USDA survey data. Though non-grazing dairies showed much higher gross farm incomes, grazing dairies showed higher returns per cow and net farm income, using fewer cows. Results of a survey of 50 PA graziers are also discussed.

**31**

Kliebenstein, James B., Carrol L. Kirtley and Lloyd A. Selby. 1983. "A Survey of Swine Production Health Problems and Health Maintenance Expenditures." *Preventive Veterinary Medicine* 1(4):357-369.

170 pork producers in MO reported disease and death information in a 1978-79 survey. Looking at expenditures for veterinary services, the pasture producers had the lowest overall costs. The average veterinary cost per animals for pastured pigs was less than half the average cost for confined pigs.

**32**

Kole, Glenn, et al. 1992. "Utilizing Controlled Grazing on Dairy Farms in Northern Michigan." *Forage and Grassland Conference*. American Forage and Grassland Council.

The authors report on the reduction in production costs of four farms in Northern Michigan that converted from conventional methods to controlled grazing. The range of savings on the four farms was $8200-15,000 in real dollars. Average savings across all four farms was $2/cwt. The text also mentions briefly the social and emotional benefits of controlled grazing for the farm family.

**33**

Kriegl, Thomas. 2000. "Wisconsin Grazing Dairy Profitability Analysis: Preliminary Fourth Year Summary." University of Wisconsin Center for Dairy Profitability. Madison, WI. http://cdp.wisc.edu/pdf/gzprofitncr4yr.pdf.

45 graziers in WI provided financial data, and comparisons are made between graziers and confinement operations. It is found that MIRG is an economically competitive system, that it is more economically flexible than a confinement system, and that it is not necessarily a *reduced* management system, but rather a *different* management system.

**34**

Kriegl, Thomas. 2001. "Wisconsin Grazing Dairy Profitability Analysis: Preliminary Fifth Year Summary." University of Wisconsin Center for Dairy Profitability. Madison, WI. http://cdp.wisc.edu/pdf/gzprofitwfc5yr.pdf.

This report is a continuation of a longitudinal study (see #33), with a fifth year of data added. Again 45 grazing farms provided financial data. The conclusions drawn the year before are merely strengthened here: MIRG is an economically competitive and flexible system. It is also found that, on the whole, graziers have higher net income per cow and lower debt per cow than confinement farms.

**35**

Kriegl, Thomas. 2002. "Fact Sheet #5: Grazing vs. Confinement Farms." *Regional Multi-State Interpretation of Small Farm Financial Data from the First Year Report on 2000 Great Lakes Grazing Network Grazing Dairy Data.* University of Wisconsin Center for Dairy Profitability. Madision, WI. http://www.cdp.wisc.edu/pdf/glgnfactsheet5_yr1.pdf.

This is a factsheet based on a larger report (study #3) that specifically points out the comparisons between graziers and confinement dairies in WI and NY. Net incomes per cow for grazier vs. confinement are $617 vs. $296 in WI and $315 vs. $181 in NY. Net incomes per cwt. are: $3.44 vs. $1.20 in WI and $1.38 vs. $0.65 in NY.

**36**

Kriegl, Thomas. 2004. "Fact Sheet #5: Grazing vs. Confinement Farms – Year 3." *Regional Multi-State Interpretation of Small Farm Financial Data from the Third Year Report on 2002 Great Lakes Grazing Network Grazing Dairy Data.* University of Wisconsin Center for Dairy Profitability. Madision, WI. http://www.cdp.wisc.edu/pdf/glgnfactsheet5_yr3.pdf.

This is a factsheet based on a larger report (study #4) that specifically points out the comparisons between graziers and confinement dairies in WI and NY. Net incomes per cow for grazier vs. confinement are $651 vs. $641 in WI and $786 vs. $672 in NY. Net incomes per cwt. are $3.14 vs. $2.36 in WI and $2.86 vs. $2.34 in NY.

**37**

Kriegl, Thomas and Gary Frank. 2004. "An Eight Year Economic Look at Wisconsin Dairy Systems." University of Wisconsin Center for Dairy Profitability. Madison, WI. http://www.cdp.wisc.edu/pdf/Eight%20Yr%20COP%2021c13.pdf.

Based on eight years of data, this is a comparison of net income per cwt. for three kinds of WI dairy farms: grazing, traditional confinement (50-75 cows), and large modern confinement (>250 cows). Under three different cost scenarios, MIRG farms consistently show the highest net incomes. When all operating costs are taken into account, grazing returned an average of $3.96/cwt. over 8 years; traditional confinement $2.39/cwt.; and large modern confinement $1.50/cwt.

**38**

Liebhardt, William C. 1993. "Farmer Experience with Rotational Grazing: A Case Study Approach," in William C. Liebhardt (ed.), *The Dairy Debate: Consequences of Bovine Growth Hormone and Rotational Grazing Technologies* (pp. 131-188). Davis, CA: University of California Sustainable Agriculture Research and Education Program.

The author presents in exhaustive detail the results of 12 case studies of dairy farms from 5 different states, plus the results of several other academic studies. Time after time, with tables of data to illustrate, the same theme is presented: feed costs are lower, labor demands are lower, milk production is sometimes lower, and profit is higher on grazing dairies than on confinement dairies.

**39**

Moore, K. C. and J. R. Gerrish. 1995. "Economics of Grazing Systems Versus Row Crop Enterprises." *Forage and Grassland Conference*. American Forage and Grassland Council.

The authors state that research in Missouri and Iowa has shown that net returns can be substantially improved under rotational grazing, and income will more than cover the costs of developing the necessary infrastructure, especially on erosive marginal land with poor crop yields. Using enterprise budgets, they compare the economics of beef production across a 3-year average for 3 intensities of grazing: 3-, 12-, and 24-paddock systems. Returns above cost per acre are $77, $104, and $109, respectively.

**40**

Mowrey, Coleen M., Carl E. Polan and Gordon E. Groover. 2000. "Can Grazing be Profitable?" *Hoard's Dairyman* 145(16):627.

The authors relate the results of five different studies in NY, PA, WI, and VA, each of which illustrates the same general phenomenon: despite lowered milk yields and lower gross incomes, grazing farms consistently bring higher profits per cow or higher returns to labor due to reduced input and labor costs. Even when grazing farms brought lower net incomes, they still brought greater returns to labor due to smaller assets.

**41**

Murphy, William M. and John R. Kunkel. 1993. "Sustainable Agriculture: Controlled Grazing vs. Confinement Feeding of Dairy Cows," in William C. Liebhardt (ed.), *The Dairy Debate: Consequences of Bovine Growth Hormone and Rotational Grazing Technologies* (pp. 113-130). Davis, CA: University of California Sustainable Agriculture Research and Education Program.

This chapter lays out three main criteria for "sustainable agriculture" -- profitability, quality of life, and positive rural landscape -- and then argues that MIRG satisfies the criteria better than confinement dairying. Topics are illustrated with case studies, and include: increased profitability, lowered costs and labor requirements, better herd health, higher quality of life for the farmer, reduced erosion on farmland, and more farmers farming.

**42**

Murphy, William M., John R. Rice and David T. Dugdale. 1986. "Dairy farm feeding and income effects of using Voisin grazing management of permanent pastures." *American Journal of Alternative Agriculture* 1(4):147-152.

An introduction to the Voisin grazing system is given. Forage samples were taken and dairy profitability measured on six VT grazing farms. On 3 farms where comparison was possible, net profits per cow were $67 more using MIRG than using continuous grazing the year before, due mainly to savings on feed costs.

**43**

Nichols, Matt and Wayne Knoblauch. 1996. "Graziers and Nongraziers Fared About the Same." *Hoard's Dairyman* 141(9):351.

Selected elements of costs and profits were compared between a set of grazing and non-grazing farms in NY. When 15 graziers were matched up with 15 similar non-graziers and examined over 3 years, milk production was consistently lower but net farm income consistently higher for graziers. When those 15 graziers were compared to a non-matched group of 79 non-graziers, both milk production and net farm income were higher for graziers.

**44**

Noyes, T. E., M. L. Bennette and D. J. Breech. 1997. "Economic Survey of Management Intensive Grazing Dairies in Northeast Ohio." *Forage and Grassland Conference*. American Forage and Grassland Council.

The authors find that although Ohio farms using MIRG have lower gross income than non-grazing farms, they also have a higher net income due to the savings in cost of production. Net return per cow on MIRG farms was $447 and $468 for 1994 and 1995, respectively. By comparison, net return per cow for all dairy farms (including MIRG) was $400 and $429.

**45**

Olsen, Jim. 2004. "A Summary of Basic Costs and Their Impact on Confinement vs. Managed Intensive Rotational Grazing (MIRG)." *Wisconsin Dairy Data.* University of Wisconsin Center for Dairy Profitability. No. 2004-01. Madison, WI. http://www.cdp.wisc.edu/pdf/wdd2004-01.pdf.

3 years of data on costs of production are compared between confinement and MIRG farms. MIRG farms featured significant cost savings in a number of categories, including Renting/Leasing ($87/head/yr); Other Livestock Expenses ($82/hd/yr); Depreciation of Purchased Breeding Livestock ($65/hd/yr); Purchased Feed Costs ($45/hd/yr); and Veterinary Expenses ($43/hd/yr). Overall, the MIRG farms held a $476/head/yr advantage in costs of production.

**46**

Rust, J.W., et al. 1995. "Intensive Rotational Grazing for Dairy Cattle Feeding." *American Journal of Alternative Agriculture* 10(4):147-151.

Two groups of cows were either grazed (+ small supplementation) or confined over 2 years. Measurements of animal performance, forage quality, and profitability were taken. Confinement cows produced 7% more milk. Grazed cows produced a net return $53 and $44 greater than confinement cows in the 2 different years. Greatest cost economies resulted from reduced use of facilities and equipment and reduced labor.

**47**

Soriano, F.D., C.E. Polan and C.N. Miller. 2001. "Supplementing Pasture to Lactating Holsteins Fed a Total Mixed Ration Diet." *Journal of Dairy Science* 84:2460-2468.

Cows were fed either TMR only, TMR+morning pasture, or TMR+afternoon pasture. Milk production was slightly higher with TMR cows. No significant differences were detected for milk fat, protein content, or body weight, but body condition was greater for TMR cows. Income-over-feed costs were 18.6% higher than TMR for afternoon grazing and 7.5% higher than TMR for morning grazing.

**48**

Tozer, P.R., F. Bargo and L.D. Muller. 2003. "Economic Analyses of Feeding Systems Combining Pasture and Total Mixed Ration." *Journal of Dairy Science* 86:808-818.

45 Holstein cows were each assigned to one of three regimes: TMR only, pasture plus TMR, or pasture plus concentrates. Data were projected to a hypothetical herd of 70 cows and analyzed at varying milk prices, feed costs, and pasture costs. Expenses and milk yields were highest for TMR and lowest for pastured cows. Overall, the TMR herd was most profitable. The pastured herd became more profitable only when milk prices were low and feed costs high.

**49**

White, S.L., et al. 2002. "Milk Production and Economic Measures in Confinement or Pasture Systems Using Seasonally Calved Holstein and Jersey cows." *Journal of Dairy Science* 85:95-104.

A four-year study comparing milk production and economic profitability of confinement and pastured herds. Pastured cows produced 11% less milk, but feed costs for pastured herds averaged $0.95 less per cow per day. Significantly more confinement cows got mastitis and were culled. Overall, the tradeoff between milk yields and economic factors showed pasture-based systems to be economically competitive with confinement systems.

**50**

Winsten, Jon, et al. 1995. "Economics of Feeding Dairy Cows on Well-Managed Pastures." University of Vermont. http://pss.uvm.edu/vtcrops/?Page=research/pasture/Economics.html.

23 VT graziers in 1994 and 21 in 1995 were compared to 24 VT confinement farms which comprised the top quarter for per-cow profitability of farms using the Agrifax accounting system. Graziers earned $579 net income per cow over 2 years, while confinement farms averaged $451 per cow. Biggest savings occured in the areas of paid labor, cropping costs, repairs, and fuel.

**51**

Winsten, Jonathan R., Robert L. Parsons and Gregory D. Hanson. 2000. "A Profitability Analysis of Dairy Feeding Systems in the Northeast." *Agricultural and Resource Economics Review* 29(2):220-228.

Data was obtained from a stratified random sample of 96 dairy farms in three categories: confinement, traditional grazing, and MIRG. Confinement farms had the highest milk production and milk sales, but also the highest grain expenses and veterinary expenses per cow. There were no significant differences in machinery use. Overall, confinement farms had the highest rate of return to assets (7.76%), followed by MIRG (5.83%). Traditional grazing lagged far behind.

**52**

Winsten, Jonathan R. and Bryan T. Petrucci. 2003. "Seasonal Dairy Grazing: A Viable Alternative for the 21st Century." American Farmland Trust. http://grassfarmer.com/papers/studies/seasonalgrazing.html.

The report begins by providing a good introduction to the many purported benefits of grazing, including environmental, farm labor, and farm profitability. Then case studies of six farms in four states (WI, MA, MI, PA) are presented, concentrating on farmers' histories with grazing, paddock construction, feeding practices, yields, and profitability. The farms usually achieve net incomes per unit well above their state averages, even when herd size or milk per cow is substantially lower than average.

**53**
Zartman, D.L. (ed.). 1994. "Intensive Grazing/Seasonal Dairying: The Mahoning County Dairy Program." Department of Dairy Science, Ohio Agricultural Research and Development Center. OARDC Research Bulletin 1190. Wooster, OH. http://ohioline.osu.edu/rb1190/.

This is an exhaustive report on many elements of a 5-year grazing project conducted to assess the viability of MIRG for Ohio dairies. Consists of 12 chapters, mostly agronomy- and animal science-related. Milk production increased each year. Costs of production were found to be 27-30% below those used in conventional OH dairy budgets. Net farm income was also higher than the national dairy farm average in the year when the project sold Grade A milk.

## D: Economic comparisons using computer models

**54**
CIAS. 1996. "Management Intensive Rotational Grazing's Sense . . . and Dollars." Center for Integrated Agricultural Systems, University of Wisconsin-Madison. Research brief #19. Madison, WI. http://www.cias.wisc.edu/archives/1996/04/01/management_intensive_rotational_grazings_senseand_dollars/index.php

5 dairy systems were simulated based on three different milk production levels to compare profitability of confinement vs. grazing operations. At 15,000 lbs./cow, none of the systems turned a profit. At 18,000 lbs./cow, the pasture system had a $3867 profit advantage over confinement. At 21,000 lbs./cow, profits were even higher for the pasture system. Pasture profits increased even more if they got rid of equipment and custom hired help.

**55**
Elbehri, Aziz and Stephen A. Ford. 1995. "Economic Analysis of Major Dairy Forage Systems in Pennsylvania: The Role of Intensive Grazing." *Journal of Production Agriculture* 8(4):501-507.

10 different feeding scenarios were modelled with and without grazing for a typical PA dairy farm. Assuming equal milk production, annual net farm income for grazing farms was 14-25% higher than for nongrazing farms, or $8400-$12,400 for a typical 60-cow farm. This increase resulted mostly from the decrease in the cost of producing milk. A "stochastic dominance" risk assessment also showed grazing farms to be more robust unless milk yields dropped by more than 6%, when nongrazing became the preferable mode.

**56**
Ford, Steve and Greg Hanson. 1994. "Intensive Rotational Grazing for Pennsylvania Dairy Farms." *Farm Economics.* Cooperative Extension, Pennsylvania State University College of Agricultural Sciences. University Park, PA.

The authors compare three hypothetical farms of 204 acres and roughly 100 head: no pasture; pasture with corn; pasture without corn. Income from milk and livestock sales is analyzed, along with various expenses. Net returns over cost are $33,700; $41,600; and $41,800, respectively, giving the pastured systems a clear advantage. Their advantage holds even if milk production per cow falls to as low as 1129 lbs. less than the confinement system.

**57**

Frank, Gary, et al. 1995. "Economics of Alternative Dairy Grazing Scenarios." *Managing the Farm.* Department of Agricultural Economics, University of Wisconsin-Madison. No. 3. Madison, WI.

Six hypothetical scenarios are developed, ranging from a standard corn-alfalfa rotation confinement dairy to a seasonal grazing dairy, and profitability is compared. Returns to labor are highest on the year-round and seasonal grazing farms. Net profitability is highest on the year-round grazing farm, then seasonal grazing, followed by confinement.

**58**

Parker, W.J., L.D. Muller and D.R. Buckmaster. 1992. "Management and Economic Implications of Intensive Grazing on Dairy Farms in the Northeastern States." *Journal of Dairy Science* 75:2587-2597.

A farm model was created to simulate a typical PA grazing dairy farm and then compared to a typical confinement farm. The grazing farm had a gross economic advantage of $131 per cow over the confinement farm. The authors predict that grazing is likely to remain at low levels until farmers are convinced that milk production can stay the same and the price of inputs changes to favor grazing.

**59**

Rotz, Alan C., Neal P. Martin and John H. Grabber. 2000. "Crop Options for an Expanding Dairy Farm in Wisconsin." *Forage and Grassland Conference.* American Forage and Grassland Council.

A computer model was used to determine the relative profitability boost and environmental impacts of taking a 150-acre, 100-cow WI dairy and adding 50 acres of either corn, barley, soybeans, or pasture. The biggest boost came from adding rotationally-grazed pasture (extra $20,000 farm profit), compared to barley ($14,000) and corn and soybeans ($10,000). N leaching also decreased 50% on the pasture, compared to 20% with the three grain crops.

**60**

Rotz, Alan C. and John R. Rodgers. 1994. "A Comparison of Grazing and Confined Feeding Systems on a Pennsylvania Dairy Farm." *Forage and Grassland Conference.* American Forage and Grassland Council.

The authors perform a comparative analysis of grazing and confined feeding systems using a model of the dairy forage system. The model is used to compare the performance and economics of a grazing dairy in central PA to similar systems with owned equipment and/or confined feeding. With custom hiring, grazing cut feed costs by $182/cow or $1/cwt. With owned machinery, savings dropped slightly to $161/cow or $0.86/cwt.

**61**

Rotz, C.A. 1995. "Economics of Grazing Alfalfa on Michigan Dairy Farms." Dairy Forage Research Center. http://www.dfrc.wisc.edu/RS95_pdfs/fp7.pdf.

Citing the need for longitudinal studies of grazing profitability, a 100-head dairy farm was simulated over 25 years of typical Michigan weather. At 18,000 lb., total costs were reduced by $0.83/cwt; at 20,000 lbs., by $0.73/cwt. Net profit of the farm increased by $146/cow or $58/acre. Milk production could even drop by up to 1600 lbs. and still retain a profit advantage. However, the variability in feed costs through different years and weather cycles was 40% greater for grazing than for confinement.

**62**
Shirley, Christopher. 1993. "Milking for Money or for Profit?" *The New Farm* 15(6):31-34.

Two typical dairy farms of SW Wisconsin are modelled, one as a seasonal MIRG farm and the other as a confinement farm. Income from culled cows and milk sales, as well as over 10 categories of expenses, are taken into account. Even assuming a 6000-lb. disadvantage in milk yields, the MIRG operation profits $701 per cow, compared to $417 per cow for the confinement operation. Biggest cost advantages are in feed, heifer replacement, and labor costs.

**63**
Soder, K.J. and C.A. Rotz. 2001. "Economic and Environmental Impact of Four Levels of Concentrate Supplementation in Grazing Dairy Herds." *Journal of Dairy Science* 84:2560-2572.

Four different types of grazing systems (differentiated by level of supplementation) were modeled and compared to a confinement system, and various milk production scenarios were simulated. Generally, profitability in the grazing systems increased as supplementation increased. At the higher supplementation levels, yearly variation among grazing dairies decreased and they were more profitable than confinement systems. Grazing dairies also showed less nitrogen leaching losses than confinement systems.

**64**
Winsten, Jonathan R. and Bryan T. Petrucci. 1996. "The Vermont Dairy Profitability Project: An Analysis of Viable Grass-Based Options for Vermont Farmers." Amerian Farmland Trust, reseach arm. http://www.aftresearch.org/researchresource/caepubs/dairy/vt.dairy.html

Hypothetical profitability models were constructed to assess the economic outlook for a traditional tie-stall dairy switching to various MIRG and confinement scenarios. Predicted profitability, from highest to lowest: (1) expand herd and invest in NZ-style milking shed; (2) retrofit tie-stall barn and expand herd size; (3) full-year MIRG with no additional investments; (4) seasonal MIRG with no additional investments; (5) total confinement with all forage purchased.

## E: Comments on methodology

**65**
Ford, Stephen A. and Wesley N. Musser. 1998. "Evaluating Profitability of Pasture Systems," in *Grazing in the Northeast: Assessing Current Technologies, Research Directions, and Education Needs* (pp. 126-143). Ithaca, NY: Northeast Regional Agricultural Engineering Service.

The authors state that although the studies of the economics of intensive grazing systems have found significant profit potential, the methodologies upon which these studies rely -- case study or cost engineering methodology -- suffer from shortcomings. They provide a discussion of these shortcomings, offer some recommended practices to evaluate grazing profitability, discuss what is known and unknown about the economics of grazing, and provide some direction for further work in the grazing area.

**66**

Gerrish, James, Sara Marley and Ronald Plain. 1992. "Economic Interpretation of Grazing Studies." *Forage and Grassland Conference*. American Forage and Grassland Council.

The authors emphasize that great care needs be taken in presenting economic data based on individual grazing studies of limited scale, and that any economic interpretation should be extrapolated to more accurately represent producer-scale operations. Extrapolation of research-generated performance data to producer-scale operations often yields different interpretations than analysis based only on the scale of the research.

# 2. Sociological Studies

## A: General surveys of graziers

**67**

Nichols, Matt and Wayne Knoblauch. 1996. "What's Motivating the Graziers." *Hoard's Dairyman* 141(10):404.

33 dairy graziers in NY responded to a survey asking why they have switched to grazing and whether and why they plan on continuing to graze. Top reasons to start included: reduced labor costs, reduced feed costs, and increased herd health. Top reasons to continue included: improved herd health, reduced feed costs, and increased profits.

**68**

Parsons, Bob. 2003. "Survey Shows Variety of Grazing Practices on Vermont Dairy Farms." *Agriview Online* 67(9) http://www.vermontagriculture.com/agriview.htm.

Results from a 2002 survey of VT dairy farms. 46% of dairy farmers rely on some amount of grazing, and nearly half of these move their cows at least once a day. Grazing herds are nearly a third the size of non-grazing herds, and grazing cows produce on average 3000 lbs. less milk, with intensive graziers producing a few hundred lbs. more than continuous graziers. 20% more graziers have a college degree. Graziers were far more likely to have low or no debt.

**69**

Parsons, Robert L., et al. 1998. "Extension Outreach Opportunities Among Segmented Dairy Producers." *Journal of Extension* 36(4).

874 surveys were collected from three kinds of PA dairy farmers: confinement (42%), traditional (extensive grazing) (41%), and intensive grazing (16%). Intensive graziers tended to be younger and more likely to have attended college. They were also more likely to plan on increasing cow numbers and acres. They were more dissatisfied with milk yields but less dissatisfied with stress level. The article also discusses differences in technology use and concludes with a discussion of the implications for Extension outreach efforts.

**70**

Welsh, Rick and Thomas A. Lyson. 1997. "Farm Structure, Market Structure and Agricultural Sustainability Goals: The Case of New York State Dairying." *American Journal of Alternative Agriculture* 12(1):14-18.

Questionnaires were administered to 48 dairy farm households in NY to analyze the connection between farm structure variables and technology choices. Farms that have grown in scale and hired more outside labor are more likely to adopt chemical-intensive methods, while farms that sell to "alternative" markets are more likely to consider pasture farming.

## B: Surveys of graziers highlighting economic data

**71**

Foltz, Jeremy and Gillis Lang. Forthcoming. "The Adoption and Impact of Management Intensive Rotational Grazing (MIRG) on Connecticut Dairy Farms." *American Journal of Alternative Agriculture*.

Econometric models are run on a random sample of CT dairy farms to evaluate costs, productivity, and profits. MIRG adopters are slightly more educated than non-adopters. Farmers who rent a lot of their land are less likely to adopt MIRG. No significant correlation is found between MIRG adoption and cost, productivity, or profitability per cow. However, evidence suggests that those who adopt MIRG fully are more profitable than those who only adopt it partially.

**72**

Jackson-Smith, Douglas B., et al. 1996. "Grazing in Dairyland: The Use and Performance of Management Intensive Rotational Grazing Among Wisconsin Dairy Farms. ATFFI Technical Report No. 5." UW-Madison Program on Agricultural Technology Studies. Madison, WI. http://www.pats.wisc.edu/pdf%20documents/grazing.pdf.

This report presents the results of two comprehensive surveys of dairy farmers in WI, with the focus on graziers. It defines MIRG and discusses the percentages and distribution of MIRG farmers in the state. It also compares MIRG operations with conventional dairies along several variables, including herd size, milk yields, farmer characteristics such as age and education, labor allocation, off-farm employment, financial viability, technology use, and attitudes.

**73**

Kriegl, Thomas, Larry Bauman and Nate Splett. 1999. "1994 Wisconsin Grazing Dairy Farm Survey Report: Overview of Management Intensive Rotational Grazing in Wisconsin." University of Wisconsin Center for Dairy Profitability. Madison, WI. http://cdp.wisc.edu/pdf/grsurvey93099.pdf.

This report presents the results of a survey of 146 graziers throughout the state of WI, sometimes comparing the results to conventional dairies by virtue of a 1993 survey of dairy farms. Report is very comprehensive and covers twelve general topics, including: Farmer characteristics; labor amounts and sources; herd size and makeup; land tenure characteristics; milk production; grazing and feeding practices; harvesting forage; financial impacts of grazing; factors influencing graziers' decisions.

**74**

Loeffler, Brian, et al. 1996. "Knee Deep in Grass: A Survey of Twenty-Nine Grazing Operations in Minnesota." University of Minnesota Extension Office. http://www.extension.umn.edu/distribution/livestocksystems/components/DI6693-A.html.

A comprehensive survey of 29 dairy graziers in Minnesota, providing information on many different topics. Similar in nature to the WI survey (#72). General categories include: farm overview; farmer characteristics; business management; pasture management techniques; herd management; labor requirements; and challenges and future opportunities. This report features an abundance of data often presented in laundry list fashion.

**75**
Ostrom, Marcia R. and Douglas B. Jackson-Smith. 2000. "The Use and Performance of Management Intensive Rotational Grazing Among Wisconsin Dairy Farms in the 1990s." UW-Madison Program on Agricultural Technology Studies. Madison, WI. http://www.pats.wisc.edu/pdf%20documents/rr8.pdf.

The adoption of grazing practices has grown through the 1990s. This report is essentially an update of the comprehensive 1996 report "Grazing in Dairyland" (#72), with new data added from a 1999 survey. The same set of variables is addressed, including herd size, milk yields, farmer characteristics, labor allocation, financial viability, technology use, and quality of life.

**76**
USDA. 1996. "Dairy Farmer Profitability Using Intensive Rotational Stocking: Better grazing management for pastures." NRCS, Grazing Lands Technology Institute.
http://www.glti.nrcs.usda.gov/technical/publications/index.html.

Reports the results of a 1992 Penn State study of 52 dairy farmers. General topics surveyed include farmer characteristics such as age and educational level, profitability of grazing farms, milk production per cow, and factors influencing farmers' decisions to graze or to expand their grazing operations. Milk production for graziers was at the bottom end, but net income at the upper end, of the range for PA confinement farms.

**77**
Winsten, J.R., R.L. Parsons and G.D. Hanson. 2000. "Differentiated Dairy Grazing Intensity in the Northeast." *Journal of Dairy Science* 83:836-842.

Analyzes the results of a mail survey of dairy graziers in VT, PA, and VA in 1997. Graziers are broken into different categories based on "grazing intensity" and compared by age, formal education, debt loads, off-farm incomes, use of different technologies, and satisfaction with quality of life and farm operation. A logit regression analysis of the data is also performed to find which factors most predict whether a farmer will rely more on grazing in the future.

## C: Testimonials by individual graziers

78
Agri-View Newpaper online. http://www.agriview.com/archives/

The Wisconsin Agri-View newspaper has a large archive of testimonials by and feature articles about graziers in the state as well as reports and articles on visiting graziers from other states and countries.

**79**
Ault, Dwight and Becky Ault. n.d. "A Gentler Way -- Sows on Pasture." Austin, MN.

This is basically a series of testimonials/brief how-to explanations from seven different pastured hog farmers, plus a few newspaper clippings which also highlight a particular pastured hog operation. Some claims include: reduced costs by $100 per sow per year; drastic reduction in health problems, particularly leg problems; more enjoyable chores on the farm; and fixed costs 30-43% lower for pasture systems versus confinement.

**80**

Bower-Spence, Kim. 1995. "Where are the Savings in Grazing?" *Pennsylvania Farmer* 226(6):8-9.

This brief article presents financial data from one PA farmer who kept meticulous records before and after a switch from confinement to MIRG. Gross income for the confinement years was nearly the same as the grazing years (~$194,000), but grazing costs were significantly less, resulting in an average $18,000 profit advantage while grazing. Also, his milk yields initially went down but were soon back to pre-grazing levels (20,000 lbs.), and he is able to milk more cows as a grazier.

**81**

Braun, Victoria. 1995. "Seasonal Dairying with Fall Calving." *What Works in Wisconsin: Results from Sustainable Agriculture Projects.* Sustainable Agriculture Program, Wisconsin Department of Agriculture, Trade and Consumer Protection. ARMPUB 39. Madison, WI.

This dairy farmer reports a comparison between her seasonal grazing dairy and the full-year confinement dairy she ran before. Upon switching, milk production went up, and gasoline and other energy needs went down. Net farm income jumped by several thousand dollars.

**82**

Burley, Gary C. 2000. "Seasonal Calving is an Important Part of Grazing." *Hoard's Dairyman* 145(6):229.

A one-page testimonial by a grazier who converted from full-year to seasonal. He cites labor reduction, herd health, and increased profitability (despite a large drop in milk production) as the main advantages to going seasonal, while successful breeding remains the biggest challenge.

**83**

CIAS. 1995. "Land Stewardship Practices on the Krusenbaum Organic Dairy Farm." Center for Integrated Agricultural Systems, University of Wisconsin-Madison. Research brief #17. Madison, WI. http://www.cias.wisc.edu/archives/1995/05/01/an_organic_dairying_overview_from_the_krusenbaum_farm_studies/index.php

This is the description of one organic grazing dairy in SE Wisconsin and its land stewardship practices, which include composting solid manure in windrows; chisel plowing and countour stripping to reduce erosion; crop rotations; and various pasture management activities. The family reports satisfaction with their decisions and experiments, and plans to continue in the same vein.

**84**

DeGroot, Lloyd and Patti DeGroot. 1995. "Conversion to Intensive Rotational Grazing and Seasonal Dairying." *What Works in Wisconsin: Results from Sustainable Agriculture Projects.* Sustainable Agriculture Program, Wisconsin Department of Agriculture, Trade and Consumer Protection. ARMPUB 37. Madison, WI.

This short summary documents one farm couple's transition from confinement to grazing. Feed costs dropped by $205 per cow, other costs dropped by $87 per cow, and energy costs dropped by $3.50 per cow. Overall, the farmers report high satisfaction with the switch.

**85**

Hansen, Mark and Colleen Hansen. 1995. "Transition to Rotational Grazing for Dairy Herds." *What Works in Wisconsin: Results from Sustainable Agriculture Projects.* Sustainable Agriculture Program, Wisconsin Department of Agriculture, Trade and Consumer Protection. ARMPUB 37. Madison, WI.

This farming family split their own herd into grazed vs. confinement over one year and summarize the results here. The grazed herd showed a profit difference of $3418 over the confined herd, due mainly to lower cull rate, feed costs, fertilizer costs, and machinery needs. Energy savings were also realized. No loss in milk production was experienced, but butterfat content dropped 0.2 percent.

**86**

McCartney, David and Lynda McCartney. 1999. "Utilizing Alternative Harvesting Methods in Storing Silage." Sustainable Agriculture Research and Education. http://grassfarmer.com/papers/NCR%20SARE%201998%20Grant%20Program%20II.htm.

The testimonial by one dairy grazing couple who investigated lower-cost methods for harvesting silage, specifically a method called the "vacuum cut silage system." They compare equipment costs, storage facility costs, and total operation costs per hour of four systems: traditional silo silage, round bales, dry round bales, and vacuum silage.

**87**

McCartney, David and Lynda McCartney. n.d. "Planning and Managing a Seasonal Dairy." Grassfarmer web site. http://grassfarmer.com/papers/McCartney%20Farm%20Desc.htm.

This is the personal testimony of one grazing couple. It includes ow and why they began grazing, and how they deal with the four major elements of maintaining their seasonal dairying operation: group calf rearing, breeding management, field crop planning, and financial management.

**88**

Nation, Allan. 1993. *Grass Farmers.* Jackson, MS: Green Park Press.

Written by the editor of the periodical *Stockman Grass Farmer*, this is essentially a long testimonial to grazing in its many forms. The book consists of 36 brief case studies of farmers who graze a variety of animals, from chickens to hogs to dairy sheep to beef cattle. The farmers consistently praise grazing as allowing them to remain competitive in farming and to improve the quality of their farmland.

**89**

Paine, Laura. 1999. "Managed Intensive Grazing: Promises and Realities." UW-Extension Columbia County. Portage, WI. http://www.uwex.edu/ces/cty/columbia/ag/grazing/articles/grazing6.pdf.

This is a case study of one successful MIRG dairy that made the switch in 1992. Herd size expanded from 60 to 100 cows, but production costs dropped from $1426 to $831/cow/year. Rolling average has dropped from 19,000 to 15,000 lbs., but total milk sales have grown substantially. Veterinary costs per cow have dropped by 40%, and cull rate from 35% to 25%, and they've slashed their fuel use by more than half.

**90**

Possin, Irv. 1995. "Pasture Hog Farrowing." *What Works in Wisconsin: Results from Sustainable Agriculture Projects.* Sustainable Agriculture Program, Wisconsin Department of Agriculture, Trade and Consumer Protection. ARMPUB 37. Madison, WI.

One farmer reports on the profitability comparsion between confinement hogs and pastured hogs. Feed costs were slightly higher per hog for pastured farrowing, but electricity and housing costs were significantly lower, resulting in a savings of nearly $5 per pig for pastured farrowing.

**91**

Ryan, Dick. 1995. "Shoreland Management and Controlled Grazing." *What Works in Wisconsin: Results from Sustainable Agriculture Projects.* Sustainable Agriculture Program, Wisconsin Department of Agriculture, Trade and Consumer Protection. ARMPUB 37. Madison, WI.

A short summary of a profitability and energy analysis on a grazing farm of stocker beef calves. 194 head of cattle produced 44,544 lbs. of beef in 208 days. Costs came to 20.3 cents per lb. Total energy costs came to 97.49 Btu's per lb. of beef produced, which is many times lower than the energy costs for producing confinement beef, which can exceed 1200 Btu's per lb.

**92**

WRDC. 1995. *The Grass IS Greener: Dairy Graziers Tell Their Stories.* Madison, WI: Wisconsin Rural Development Center.

This slim volume presents short testimonials from 16 dairy graziers in WI and MN. They speak about their transitions to grazing, the benefits of grazing, and what they've learned from the experience. They are almost universally positive about the grazing experience, including its environmental and labor benefits. Includes black & white photos of the farmers with their families.

## D: Other socially-oriented studies

**93**

Campbell, David. 1993. "The Economic and Social Viability of Rural Communities: BGH vs. Rotational Grazing," in William C. Liebhardt (ed.), *The Dairy Debate: Consequences of Bovine Growth Hormone and Rotational Grazing Technologies* (pp. 277-316). Davis, CA: University of California Sustainable Agriculture Research and Education Program.

The author discusses the documented and probable impacts on rural communities of the widespread adoption of BGH and MIRG, respectively. Most of the paper concerns the effects of BGH. The general conclusion is that MIRG "can better serve the needs of family farms and rural communities" than more input-heavy technologies for one simple reason: it can keep more family dairy farms in business.

**94**

CIAS. 1998. "Women on Dairy Farms: Juggling Diverse Roles and Responsibilities." Center for Integrated Agricultural Systems, University of Wisconsin-Madison. Research brief #29. Madison, WI. http://www.cias.wisc.edu/archives/1998/02/02/women_on_dairy_farms_juggling_roles_and_responsibilities/index.php

600 dairy farm couples, both graziers and non-graziers, were surveyed to find out how decisions and labor on the farm are split between the man and the woman. More difference was found between men and women than between graziers and non-graziers, including women working more hours and more often feeling like they were secondary in the decision-making process. Graziers were found to work slightly fewer hours and have slightly more leisure time to spend with the family.

**95**

CIAS. 1998. "Spreading the Word: Ag Professionals and MIRG." Center for Integrated Agricultural Systems, University of Wisconsin-Madison. Research brief #25. Madison, WI. http://www.cias.wisc.edu/archives/1998/09/01/spreading_the_word_ag_professionals_and_mirg/index.php

A survey was administered to ag professionals in 18 occupations to assess their knowledge and support of MIRG. Most had heard of MIRG, but 80% said they had to see a new farming practice working for farmers before they recommended it. They were more likely to recommend it, and they were more positive about its benefits, if they personally knew a grazier. Only 37% of respondents are actively seeking and using MIRG information, with business consultants and lenders being the least likely to do so.

**96**

CIAS. 2000. "Wisconsin's Grazing Networks: A Status Report." Center for Integrated Agricultural Systems, University of Wisconsin-Madison. Research brief #49. Madison, WI. http://www.cias.wisc.edu/archives/2000/01/03/wisconsin_grazing_networks_a_status_report/index.php

A survey was sent to coordinators of WI's 23 grazing networks to find out characteristics such as age, size, membership, and activities. Average network is 5 years old (range 2-10), has 84 members (range 10-200), and consists of 80% dairy farmers (range 50-100%). About half of the networks are coordinated by a state or university agency. Pasture walks are the primary activity, and meeting the needs of both new and established graziers was the most commonly cited challenge.

**97**

Hassanein, Neva. 1999. *Changing the Way America Farms: Knowledge and Community in the Sustainable Agriculture Movement.* Lincoln, NE: University of Nebraska Press.

This book is a qualitative examination of knowledge production and community building within two sustainable agriculture groups, one a grazing network in SW Wisconsin. The network is conceptualized as a "social movement community," in that its members come together with a purpose and a desire for change. Local knowledge and a sense of local place are found to be important components. Knowledge is shared horizontally among members rather than existing idiosyncratically. Graziers see themselves as conspicuously alternative: WHY to graze is just as important as HOW to graze.

**98**

Hassanein, Neva and Jack R. Kloppenburg Jr. 1995. "Where the Grass Grows Again: Knowledge Exchange in the Sustainable Agriculture Movement." *Rural Sociology* 60(4):721-740.

This article uses "social movement theory" and examines rotational grazing networks in Wisconsin as one expression of the larger sustainable agriculture movement. Knowledge creation within the grazing network is shown to be communal rather than idiosyncratic, and knowledge production becomes a crucial element in the formation of a unique social movement. A technological dimension, a cosmological dimension, and an organizational dimension of the movements are explored, and particular emphasis is placed on the fact that these networks are organized horizontally rather than vertically.

**99**

Millar, Joanne and Allan Curtis. 1999. "Challenging the Boundaries of Local and Scientific Knowledge in Australia: Opportunities for Social Learning in Managing Temperate Upland Pastures." *Agriculture and Human Values* 16(4):389-399.

A set of grazing farm families (not necessarily MIRG) as well as consultants and university scientists are interviewed. Farmer knowledge of native and introduced grasses and grass mgmt. practices seem to take place largely through observation. They find that farmer knowledge is varied and contextual, that it is important to successful collaboration with universities and govt. agencies, and that there are limits to such information exchange that are determined by the social distances between farmers and scientists.

100

Paine, L.K., Richard M. Klemme, Daniel J. Undersander, and Margaret Welsh. 2000. "Wisconsin's Grazing Networks: History, Structure, and Function." *Journal of Natural Resources and Life Sciences Education*. 29:60-67.

This article documents the farmer-to-farmer learning taking place through the numerous grazing networks formed in Wisconsin. A 1998 survey of all 23 WI network coordinators was done to evaluate the structure and coordination, programming and activities, and challenges, concerns, and accomplishments of the different networks. Factors impacting network effectiveness in farmer-to-farmer information exchange include; regular communication, agency support, homogeneity, attention to the needs of both advanced and beginning graziers, and a personal commitment to the network on the part of the individual members.

101

Posner, Joshua L, Gary G. Frank, Kenneth V. Nordlund and Ronald T. Schuler. 1998. Constant goal, changing tactics: A Wisconsin dairy farm start-up., American Journal of Alternative Agriculture 13(2) 50-60.

This case study of the Krusenbaum farm in SE Wisconsin documents the start-up phases of an alternative dairy farm. They started in 1992 and by 1994 had seeded their entire farm to sod. To cut down on the continued heavy work load they went to seasonal dairying. By the end of 1995 the annual net farm income has risen from $21,500 (1990 and 1991) to $54,000 (1994 and 1995). The grass-based system required low purchased feed inputs ($300 per cow). Renting the farm and managing money carefully have resulted in a low debt load ($73 per cow).

**102**

Stevenson, G.W., Russell O'Harrow and Douglas Romig. 1996. "Dairy Farmer Career Paths. Farm Entry and Exit Transitions in New Zealand and Wisconsin: Observations, Challenges, and Opportunities for Exchange." Babcock Institute International Dairy Research and Development, Agricultural Technology and Family Farm Institute, and Center for Integrated Agricultural Systems; University of Wisconsin-Madison. Madison, WI.

The authors use the dairy system in NZ to comment on possibilities in WI. Both places have experienced huge drops in the number of dairy farms, but NZ is considered to have a more robust dairying network. The authors contend that this is for three main reasons, all of which would benefit Wisconsin's entire dairy industry: a favorable climate and the nationwide adoption of MIRG; a nationwide organizational structure that provides leadership to the entire industry and responds to farmers' needs; and institutionalized channels for farmer entry, mid-career transition, and retirement.

**103**

Vogt, Jennifer, et al. 2001. "The Roles of Women on Wisconsin Dairy Farms at the Turn of the 21st Century." Program on Agricultural Technology Studies, University of Wisconsin-Madison. Madison, WI.

This is a general report on womens' contributions to WI dairy farms. Discussion centers on the variety of responsibilities women have on farms, their contributions to on- and off-farm labor, their role in making farm decisions, and their satisfaction with farm life. No significant differences among these variables are detected for MIRG farms relative to conventional or large-scale confinement farms.

**104**

Zepeda, Lydia and Marco Castillo. 1997. "The Role of Husbands and Wives in Farm Technology Choice." *American Journal of Agricultural Economics* 79(2):583-588.

A telephone survey of 600 dairy farm couples was conducted. Farmers that have more education and larger farms are more likely to adopt MIRG. The more a woman participates in household decisions, the more likely the farm is to adopt MIRG. Also, the higher the female wage, the more likely the farm is to adopt MIRG, suggesting that one impetus for adopting MIRG may be to free up women to work off-farm.

# 3. General Reports on Grazing

## A: Overviews

**105**
Fales, S.L., S.A. McMurry and W.T. McSweeny. 1995. "The Role of Pasture in Northeastern Dairy Farming: Historical Perspectives, Trends, and Research Imperatives for the Future," in Tom Sims (ed.), *Agricultural Research in the Northeastern United States: Critical Review and Future Perspectives* (pp. 111-132). Madison, WI: American Society of Agronomy, Inc.

The title of this work says it all: it presents a history of pasture farming in the Northeast, then an analysis of current trends in pasture research, and finally suggestions for where future pasture research should be directed. Pasture research declined significantly in the 2nd half of the 20th century. Suggested future research areas include animal nutrition for maximum milk production, strategies for year-round forage production, controlling nitrate leakage into groundwater, and better economic analyses of grazing.

**106**
SAN. 2003. "Profitable Pork: Strategies for Hog Producers." USDA Sustainable Agriculture Research and Education. http://www.sare.org/publications/hogs/profpork.pdf.

This is a general report on alternative methods for raising pigs. One section is devoted to pastured pigs, including a basic introduction as well as a few brief case studies which give an indication of the cost efficiencies that can be achieved. A second section covers environmental benefits of pastured hogs (manure management, odor reduction, soil health, animal health). A third section covers alternative marketing opportunities. A fourth section covers community, family, and lifestyle benefits, including working conditions and human health. All are fairly general in their coverage.

**107**
SARE. 2002. "Profitable Poultry: Raising Birds on Pasture." USDA Sustainable Agriculture Research and Education. http://www.sare.org/publications/poultry/poultry.pdf.

This is an all-encompassing report on raising chickens and turkeys on pasture. General topics covered include: basic production methods; economic benefits; environmental benefits; lifestyle benefits; marketing options. The report features a number of individual case studies to illustrate methods or net returns possible on pasture. Net returns were as high as $7 per bird and averaged between $3-4 for the producers in this report.

## B: Pro-grazing musings

**108**

Murphy, Bill. 1998. "Feeding Livestock on Well-Managed Pasture: Effects on Farm Family, Rural Community, and Landscape," in *Grazing in the Northeast: Assessing Current Technologies, Research Directions, and Education Needs* (pp. 179-192). Ithaca, NY: Northeast Regional Agricultural Engineering Service.

American agriculture, by adopting capital-intensive mechanical, biological, and chemical technologies, has been extremely successful in producing food. But in the emphasis on maximum production, the well-being of farmers, farm families, communities, and the environment has been overlooked. Rural communities and the landscape/environment are suffering. The author believes that well-managed pasture-based farming could regenerate rural communities, farm families, and the environment.

**109**

Nott, Sherrill B. 2003. "Evolution of Dairy Grazing in the 1990's." Michigan State University, Department of Agricultural Economics. East Lansing, MI. http://www.msu.edu/user/nott/Past03.pdf.

This is a short paper written by a long-time grazing researcher, assessing the state of grazing practice and research in 2003. It is a mix of literature review and personal commentary. Overall, he is very positive about the advances grazing has made in the 1990s and its potential to expand in the future. He briefly covers topics such as grazing technology, grazing economics, response to grazing from the private sector and institutions, and future directions in grazing research.

**110**

Petrucci, Bryan T. 1997. "The Potential of Dairy Grazing to Protect Agricultural Land Uses and Environmental Quality in Rural and Urban Settings." *Stockman Grass Farmer Conference*. American Farmland Trust. http://grassfarmer.com/papers/bp-sgf.html.

Essentially a speech touting the opportunities that grass-based livestock farming holds for saving threatened farmland on the urban fringes. The author, a director of AFT's "Farms Division," states that grazing is an ideal candidate for holding onto threatened farmland because of its low input costs. He proposes a number of different methods for combining farmland preservation techniques with grass-based farming: conservation easements; land shares between absent landowners and aspiring farmers; finding investors for new farms.

# 4. Secondary Issues

## A: Agronomy

**111**

Clark, E. Ann, J.G. Buchanan-Smith and Stephan F. Weise. 1993. "Intensively Managed Pasture in the Great Lakes Basin: A Future-Oriented Review." *Canadian Journal of Animal Science* 73:725-747.

This is an extensive literature review focusing on the past and projected contribution of pasture to Great Lakes agriculture, with a focus on Ontario. Topics covered include animal performance; proper management of pastures for high nutrient quality; simple vs. complex grass mixes; and nitrogen fertilization. Suggestions are also given for future research priorities, including the creation of alternative indices for assessing pasture health and animal performance. It includes an extensive bibliography of Agronomy and Crop Science articles.

**112**

Kolver, E.S. and L.D. Muller. 1998. "Performance and Nutrient Intake of High Producing Holstein Cows Consuming Pasture or a Total Mixed Ration." *Journal of Dairy Science* 81:1403-1411.

Two groups of 8 cows each were fed either TMR or pasture to compare nutrient intake and milk production. TMR cows had significantly higher dry matter intake, milk production, milk protein content, live weight, and body condition. The chief limiting factor for milk production for pastured cows was determined to be metabolizable energy, i.e. the greater energy required to find and eat grass.

**113**

Bargo, F., et al. 2002. "Performance of High Producing Dairy Cows with Three Different Feeding Systems Combining Pasture and Total Mixed Rations." *Journal of Dairy Science* 85:2948-2963.

To test several elements of animal performance, 45 Holsteins were put on three different treatments: pasture plus concentrate, pasture plus partial TMR, and TMR only. Dry matter intake, body weight gain, and milk production were highest for TMR and lowest for pasture. Pastured cows were also lowest in milk fat and true protein. Milk from pastured cows had the highest plasma nonesterified fatty acids.

**114**

Proceedings of the Forage and Grassland Conference." *Forage and Grassland Conference*. American Forage and Grassland Council.

This series, published annually by the American Forage and Grassland Council, contains dozens of articles on various aspects of rotational grazing, most of them of an agronomic nature.

## B: Environment

**115**

Driscoll, Melissa and Bruce Vondracek. 2002. "Water, Grass & Livestock: An Annotated Bibliography of Riparian Grazing Publications." The Land Stewardship Project. White Bear Lake, MN.

This annotated bibliography of over 200 sources concentrates on the environmental effects of rotational grazing on water resources, including streams, streambanks, and riparian zones. At least one short paragraph summarizes each source.

**116**

DeVore, Brian. 2001. "Same Storm - Different Outcomes." Land Stewardship Project. http://www.landstewardshipproject.org/lsl/lspv19n2.html#coverstory.

Article reports on two soil erosion studies performed in the Sand Creek watershed. Researchers found that after a heavy rain storm in June 1998, the farm under managed pasture, despite its greater steepness, lost much less soil per acre (53 lbs.) than the farms under moldboard plow and chisel plow tillage (10 tons). The author also discusses the impact of eroded soil sediments and chemical runoff on the quality of municipal water supplies.

**117**

Myers, Thomas J. and Sherman Swanson. 1995. "Impact of Deferred Rotation Grazing on Stream Characteristics in Central Nevada: A Case Study." *North American Journal of Fisheries Management* 15(2):428-439.

Stream and streambank quality were assessed over 12 years at several creeks to examine the effects of "deferred rotation grazing" and the presence of roads. The streams that experienced grazing improved significantly in bank stability, especially the one without roads. Overall, complete rest resulted in the best riparian area quality, while deferred grazing without roads was second.

**118**

Paine, L., et al. 1996. "Cattle Trampling of Simulated Ground Nests in Rotationally Grazed Pastures." *Journal of Range Management* 49(4):294-300.

Simulated egg nests were placed in pastures of three grazing systems in SW Wisconsin to evaluate trampling by cattle: 1-day rotation with 60 cattle/ha; 4-day rotation with 15/ha; and 7-day rotation with 8/ha. The trampling rate was the same in all three: 75% of nests were trampled each time, in 8 consecutive trials. The only difference was the less intensive system (7-day) had a greater trampling rate during rumination than during grazing.

119
Paine, L. K., D.J. Undersander, S.A. Temple, and D.W. Sample. 1997. "Managing Rotationally Grazed Pastures for Forage Production and Grassland Birds." *Proceedings of the 1997 Forage and Grassland Conference.* M.J. Williams, ed. American Forage and Grassland Council. Georgetown, TX 6:54-58.

Bird communities and forage production were compared in continuously grazed pastures (CON), rotational paddocks (ROT) and refuges (REF) in which pastures were not mowed or grazed between May 15 and July 1. Together, ROT and REF had 65% more nesting pairs/acre than CON. REF has 11% more nesting pairs/acre than ROT. Forage quality of REF hay was lower than that of adjacent ROT paddocks. After the refuge period, forage availability was similar for REF and ROT for the rest of the season. In August, forage quality was higher for REF than for ROT.

**120**
Rayburn, Edward B. 1993. "Potential Ecological and Environmental Effects of Pasture and BGH Technology," in William C. Liebhardt (ed.), *The Dairy Debate: Consequences of Bovine Growth Hormone and Rotational Grazing Technologies* (pp. 247-276). Davis, CA: University of California Sustainable Agriculture Research and Education Program.

The author examines the possible environmental consequences of widespread adoption of BGH and MIRG. Elements discussed include the technologies' effects on number and size of farms; landscape; manure management; crops and feed production; soil loss; the greenhouse effect; and water quality. Though he states that neither technology is inherently bad or good, it is clear that grazing is preferable in terms of most of these factors. In particular, soil erosion and fuel use would be reduced, and the number of dairy farmers still farming would stabilize or increase.

**121**
Stout, W.L., et al. 2000. "Assessing the Effect of Management Intensive Grazing on Water Quality in the Northeast U.S." *Journal of Soil and Water Conservation* 55(2):238-243.

Using experimental data from an intensively grazed pasture as well as a review of the literature on the topic, the researchers determine that even with a relatively low stocking rate of 200 cows/ha, the concentration of nitrates in the leachate beneath the pasture could be as high as 10 mg/liter. This has implications for water quality beneath pastures, but more case-by-case studies need to be carried out.

## C: Nutrition and human health

**122**

Beaulieu, Denise A. 2000. "Grazing and CLA in Milk and Meat. What is CLA and Why Do We Care?" *2000 Great Lakes International Grazing Conference*. http://www.msue.msu.edu/jackson/Dairy/Grazing/2000/Proceedings/GLIGC_2000_Proceedings.htm.

This article reviews past literature on the existence of conjugated linoleic acid, a demonstrated anti-carcinogen, in grazed vs. nongrazed milk and beef. Numerous studies from various locations, and using various methodologies, have found that CLA levels are increased in milk and meat that comes from cows that graze on pasture vs. those in confinement operations.

**123**

Dhiman, T.R., et al. 1999. "Conjugated Linoleic Acid Content of Milk from Cows Fed Different Diets." *Journal of Dairy Science* 82:2146-2156.

This clinical trial consisted of four different experiments, each feeding a group of cows a different kind of diet. Examples include high oil diets, fish meal mixed with monensin, pasture + TMR, all pasture, and finely chopped alfalfa. Cows with all pasture and no supplements had 500% more CLA in their milk fat than cows on typical dairy diets.

**124**

White, S.L., et al. 2001. "Comparison of Fatty Acid Content of Milk from Jersey and Holstein Cows Consuming Pasture or a Total Mixed Ration." *Journal of Dairy Science* 84:2295-2301.

37 cows were split into two groups and fed either a TMR diet or a pasture diet with some supplemental grain, to determine differences in fatty acid composition, crude protein, and total fat of the milk. Mik from pastured cows had nearly double the levels of CLA, and it stayed fairly constant across the four week trial, while milk from TMR cows showed more variation in CLA content.

**125**

Schroeder, G.F., et al. 2003. "Milk Fatty Acid Composition of Cows Fed a Total Mixed Ration or Pasture Plus Concentrates Replacing Corn with Fat." *Journal of Dairy Science* 86:3237-3248.

31 Holsteins were fed one of three diets to determine milk fatty acid and CLA levels: (1) TMR, (2) pasture plus corn conentrate, and (3) pasture plus corn concentrate plus fatty acid supplementation. No differences were found for dry matter intake, total volatile fatty acid concentration, or milk production. Milk protein was higher for TMR. CLA content was highest for (3), then (2), and lowest for TMR.

**126**

Martz, F., et al. 1997. "Quality of Beef from Pasture Finished Cattle." *Forage and Grassland Conference*. American Forage and Grassland Council.

The objective of the authors' study is to determine if some level of grain supplementation on pasture will overcome the four main criticisms of pastured beef: lacking in tenderness, yellow fat, dark cutting, and off flavors. The study consists mainly of a consumer evaluation of steak samples from cattle that received 0, 25, 50, 75, or 100% grain diet. The authors find that some grass feeding of beef may be possible without detrimentally affecting steak quality.

**127**

Carpino, S., et al. 2004. "Contribution of Native Pasture to the Sensory Properties of Ragusano Cheese." *Journal of Dairy Science* 87:308-315.

16 samples of an artisinal Sicilian cheese from two different feeding systems -- pasture and TMR -- were sampled for odor, taste, consistency, and mouth structure in a series of blind taste tests. The cheeses were significantly different in color, with the pastured cheeses being much more yellow due to transfer of beta carotene. Pasture cheeses were found to be more odor-intense, less oily, and easier to fracture than TMR cheeses.

**128**

Carpino, S., et al. 2004. "Composition and Aroma Compounds of Ragusano Cheese: Native Pasture and Total Mixed Rations." *Journal of Dairy Science* 87:816-830.

Raw milk artisinal Sicilian cheese from 13 TMR cows and 13 TMR + pasture cows was analyzed for odor-active compounds using gas chromatography olfactometry. The pasture cheese was found to contain 27 distinct odor-active compounds, while the TMR cheese contained only 13. Eighteen of the odor-active compounds found in pasture cheese were not present in TMR cheese.

**129**

Larsson, Britt-Marie, et al. 1999. "Airway Responses in Naive Subjects to Exposure in Poultry Houses: Comparison Between Cage Rearing System and Alternative Rearing System for Laying Hens." *American Journal of Industrial Medicine* 35(2):142-149.

34 subjects with no prior exposure were confined for 3 hours in poultry houses that either had cages or did not have cages. Inhalable dust levels were twice as high in the cageless buildings, but concentrations of endotoxin were about the same in both. All the subjects experienced an acute inflammatory reaction in the upper airways.

**130**

ISU. 2002. "Livestock Confinement Dust and Gases." Iowa State University Extension. http://www.cdc.gov/nasd/docs/d001501-d001600/d001501/d001501.html.

This report is posted on the Centers for Disease Control website and consists of a matter-of-fact statement of the human health risks posed by high levels of dust, ammonia, and hydrogen sulfide in confinement livestock facilities. Dust and gases can rise to harmful or even lethal levels very quickly. Potential responses range from bronchitis to airways reactivity to asthma to toxic organic dust syndrome (TODS). They estimate that there are 700,000 confinement workers in the U.S., and nearly 70% of swine confinement workers exhibit respiratory illness symptoms.

**131**

*Eatwild.com.* http://www.eatwild.com.

Billed as "the clearinghouse for information about grass-based farming," this web site features a wealth of information, including links to numerous scientific articles. An article archive is broken into four categories: animal health, farm sustainability, environmental benefits, and human nutrition, with the last section being the strongest.

## D: "How-to" publications

**132**
*Graze*. http://www.grazeonline.com.

A monthly publication mostly aimed at graziers themselves, *Graze* features basic variations on "how-to" articles and testimonials from grass farmers, as well as articles about marketing grassfed products. Many types of animal are covered. Examples of recent articles include:

- "Calf raising made simple"
- "Research shows streambank grazing can improve water quality. "
- "What to watch for in winter sheep grazing."
- "Changing pastured pig behavior through genetics."

**133**
*Stockman Grass Farmer.* http://www.stockmangrassfarmer.com/sgf.

This is a monthly publication in newsprint format, usually 40 pages long, aimed at the population of graziers throughout the U.S. As such, articles tend to be "how-to" and testimonial in nature, dealing mostly with topics such as weed control, animal management, and marketing. In addition, there are a large number of advertisements, both commercial and classified. Examples of articles from recent issues include:

- "Irrigated Pasture Management: One Thousand Pounds of Gain per Acre is Very Doable with Irrigation"
- "Milk, Meat and Mow (with Buffalo) is the Goal of This Innovative Nebraska Dairy"
- "Grass and Genetics: Rediscovering the Dual Purpose Cow"

**134**
*Great Lakes International Grazing Conference Proceedings.*
http://www.msue.msu.edu/jackson/Dairy/Grazing/glgc_invoice.html.

The proceedings for the annual Great Lakes International Grazing Conference can be ordered online. Like the two periodicals above, they feature articles and presentations meant primarily for an audience of graziers. They also cover the entire gamut of grazing interests, including dairy, beef, sheep, horses, and marketing. Examples of presentations from recent conferences include:

- "Getting Grass Cattle To Your Farm or Ranch"
- "Share Milking Arrangements"
- "Grazing Feeder Lambs on Dwarf Essex Rape"
- "Suggestions for Direct Marketing Livestock Products"

# Index

*Note: Unless otherwise noted, entries refer to dairies and/or dairy cattle.*

# ADDITIONAL INTERNET RESOURCES

## I. Government Websites

**ARS: Grazing Management: Livestock Production and the Environment**
http://www.ars.usda.gov/research/programs/programs.htm?np_code=205&docid=336

**ATTRA (Appropriate Technology Transfer for Rural Areas):**
www.attra.org

## II. University Websites

**Cornell University: Forage-Livestock Systems**
http://www.css.cornell.edu/forage/forage.html

**Michigan State University Extension - Forage/Pasture/Grazing Area of Expertise**
http://www.msue.msu.edu/aoe/fpg.html

**Minnesota Extension Publications - Farm: Alternative Animal Enterprises**
http://www.extension.umn.edu/topics.html?topic=4&subtopic=118

**Ohio Forage Network – Ohio State University extension**
http://forages.osu.edu/

**Oregon State University: Forage Information System- Oregon State University**
http://forages.oregonstate.edu/

**Penn State Forage Site**
http://www.forages.psu.edu

**Purdue University - Pasture Management**
http://www.agry.purdue.edu/ext/forages/rotational/index.html

**University of Missouri Forage Systems Research Center**
http://aes.missouri.edu/fsrc/

**University of Nebraska: Center for Grassland Studies**
http://www.grassland.unl.edu/

**University of Vermont: Pasture and Grazing Management**
http://pss.uvm.edu/vtcrops/?Page=pasturegrazing.html

**West Virginia University Extension, Forage-livestock system**
http://www.caf.wvu.edu/~forage/

**University of Wisconsin Extension, Forage Resources and UW Team Forage**
http://www.uwrf.edu/grazing/
http://wwwuwex.edu/ces/crops/uwforage/uwforage.htm
http://www.uwrf.edu/grazing

## III. Organization Websites

**American Farmland Trust (AFT):** www.grassfarmer.com

**American Forage & Grassland Council**
http://www.afgc.org/ab000000.html

**Graze-L archive**
http://grazel.taranaki.ac.nz/welcome.html

**Grazing Lands Conservation Initiative**
http://www.glci.org

**Great Lakes Grazing Network**
http://www.glgn.org

**Pasture Systems & Watershed Management Research Laboratory**
http://pswmru.arsup.psu.edu/

**Pennsylvania Forage and Grassland Council**
http://www.forages.psu.edu/topics/PFGC/who.html

## IV. Private Websites

**The Cannons - Dairy Farm Dairy Farming (J. Rankin, Ireland)**
http://www.loughries.demon.co.uk//

**Case's Agworld Resources for North America's Livestock, Forage, and Specialty Farmers** http://www.case-agworld.com/